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The Administrative Record Staff

TREATABILITY STUDY PLAN

903 Pad, Mound, and East Trenches Areas

Operable Unit No. 2

Volume III

APPENDIX D Health and Safety Plan

EG&G ROCKY FLATS

Environmental Restoration Program

October 16, 1990

U.S. DEPARTMENT OF ENERGY
Rocky Flats Plant
Golden, Colorado

ADMIN RECORD

A-OU02-000343

REVIEWED FOR CLASSIFICATION/UCNI
By [signature]
Date 6/29/92

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COLD STRESS

RESPIRATOR INSPECTION, CARE, MAINTENANCE, AND STORAGE

DECONTAMINATION

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SITE CONTROL

EMERGENCY PREPAREDNESS

PERSONNEL ASSIGNMENTS

ATTACHMENT F - EXPOSURE LIMITS

ATTACHMENT G - MATERIAL SAFETY DATA SHEETS FOR LABORATORY WORK

DRAFT

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HEALTH AND SAFETY PLAN

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SITE CONTROL

EMERGENCY PREPAREDNESS

PERSONNEL ASSIGNMENTS

ATTACHMENT F - EXPOSURE LIMITS

ATTACHMENT G - MATERIAL SAFETY DATA SHEETS FOR LABORATORY WORK

10
PROJECT IDENTIFICATION

Project Name	Bench Scale Treatability Study (Surface Water)
Project Number	WCFS 4020-300-39 WCC 22558
Project Location	Rocky Flats Plant, Jefferson County, Colorado, and Hazen Research, Inc , Golden, Colorado
Woodward-Clyde (WC) Administrative Operating Unit	Denver ESE
WC Operating Group	Central
Project Manager	JoAnn Tischler
Author of the Plan	William Sams/Karen Scudder
Effective Dates	September 15 through December 31, 1990

APPROVALS

JoAnn Tischler
Project Manager

Date

Jerry Andersen
WC Regional Manager, Health and Safety

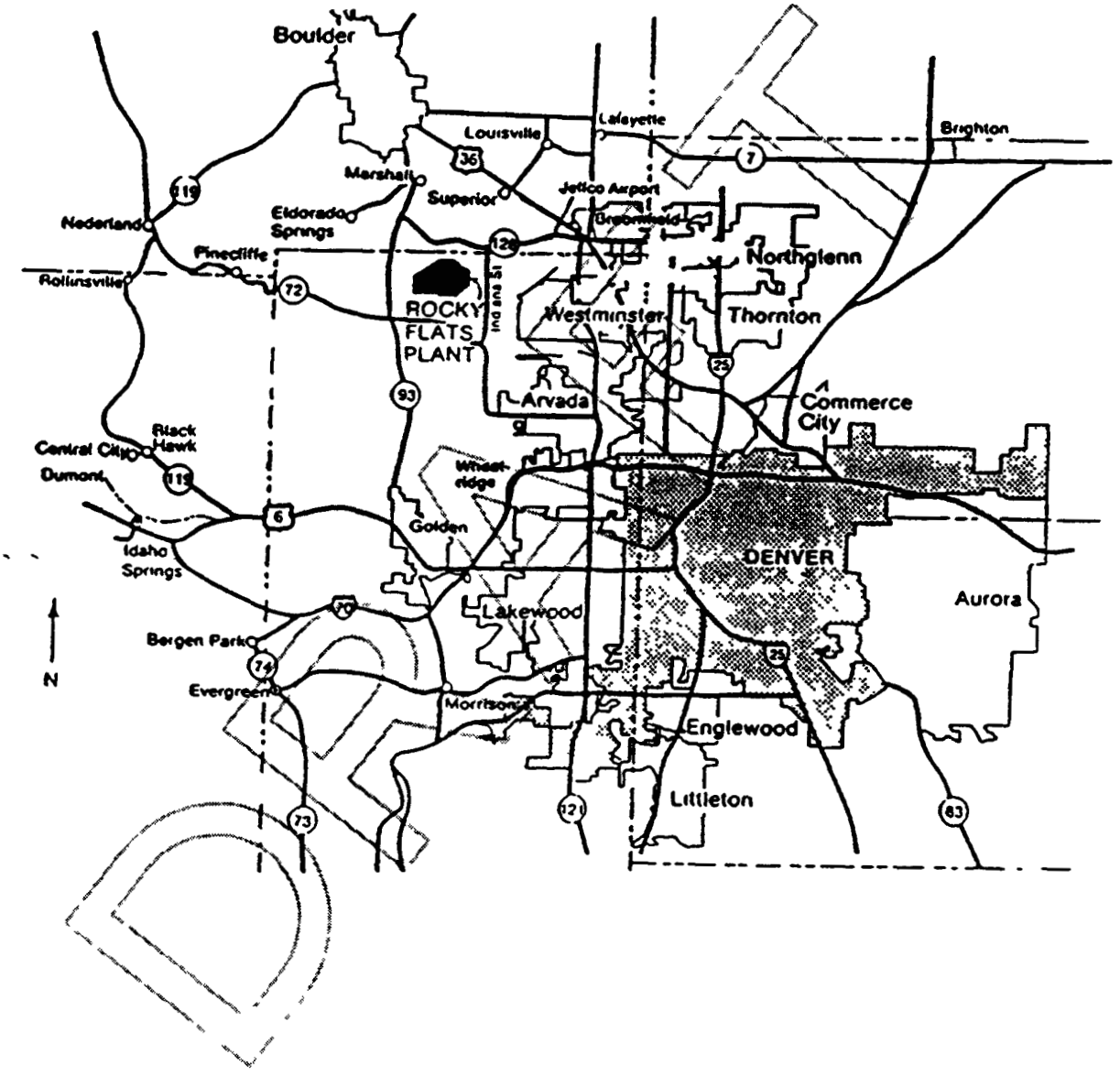
Date

John Doherty
WC Corporate Health and Safety Officer

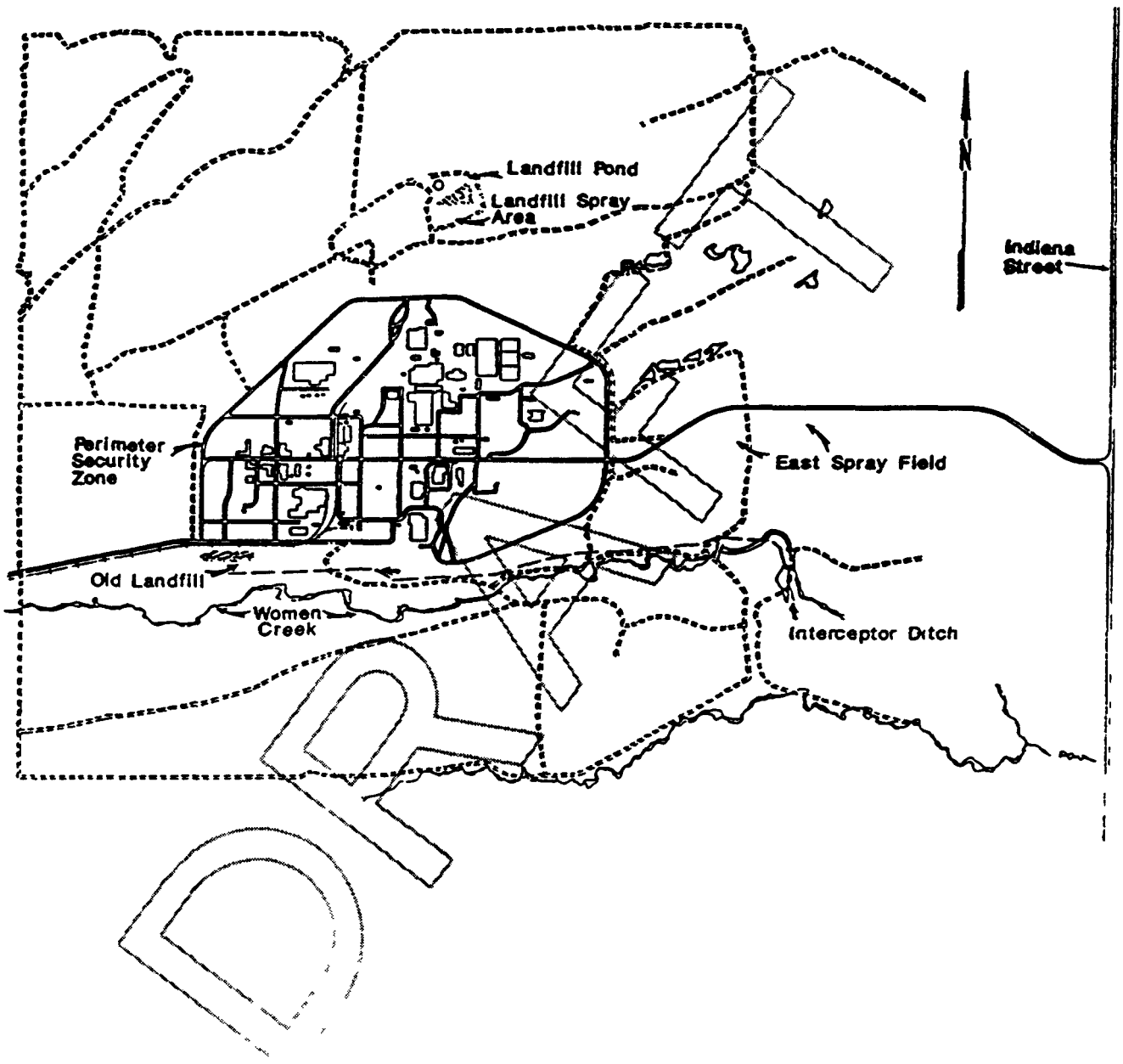
Date

This Health and Safety Plan (HSP) presents health and safety requirements and guidelines for performance of the work to be performed at the Rocky Flats Plant (RFP) and Hazen Laboratory It is in compliance with applicable sections of 29 CFR 1910 120, Hazardous Waste Operations and Emergency Response. Specific subjects addressed include staff organization, work activities, hazard assessment, general health and safety requirements, site-specific health and safety requirements, emergency procedures, and logs, reports, and record keeping This HSP was prepared for exclusive use by employees of Woodward-Clyde (WC) and its subcontractors This plan shall not be modified or used after the expiration date without written approval by the Project Manager (PM), Health and Safety Officer (HSO), and Corporate Health and Safety Officer (CHSO) In addition, this plan shall not be used by firms or persons not under contract to WC without written approval by WC's Executive Vice President-Practice This plan is not valid unless it is signed and dated by the PM, HSO, and CHSO Any modifications to this plan must be approved by the individuals signing on the title page or by their representatives

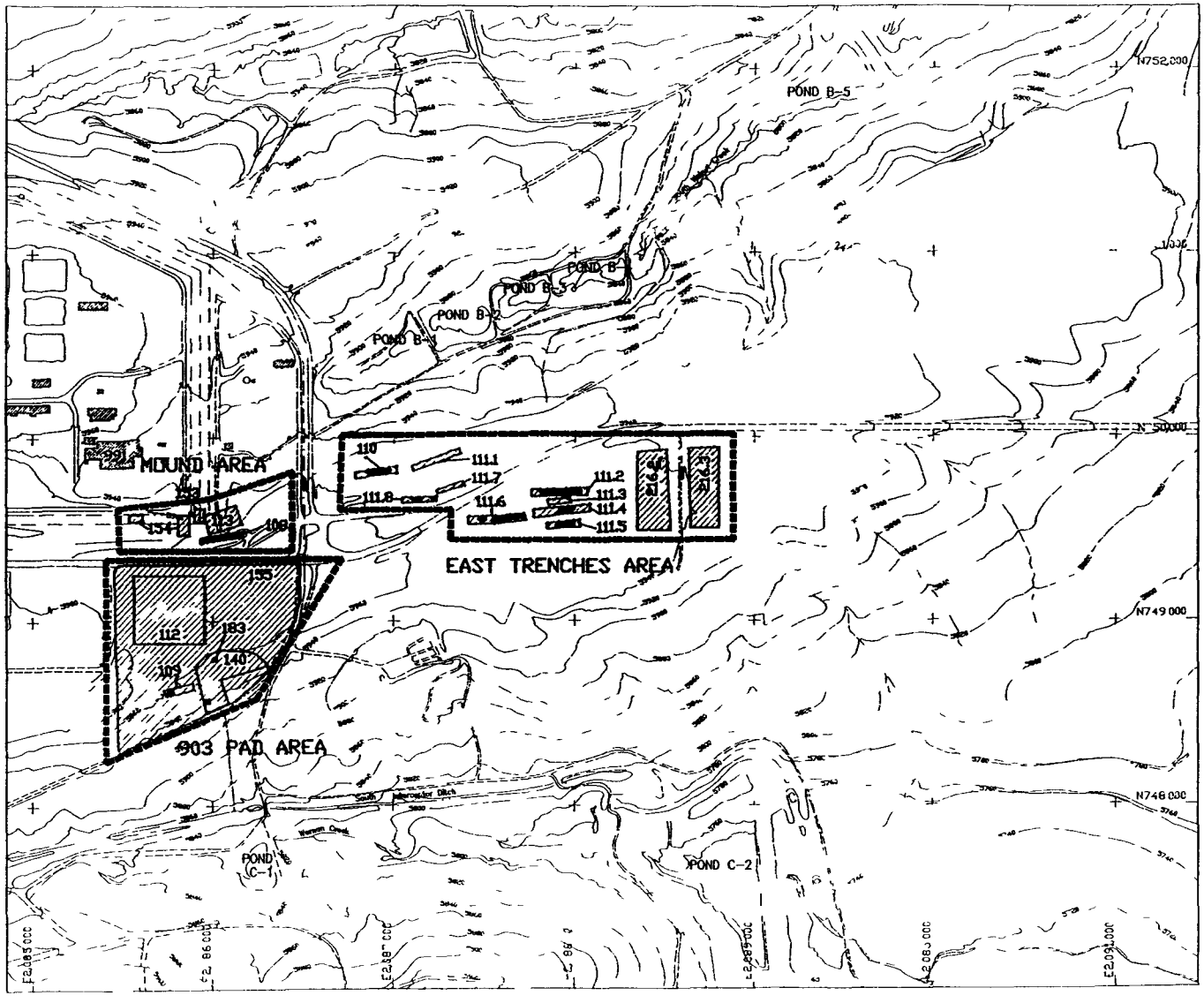
The project's field sampling location in relation to the Denver area is shown in Figure 1-1, Location Map Figure 1-2, RFP General Map, shows major structures and roads Figure 1-3, Operable Unit 2 (OU2), indicates the boundaries of OU2



Job No 4002-140-39	LOCATION MAP
Prepared by M S	
Date 3/19/90	Figure 1-1



Job No 4002-140-39	RFP - GENERAL MAP
Prepared by M S	
Date 3/19/90	Figure 1-2



EXPLANATION

216.2 — SOLID WASTE MANAGEMENT UNIT (SWMU) AND SWMU DESIGNATION

LOCATION OF BARRELS DETERMINED BY VISUAL INSPECTION OR MAGNETOMETER SURVEY

REMEDIAL INVESTIGATION AREAS

N

Scale 1" = 600

0' 300' 600'

CONTOUR INTERVAL = 20'

U S DEPARTMENT OF ENERGY
Rocky Flats Plant
Golden Colorado

903 PAD MOUND AND EAST TRENCHES AREA
HEALTH AND SAFETY PLAN

FIGURE 1 3

OPERABLE UNIT NO 2 BOUNDARIES

April 1

RF6004 WB-032390

2.0
STAFF ORGANIZATION

This section describes the roles of the various positions on this project as they pertain to health and safety The responsibilities and authority of each individual are presented in Table 2-1

Personnel who may be involved in surface water sample collection activities and/or bench-scale treatability studies inside Hazen Laboratory must be approved by the Health and Safety Officer (HSO) or Corporate Health and Safety Officer (CHSO) before they commence work on this project

TABLE 2-1
RESPONSIBILITIES AND AUTHORITY OF HEALTH AND SAFETY PERSONNEL

EXECUTIVE VICE PRESIDENT-PRACTICE (EVPP): William Gardner

Responsibilities

- Direct and monitor the implementation of the health and safety program
- Advise CEO on health and safety matters
- Issue directives, advisories, and information to CHSOs

Authority

- Direct changes in the health and safety program
- Determine and implement personnel disciplinary actions as required

TABLE 2-1
(Continued)

CORPORATE HEALTH AND SAFETY ADMINISTRATOR (CHSA): Phil Jones

Responsibilities

- Track health and safety regulations and implement improvements to the Woodward-Clyde (WC) health and safety program
- Maintain records pertaining to medical surveillance, training, fit testing, chemical exposure, and incidents
- Update health and safety manual
- Manage medical surveillance program
- Develop and implement the health and safety training program
- Provide industrial hygiene/chemical safety guidance to CHSO and HSO
- Audit key aspects of health and safety program and report effectiveness to EVPP

TABLE 2-1
(Continued)

Authority

- Approve the qualifications of employees to work at hazardous waste sites
- Approve health and safety plans
- Establish employee training and medical surveillance procedures
- Suspend work on any project that jeopardizes the health and safety of personnel

TABLE 2-1
(Continued)

CORPORATE HEALTH AND SAFETY OFFICER (CHSO): John Doherty

Responsibilities

- Direct the implementation of the health and safety program of the operating group and provide recommendations for improvement of the program
- Coordinate health and safety activities of the business unit offices in the operating group
- Review health and safety plans
- Investigate reports of incidents or accidents and report accidents or incidents to the CHSA and EVPP
- Assist CHSA with employee health and safety training in the operating group
- Monitor implementation of health and safety plans
- Determine whether an accidental exposure or injury merits a change in the affected individual's work assignments and whether changes in work practices are required
- Determine need for project health and safety plans

TABLE 2-1
(Continued)

Authority

- Coordinate business units with regard to health and safety equipment needs
- Approve or reject health and safety plans
- Direct business unit HSO to prepare project health and safety plans
- Access project files
- Direct changes in personnel work practices to improve health and safety of employees involved in hazardous waste management projects
- Remove individuals from projects if their conduct jeopardizes their health and safety or that of co-workers
- Suspend work on any project that jeopardizes the health and safety of personnel involved

TABLE 2-1
(Continued)

HEALTH AND SAFETY OFFICER (HSO) Karen Scudder
Alternate William M Sams

Responsibilities

- Interface with project managers in matters of health and safety
- Keep the project manager informed on the status of the site health and safety program
- Provide budget input to project manager and manage health and safety budget
- Report to CHSO on health and safety matters
- Develop or review and approve project health and safety plans prior to submittal to the CHSO for review
- Conduct staff training and orientation on health and safety related activities
- Appoint or approve site safety officers
- Monitor compliance with health and safety plans and conduct site audits
- Assist project managers to obtain required health and safety equipment

TABLE 2-1
(Continued)

- Approve personnel to work on hazardous waste management projects with regard to medical examinations and health and safety training

Authority

- Suspend work or otherwise limit exposures to personnel if health and safety plans appear to be unsuitable or inadequate or if health or safety of personnel is endangered

- Direct personnel to change work practices if existing practices are deemed to be hazardous to health and safety of personnel

- Remove personnel from projects if their actions or condition endanger their health and safety or the health and safety of co-workers

TABLE 2-1
(Continued)

PROJECT/SITE MANAGER (PM) JoAnn Tischler/Robert Hencmann

Responsibilities

- Ensure that the project is performed in a manner consistent with the WC health and safety program
- Ensure that the project health and safety plan is prepared, approved, and properly implemented
- Provide the HSO with the information needed to develop health and safety plans
- Implement health and safety plans
- Ensure that adequate funds are allocated to fully implement project health and safety plans
- Ensure compliance with health and safety plans of contractor personnel

Authority (Safety Related)

- Coordinate with the HSO on health and safety matters
- Assign HSO-approved Site Safety Officer (SSO) to project and, if necessary, assign a suitably qualified replacement

TABLE 2-1
(Continued)

- Temporarily suspend field/laboratory activities if health and safety of personnel are endangered, pending an evaluation by the HSO and/or CHSO

- Temporarily suspend an individual from field/laboratory activities for infractions of the health and safety plan, pending an evaluation by the HSO, CHSO, and/or CHSA

TABLE 2-1
(Continued)

SITE SAFETY OFFICER (SSO) - FIELD ACTIVITIES Tony Renk
Alternate Bruce Larue

SITE SAFETY OFFICER (SSO) - LABORATORY: Brian Clow

Responsibilities

- Direct health and safety activities on site
- Report immediately all safety-related incidents or accidents to the HSO and project manager
- Assist project managers in all aspects of implementing health and safety plans
- Maintain health and safety equipment on site
- Implement emergency procedures as required

Authority

- Temporarily suspend field/laboratory activities if health and safety of personnel are endangered, pending further consideration by the HSO and/or CHSO

TABLE 2-1
(Continued)

- Temporarily suspend an individual from field/laboratory activities for infractions of the health and safety plan, pending further consideration by the HSO and/or CHSO

TABLE 2-1
(Continued)

HEALTH AND SAFETY TECHNICIAN (HST): As assigned by the Project Manager

The health and safety technician (HST) shall assist the SSO in implementing this plan An HST will be present (in the immediate vicinity) during all field activities involving surface water data collection

Responsibilities

- Ensure that each individual within his or her jurisdiction complies with the provisions of this plan
- Audit safety practices used by onsite teams
- Communicate with command post for onsite activities
- Supervise decontamination, monitor workers for heat or cold stress, and distribute health and safety equipment
- Document safety practices
- Initiate appropriate emergency procedures

TABLE 2-1
(Continued)

Authority

The HST shall have the authority to stop work in case of an imminent safety hazard or potentially dangerous situation After stopping work, the HST shall immediately consult the SSO

The HST shall have completed the minimum training requirements for site workers as required by 29 CFR 1910 120 and Woodward-Clyde policy

3.1 FIELD ACTIVITIES

This Health and Safety Plan covers activities associated with the collection of surface water samples as described in Standard Operating Procedure (SOP) No 7, Surface Water Sampling, dated April 18, 1990 This plan does not cover surface water sampling subsequent to an unexpected release of nonradioactive or radioactive materials

3.2 LABORATORYACTIVITIES

The scope of work for the laboratory portion of this project is outlined in Appendix B of the Rocky Flats Plant Operable Unit 2 Treatability Study Plan Work to be completed includes

1 Sample preparation
2 Granulated activated carbon - organics tests
3 Granulated activated carbon - radionuclides tests
4 Coagulation/flocculation - microfiltration tests
5 Coagulation/flocculation, precipitation, suspended solids filtration tests
6 Ion exchange tests

Water samples to be tested include those collected during field sampling activities

Sample preparation and analysis will require the use of standard laboratory equipment including hot plates, a sample apparatus as seen in figures in Appendix B, multiposition

stirrers, a peristaltic pump, a small vacuum pump, a rotometer, a filter and filter apparatus, a small feed tank (probably 5 gallons), associated glassware, and measuring devices

It is anticipated that Woodward-Clyde personnel will maintain an oversight role of these tests However, they may be required to assist at any point Therefore, this HSP covers personnel during all aspects of the above work activities

4.1 FIELD ACTIVITIES

4 1 1 Overview

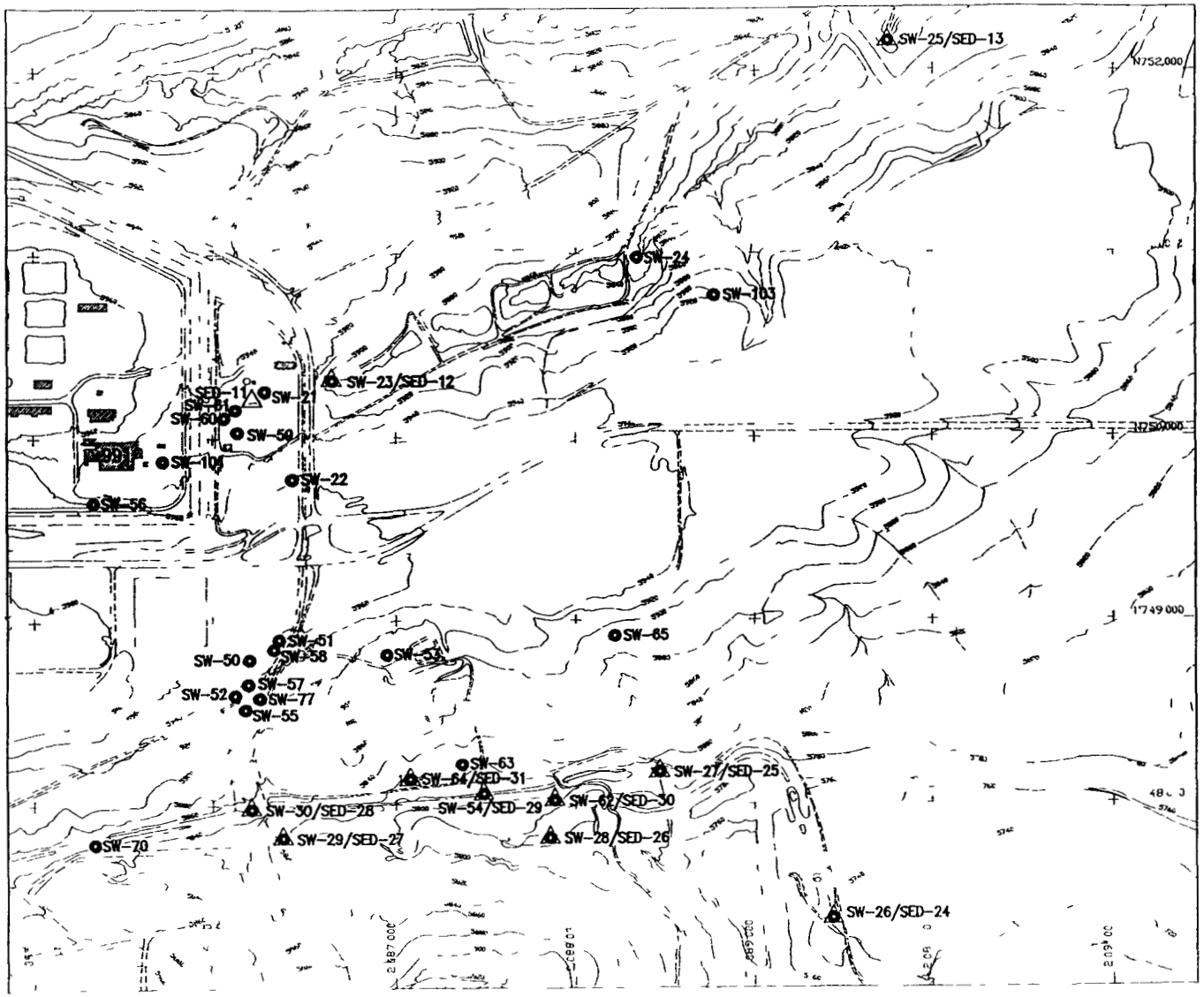
The specific tasks covered by the plan are as follows

- Traveling to and from data collection sites illustrated on Figure 4-1
- Collecting surface water samples as described in SOP 7, Surface Water Sampling, dated April 18, 1990
- Personnel decontamination
- Equipment decontamination

This HSP does not make provisions for worker protection inside confined spaces This plan covers outdoor tasks accomplished during daylight hours

4 1 2 Hazard Summary

This hazard summary is partially based upon results of an environmental monitoring program conducted during 1988 by the RFP, which includes analyses results of airborne effluents, ambient air, and soil



EXPLANATION

SW-102 SURFACE WATER MONITORING STATION

SED-11 SEDIMENT SAMPLING STATION

Scale 1" = 600

0' 300' 600'

CONTOUR INTERVAL = 20'

U S DEPARTMENT OF ENERGY
Rocky Flats Plant
Golden, Colorado

903 PAD MOUND AND EAST TRENCHES AREA
HEALTH AND SAFETY PLAN

FIGURE 4-1

SURFACE WATER AND SEDIMENT
MONITORING STATIONS

The remainder of the hazard summary is based upon 12 months of analysis results of waters and sediments from the sites where samples are to be collected Those sites to be sampled will be selected from the sites identified in Table 4-1 Site selection is dependent upon which sites contain a sufficient volume of water to sample

TABLE 4-1
MONITORING STATIONS

STATION ID	STATION ID
Water	Water
SW-050	SW-064
SW-051	SW-077
SW-052	SW-101
SW-053	SW-103
SW-055	
SW-056	
SW-057	
SW-058	
SW-059	
SW-060	
SW-061	
SW-063	

The Health and Safety Officer (HSO) must be contacted prior to sampling at a site not listed in Table 4-1 The HSO will review the available information and furnish health and safety procedures The review process will be expedited when information such as site history, previous sampling results, and why samples are desired are furnished with the request to sample

4 1 2 1 Airborne Effluents - Radioactive Materials and Beryllium

Particulate and tritium sampling of the building exhaust systems was conducted continuously during 1988 The particulate samples were analyzed for beryllium and specific radionuclides of interest. Results of the monitoring reveal that all building exhaust discharges were within 10 CFR 20 106 limits for release to an unrestricted environment, and therefore do not present a significant hazard Specific monitoring results are provided as follows plutonium and americium monitoring in Table 4-2, uranium and tritium monitoring in Table 4-3, and beryllium monitoring results in Table 4-4

4 1 2 2 Ambient Airborne Nonradioactive Materials

Monitoring of ambient air for total suspended solids, respirable particulates, ozone, sulfur dioxide, carbon monoxide, nitrogen dioxide, and lead was conducted The results indicate that none of these materials will present a significant hazard Specific monitoring results are provided in Table 4-5

4 1 2 3 Soil

The highest total activity measured in soil at a permanent monitoring station and reported in the environmental monitoring report for 1988 is 15 pCi/gm That activity does not present an inhalation hazard when calculations are used to suspend it in the highest airborne dust concentration (0 15 mg/m^3) reported in the same report However, walking across the soil surface could result in a concentration buildup on footwear, and personal decontamination is warranted

TABLE 4-2
PLUTONIUM AND AMERICIUM IN AIRBORNE EFFLUENTS
Measured Inside Exhaust Ventilation Systems During 1988

PLUTONIUM -239-240*

* 10 CFR 20 106 Limits for Release in Air to an Unrestricted Environment
Plutonium -239 emissions must be less than 0 06 x 10^{12} μCi/ml
Plutonium -240 emissions must be less than 0 06 x 10^{12} μCi/ml

AMERICIUM -241**

** 10 CFR 20 106 Limits for Release in Air to an Unrestricted Environment
Americium -241 emissions must be less than 0 2 x 10^{12} μCi/ml

Month	Number of Analyses	Total Discharge (μCi)	C_{max}*** (X 10^{-12} μCi/ml)	Number of Analyses	Total Discharge (μCi)	C_{max}*** (X 10^{12} μCi/ml)
January	45	1 10	0 004±0 0005	45	0 17	0 005±0 0001
February	47	2 32	0 013±0 0014	47	0 24	0 004±0 0006
March	47	2 73	0 010±0 0024	47	0 29	0 001±0 0002
April	47	1 18	0 005±0 0007	47	0 11	0 001±0 0006
May	47	1 84	0 015±0 0017	47	0 26	0 001±0 0006
June	47	1 01	0 023±0 0052	47	0 24	0 008±0 0011
July	47	1 79	0 012±0 0013	47	0 23	0 001±0 0002
August	47	1 75	0 010±0 0010	47	0 25	0 004±0 0006
September	47	0 40	0 010±0 0011	47	0 05	0 001±0 0002
October	47	0 66	0 007±0 0008	47	0 09	0 001±0 0002
November	47	0 25	0 003±0 0003	47	0 04	0 001±0 0002
December	47	0 30	0 001±0 0001	46	0 05	0 000±0 0000
Summary	562	15 33	0 023±0 0052	562	2 02	0 008±0 0011

*** C_{max} is the maximum measured concentration

TABLE 4-3

URANIUM AND TRITIUM IN AIRBORNE EFFLUENTS
Measured Inside Exhaust Ventilation Systems During 1988

URANIUM -233, -234, -238*

* 10 CRF 20 106 Limits for Release in Air to an Unrestricted Environment
Uranium 233 emissions must be less than $4\ 0 \times 10^{12}\ \mu Ci/ml$
Uranium 234 emissions must be less than $4\ 0 \times 10^{-12}\ \mu Ci/ml$
Uranium 238 emissions must be less than $3\ 0 \times 10^{-12}\ \mu Ci/ml$

TRITIUM (H-3)**

•• 10 CFR 20 106 Limits for Release in Air to an Unrestricted Environment
Tritium emissions must be less than $2 \times 10^{7}\ \mu Ci/ml$

Month	Number of Analyses	Total Discharge (μCi)	C_{max}*** ($X\ 10^{-12}\ \mu Ci/ml$)	Number of Analyses	Total Discharge (μCi)	C_{max}*** ($X10^{-12}\ \mu Ci/ml$)
January	53	2 23	0 005±0 0005	261	-0 001	188±100
February	55	2 00	0 009±0 0009	260	0 006	417±250
March	55	1 49	0 004±0 0024	275	-0 003	135±100
April	55	1 33	0 006±0 0007	262	0 006	250±180
May	55	0 82	0 004±0 0004	278	-0 002	243±150
June	55	0 87	0 004±0 0004	275	0 002	194±120
July	55	0 59	0 004±0 0004	240	0 004	100±120
August	55	0 72	0 004±0 0004	211	0 001	194±100
September	55	0 26	0 002±0 0003	41	0 000	139±120
October	55	0 58	0 003±0 0004	65	0 000	97±155
November	55	0 39	0 001±0 0001	65	0 001	83±165
December	55	0 65	0 001±0 0002	70	0 001	104±120
Summary	658	11 93	0 009±0 0009	2303	0 015	417±250

***C_{max} is the maximum measured concentration

TABLE 4-4

BERYLLIUM IN AIRBORNE EFFLUENTS

Measured Inside Exhaust Ventillation Systems During 1988

The beryllium stationary-source emission-standard is no more than 10 grams of beryllium over a 24-hour period under the provisions of subpart C of 40 CFR 61 2(a)

Month	Number of Analyses	Total Discharge (g)	C_{max}* ($\mu g/m^3$)
January	53	0 0395	0 00031
February	55	0 0018	0 00003
March	55	0 0129	0 00041
April	55	0 0131	0 00031
May	55	0 0200	0 00033
June	55	0 0159	0 00025
July	55	0 0067	0 00016
August	55	0 0101	0 00021
September	55	0 0038	0 00012
October	55	0 0058	0 00005
November	55	0 0102	0 00010
December	55	0 0061	0 00007
Summary	658	0 1383**	

0 00041

* C_{max} is the maximum measured concentration

** This value is not significantly different from the background associated with the analysis

TABLE 4-5
MONITORING RESULTS AND 1988 NATIONAL AMBIENT AIR QUALITY STANDARDS
(NAAQS)
FOR PARTICULATES

Ozone, Sulfur Dioxide, Carbon Monoxide, Nitrogen Dioxide, and Lead
Monitoring Station Located Near East Plant Entrance (Gate 10)

Parameter	NAAQS Averaging Time	REGIONAL Compliance Standards	Meas Con-centrations
Total Suspended Particulates (TSP)	Annual Geometric Mean Primary[a]	75 $\mu g/m^3$	39 5 $\mu g/m^3$
	Secondary[b]	60 $\mu g/m^3$	
	24-Hour Primary[a,c]	260 $\mu g/m^3$	83 $\mu g/m^3$
	Secondary[b,c]	150 $\mu g/m^3$	
PM-10 (Particulate Matter less than 10 micrometers in diameter)	Primary Annual Arithmetic Mean	50 $\mu g/m^3$	15 8 $\mu g/m^3$
	24-Hour Average	150 $\mu g/m^3$	39 1 $\mu g/m^3$
Ozone (O_3)	1-Hour Primary [a,d]	0 12 ppm	0 09 ppm
Sulfur Dioxide (SO_2)	Annual Arithmetic Mean Primary[a]	0 030 ppm	0 003 ppm
	24-Hour Primary[a]	0 140 ppm	0 009 ppm
	3-Hour Secondary	0 500 ppm	0 019 ppm
Carbon Monoxide (CO)	1-Hour Primary[a,c]	35 ppm	5 ppm
	8-Hour Primary[a,c]	9 ppm	2 ppm
Nitrogen Dioxide (NO_2)	Annual Arithmetic Mean Primary[a]	0 05 ppm	0 005 ppm
Lead	Calendar Quarter Primary[a]	1 5 $\mu g/m^3$	0 02 $\mu g/m^3$

[a] Primary NAAQS are intended to protect public health
[b] Secondary NAAQS are intended to protect public welfare
[c] Not to be exceeded more than once a year
[d] Statistically estimated number of days with concentrations in excess of the standard is not to be more than 1 0 per year

4 1 2 4 Surface Water and Sediments

A review of monthly sampling results from the past year for volatile and semivolatile organics, metals, radioisotopes, pesticides, and polychlorinated biphenyls indicates they will not present an inhalation hazard The potential for skin absorption and ingestion is eliminated by use of the specified personal protective equipment (PPE) and decontamination procedures established in SOP Nos 4 and 5 A listing of all nonradioactive sample analytes previously sampled for is provided as Attachment A. A summary of maximum detected concentrations of the analytes and the potential health hazards presented by those analytes that have been detected in surface waters and sediments is provided in Attachment B

4 1 2 5 Biological Hazards

Poisonous and nonpoisonous snakes are found at RFP All snakes should be avoided If a team member is bitten, he/she should be transported to the medical facility immediately A description of the snake (such as, coloration, etc) will assist the medical personnel in determining the best course of action

Fleas at RFP may transmit the plague Field personnel should not approach dead animals or animals behaving erratically

4 1 3 Hazard Analysis Procedure

An analysis was performed to determine site-specific health and safety requirements to protect workers performing tasks listed in subsection 4 1 4 The analysis was performed by studying sampling and site history information available at the RFP Taken into

account were the chemicals actually found and the toxicity and routes of exposure to workers

4 1 4 Hazard Assessment by Task

This section presents a judgment of general risk by task from the hazards associated with working at the surface water collection sites on the Rocky Flats Plant (such as, chemicals, radioactive materials, and physical hazards) These judgments of risks assume that the requirements established by this Health and Safety Plan are complied with

4 1 4 1 Traveling To and From Data Gathering Sites

The risk during travel across Rocky Flats Plant is low

4 1 4 2 Conducting Field Data Collection Activities Specified in Subsection 4 2

The risk during data collection is low

4 1 4 3 Personnel Decontamination

The risk during personnel decontamination is low

4 1 4 4 Equipment Decontamination

The risk during equipment decontamination is moderate

4 1 4 5 Physical Injuries

Physical injuries are the most likely threat to health and safety Back injuries from improper lifting, falls, and motor vehicle accidents constitute the highest probability of injuries, both minor and serious The risk from heat or cold injury is dependent upon immediate weather conditions The risk from vehicle accidents is low

The risk during sampling equipment decontamination is low. This plan assumes that heavy equipment such as vehicles will not become contaminated and therefore will not require decontamination If a vehicle is suspected of having become radiologically contaminated, the HSO should be contacted immediately for advice The HSO will provide information regarding how to determine if contamination is present and if warranted how to conduct decontamination procedures

4.2 LABORATORYACTIVITIES

HAZARD ASSESSMENT

4 2 1 Field Samples

An analysis of the hazards associated with field samples is presented in Section 4 1 Samples brought into the laboratory are expected to pose limited toxicological and radiological hazard to workers. No external radiological hazard will result from this work A detailed analysis of the associated contaminants and their hazards can be found in Attachment B which includes tables of the maximum expected concentrations and Material Safety Data Sheets (MSDSs) for all known contaminants

4 2 2 Laboratory Materials

Hazardous chemicals and reagents will not be utilized during this work Although dilute acids and bases may be required during some work, there will be no use of flammable liquids, explosives, oxidizers, solvents, or toxic compounds

MSDSs for all compounds used throughout this project are to be made available to research personnel MSDSs for column materials and anticipated chemicals are located in Attachment G If use of additional column materials or chemicals is required, MSDSs must be obtained prior to use The HSO will conduct a hazard assessment by reviewing the MSDS and will determine if the revised procedures and chemical usage are sufficiently covered by this plan with reference to the Hazen Research Safety Manual, or if an addendum to this HSP is required

4 2 2 1 Dust Hazard

The material which will be placed in glass columns will consist of various fine - grained materials These may present a dust hazard when columns are filled

4 2 3 Criticality

Criticality may be defined as the attainment of physical conditions such that a fissile material will sustain a chain reaction During this chain reaction, the nuclei of the fissile material (material whose atoms can be made to fission) splits, thereby liberating tremendous amounts of energy in the form of radiation and producing large quantities of radioactive fission product Calculations indicate that the minimum mass required to achieve criticality will not be attained

5.1 MEDICAL SURVEILLANCE

All employees collecting samples in the field shall be active participants in the Woodward-Clyde (WC) medical surveillance program or equivalent All medical examinations and procedures shall be performed by or under the supervision of a licensed physician, preferably an occupational physician The examination shall include the tests, procedures, and frequencies described in Attachment C

5.2 SAFETY TRAINING

Employees shall not participate in field activities until they have been trained to a level required by their job function and responsibility Trainers shall have received a level of training higher than and including the subject matter of the level of instruction they are providing All training and field experience shall be certified Training requirements are discussed below

5 2 1 40-hour Basic Training

All field employees must have completed the 40-hour basic health and safety training required under 29 CFR 1910 120 and receive 8-hour annual refresher training thereafter

5 2 2 Three-day Onsite Supervision

All field employees shall be required to receive a minimum of 3 days of onsite training under the supervision of a trained and experienced supervisor Onsite time under supervision shall be documented

5 2 3 Onsite Supervisor

The onsite supervisor (site manager) must have completed the basic 40-hour training course, 3 days of onsite supervision, standard first aid training, adult CPR training, and at least 8 hours of specialized training on managing hazardous waste operations The 8 hours of specialized training shall include instruction covering the WC health and safety program, employee training program, personal protective equipment program, spill containment procedures, and health hazard monitoring procedures and techniques

5 2 4 Site Safety Officer (SSO)

The SSO must have completed the 40-hour training, 3-day onsite supervision, adult CPR, and standard first aid training

5 2 5 Site-specific Safety Orientation Meeting

A site-specific safety orientation meeting shall be conducted for all employees, including subcontractors, prior to commencement of field/laboratory activities The following topics will be discussed at this meeting

- Names of health and safety personnel and alternates responsible for site health and safety

- Health and safety organization
- Hazards at the site
- Exposure risk
- Personal protective equipment to be used
- Personnel and equipment decontamination procedures
- Air monitoring
- Emergency procedures

All field personnel must be provided with and read a copy of this HSP At the end of the meeting, attendees shall be informally quizzed to assess their understanding of the health and safety requirements, and shall sign a safety compliance agreement form stating that they have read, understand, and agree to comply with the provisions of the plan Anyone refusing to sign the form will be prohibited from working at the site

If a new employee who has not gone through the site-specific safety orientation meeting is assigned to the site, the SSO must present a similar briefing to the new employee before he or she participates in any field activities All new employees must sign the safety compliance agreement form before beginning fieldwork at RFP

5.3 ACCIDENT/INCIDENT REPORTING

5 3 1 Woodward-Clyde Consultants (WCC)/Woodward-Clyde Federal Services (WCFS)Procedures

In the event of an accident or incident, the SSO will immediately notify the WC Project Manager, Health and Safety Officer (HSO), and Corporate Health and Safety Officer (CHSO) Types of accidents or incidents that are considered reportable are

- Illness resulting from chemical exposure or unknown causes

- Physical injury, including an injury that does not require medical attention
- Fire, explosions, and flashes resulting from activities performed by WC and its subcontractors
- Infractions of safety rules and requirements
- Unexpected chemical exposures

Work will be suspended to correct the cause of the accident/incident and to modify this plan as necessary

A WC accident/incident report form (Attachment D) must be submitted to the Project Manager (PM) and CHSO within 24 hours of occurrence

5 3 2 Rocky Flats Plant Procedures

The SSO will notify the Project Manager, the RFP Environmental Restoration (ER) Program Field Supervisor, the RFP ER Program Manager, and the RFP HSE Area Safety Engineer of any accidents or incidents that occur during field activities The SSO will also submit a completed DOE Form F 5484 X for any of the following incidents

1 "Recordable" occupational injuries or illnesses as defined below

OCCUPATIONAL INJURY is any injury such as a cut, fracture, sprain, or amputation that results from a work accident or from an exposure involving a single incident in the work environment NOTE Conditions resulting from animal or insect bites, or one-time exposure to chemicals, are considered to be injuries

OCCUPATIONAL ILLNESS of an employee is any abnormal condition or disorder, other than one resulting from an occupational injury, caused by exposure to environmental factors associated with employment It includes acute and chronic illnesses or diseases that may be caused by inhalation, absorption, ingestion, or direct contact with a toxic material

2 PROPERTY DAMAGE LOSSES of $1,000 or more are reported as follows accidents that cause damage to Department of Energy (DOE) property, regardless of fault, or accident wherein DOE may be liable for damage to a second party, are reportable if damage is $1,000 or more Include damage to facilities, inventories, equipment, and properly parked motor vehicles Exclude damage resulting from a DOE reportable vehicle accident

3 GOVERNMENT MOTOR VEHICLE ACCIDENTS resulting in damages of $250 or more, or involving injury, are reported unless the government vehicle is not at fault, damage of less than $250 is sustained by the government vehicle, or no injury is inflicted on the government vehicle occupants Accidents are also reportable to DOE if

- Damage to DOE property is greater than or equal to $250 and the driver of a government vehicle is at fault

- Damage to any private property or vehicle is greater than or equal to $250 and the driver of a government vehicle is at fault

- Any person is injured and the driver of a government vehicle is at fault

5.4 VISITOR CLEARANCES

All visitors to field activity sites must be cleared by RFP personnel And, all personnel working or visiting the field activities will report their presence to the site safety officer by making all necessary entries in the sign in/sign out log maintained by the SSO and described in Subsection 8 2

6.1 FIELD ACTIVITIES

This HSP encompasses only those activities and areas that warrant Level D personal protective equipment (PPE) Work at sites other than those specified in Section 6 1 1, below, or work at those sites that may reasonably be expected to require PPE other than that specified in Section 6 1 6 2 may not be accomplished without first consulting with and then receiving written approval from either the Health and Safety Officer (HSO) or from the Corporate Health and Safety Officer (CHSO), if the HSO is not available Verbal approval is acceptable if it is recorded in the Site Safety Officer (SSO) logbook and written approval follows

6 1 1 Work Sites

Work sites are listed in Table 4-1, Monitoring Stations Procedures for giving health and safety approval to work at other sites are provided in Section 6 1

6 1 2 Buddy System

The "buddy system" will be used during all field activities At no time will an individual conduct surface water sampling alone

6 1 3 Work Zones

Three zones/levels of contamination (an exclusion zone, a contamination reduction zone, and a support zone) are specified in 29 CFR 1910 120 However, it will not be necessary to erect physical barriers around each sampling site due to the low concentrations of contaminants present and the brief time required to complete data gathering at each site Nonetheless, personnel must be decontaminated before leaving the sampling site This practice will limit the risk of exposure to personnel and limit the potential for buildup of contaminants within vehicles by muddied boots and sample site water runoff from boots

Decontamination sites should be selected by the team leader considering that the location should be as close as practical to the data gathering site without being affected (for example, muddied) by the water being monitored

6 1 4 Housekeeping

Housekeeping is an important aspect of an investigation program and will be strongly stressed in all aspects of fieldwork Good housekeeping plays a key role in occupational health protection and is a way of preventing dispersion of dangerous contaminants All work areas will be kept as clean as possible at all times, and spills will be cleaned up immediately Housekeeping will be the responsibility of all employees

Woodward-Clyde will implement a housekeeping program for the field activities to minimize the spread of contamination beyond the work site The program will include

- Daily scheduling to police the area of debris, including paper products, cans, and other materials brought on site

- Daily changing of wash and rinse water for hands, face, and equipment

- Periodic (daily minimum) removal of all garbage bags and containers used to dispose of food products, plastic inner gloves, and contaminated disposable clothing

6 1 5 General Rules For Field Activities

6 1 5 1 Traveling To and From the Data Gathering Sites

- Seat belts must be worn

- Travel only on established roadways

- Personnel will not normally be allowed to ride in the rear of pickup trucks

- Field laboratory type operations may not take place in the rear of the vehicle as the vehicle moves between sites

6 1 5 2 Conducting Field Data Collection Activities

- Personnel will not enter groundwater seeps

- Personal protective equipment specified in Section 7 1 6 2 will be worn

6 1 5 3 Personal Decontamination

- Personal decontamination will be accomplished in a dry area approximately 50 feet from each data-gathering site as described in SOP 5, Level D Personnel Decontamination, dated April 18, 1990

6 1 5 4 Equipment Decontamination

- Equipment decontamination will be accomplished as described in SOP No 4, General Equipment Decontamination, dated April 23, 1990

6 1 5 5 Personal Requirements/Prohibitions

- No running or horseplay

- The required level of personal protective equipment must be worn by all onsite personnel

- Eating, drinking, chewing gum or tobacco, smoking, or any practice that increases the probability of hand-to-mouth transfer and ingestion of material is prohibited for persons conducting surface water data collection at a field site Drinking of water, Gatorade, or equivalent fluids may occur in the field at the discretion of the SSO Individually sealed cups will be used and discarded after each use Stacked disposable cups may also be used if the stack assembly is maintained intact, a cup is used only once, and the first/outermost cup is always first discarded before the next cup is used to drink from

- No jewelry may be worn by personnel engaged in fieldwork, except for watches, which will be disposed if they become contaminated

- Medicine and alcohol can potentiate the effects from exposure to toxic chemicals PRESCRIBED DRUGS SHOULD NOT BE TAKEN BY PERSONNEL ON OPERATIONS WHERE THE POTENTIAL FOR ABSORPTION, INHALATION, OR INGESTION OF TOXIC SUBSTANCES EXISTS UNLESS SPECIFICALLY APPROVED BY A QUALIFIED PHYSICIAN Alcoholic beverage intake will not be allowed during breaks or on the job site

- Safety devices on equipment must be left intact and used as designed

- Equipment and tools will be kept clean and in good repair and used only for their intended purpose

- Eye protection must be worn when any hammering, pounding, grinding, or any other operation is performed that may produce flying particles or slivers

- Leather gloves must be worn when handling objects that may produce slivers (for example, driving wooden stakes)

6 1 5 6 Contamination/Exposure Prevention

The team leaders will be responsible for overseeing personnel decontamination at each site Personnel decontamination will be performed in a separate area from equipment decontamination Ways in which onsite personnel may become contaminated include the following

- Being splashed by contaminated liquids while sampling or handling liquids
- Coming in contact with contaminated solids or liquids
- Walking through contaminated materials, either in solid or liquid state
- Being in contact with contaminated equipment
- Being in contact with contaminated solid substances in waste piles or on the soil surface
- Sitting or kneeling on the ground, especially damp/muddy areas near data collection sites

Onsite team members will avoid, as much as possible, becoming contaminated

Onsite personnel will avoid exposure to hazardous materials by employing the required personal protective equipment described in Section 6 1 6 2

Care will be taken to prevent equipment contamination as much as possible Sampling and monitoring equipment will not be laid on contaminated surfaces Monitoring equipment that cannot be decontaminated easily will be bagged, and the bag taped and secured around the instrument.

6 1 6 Personal Protective Equipment (PPE)

6 1 6 1 Field Activities

The level of PPE required for surface water sample collection will be continually reevaluated as fieldwork progresses It is expected that there will be a tailoring of requirements for specific sites and weather variations PPE requirements for specific operations shall be agreed upon beforehand by the Site Manager and the SSO, and a document to that effect will be drawn up, dated, and signed by the Site Manager and

SSO The SSO shall post PPE requirements in the crew trailer and announce changes and justification for those changes at a site safety meeting The HSO or CHSO will publish a change to this plan if PPE changes are permanent and if the HSO/CHSO considers the change significant

6 1 6 2 Level D Personal Protective Equipment Items

The SSO and Site Manager (SM) may select from the following items of PPE to complete a Level D ensemble that provides foot, body, hand, and eye protection against liquids and splashes

6 1 6 2 1 Foot Protection

- Leather boot with steel toe and disposable boot cover
- Rubber knee boot, chemical resistant with steel toes
- Rubber hip boot, chemical resistant
- Rubber chest wader, chemical resistant

6 1 6 2 2 Body Protection

- Tyvek or equivalent disposable coverall
- Saranex-coated or equivalent disposable coverall
- Waterproof apron worn over cotton coveralls

6 1 6 2 3 Hand Protection

- Chemical-resistant gloves (nitrile or butyl)
- Surgical gloves or equivalent

6 1 6 2 4 Eye Protection

- Full-face shield
- Goggles
- Wrap-around type safety glasses

6 1 6 2 5 Cold Weather Items - Worn Under PPE Items Specified

- Wool socks
- Insulated gloves
- Hard hat liners or hats, caps
- Insulated chemical-resistant boots
- Insulated coveralls

6 1 6 3 Personal Protective Equipment Inspection

Personal protective equipment should be inspected before use The following checks should be made before use

- Determine that the clothing material is correct for the specific task at hand

- Visually inspect for
  - Imperfect seams
  - Tears
  - Malfunctioning closures

- Hold up to light and check for pinholes

During the work task, periodically inspect for the following

- Evidence of chemical attack such as discoloration, swelling, stiffening, and softening Keep in mind, however, that chemical permeation can occur without any visible effects

- Closure failure

- Tears

- Punctures

- Seam discontinuities

Before using gloves, pressurize each glove to check for pinholes Blow or otherwise introduce air into each glove, then seal, and roll the gauntlet toward the fingers, or inflate the glove and hold it under potable water In either case, no air should escape

6 1 7 Action Levels

Establishment of chemical or radiological agent action levels is not warranted by review of generalized Rocky Flats Plant-wide environmental monitoring results and previous analytical results from the sites specified in Table 4-1, Monitoring Stations. However, unforseen releases of chemical or radiological materials are a possibility All field team members should be alert to unusual conditions at each site during each visit and notify both the Site Manager and the Site Safety Officer if conditions seem to be unusual Those two individuals will make a decision on whether data gathering should proceed without further investigation into the source of the unusual conditions

6 1 8 Equipment Decontamination

Equipment decontamination will be accomplished as described in SOP 4, General Equipment Decontamination, dated April 23, 1990 Before rented or leased equipment that has been used in the field is returned, it will be wipe tested for radio isotopes and the results furnished to the HSO The HSO will determine if the item is suitable for return to the owner

6 1 9 Heat Stress Monitoring

Warm weather and several layers of protective clothing may induce heat stress in field employees The SSO or HST will be responsible for monitoring personnel for signs of heat stress Monitoring, by taking heart rates, will be performed, at a minimum, every time employees break If the heart rate exceeds 110 beats per minute at the beginning of the rest period, the next work cycle should be shortened by one-third If the heart rate still exceeds 110 beats per minute at the next rest period, shorten the work cycle should be shortened by another one-third

At the beginning of the work day, at lunch break, and at the end of the day, workers must weigh in on a scale Body water loss during the work day should not exceed 1 5 percent of total body weight The amount of fluids lost must be replaced Potable water and Gatorade or other electrolyte replacement fluid will be available Workers should be encouraged to drink fluids during breaks Attachment E presents WC operating procedures for work under heat stress conditions

6 1 10 Work During Darkness

This health and safety plan does not cover fieldwork after daylight hours

6 1 11 Confined Space Work

No work in confined spaces or places with limited egress is permitted by this plan

6.2 LABORATORYACTIVITIES

6 2 1 Safety Rules

Laboratory work will be conducted at Hazen Research Inc Woodward-Clyde personnel assigned to conduct the laboratory portion of this work must, therefore, be aware of, and comply with the Hazen Research safety program They may be required to obtain assistance from personnel at Hazen in order to comply with this program Portions of the safety program applicable to this work are presented below Woodward-Clyde personnel are referred to the Hazen Research Employee Safety Manual for further details All policies defined in the Hazen Safety Manual are incorporated by reference into this HSP

6 2 1 1 General Safety

These general safety rules and precautions are applicable to all employees regardless of work areas In addition to the general rules, employees who perform specialized jobs are to be thoroughly familiar with the safety rules pertaining to their unique tasks as outlined in the various sections

USE COMMON SENSE!!!!

1 Follow instructions and do not take chances If you do not know the rules or proper procedures, ask your supervisor

2 Correct or report unsafe conditions immediately

3 Report all accidents and get first aid promptly for all injuries

4 Use, adjust, and repair equipment only when authorized

5 Use the proper tool for the job, and use it correctly

6 No horseplay

7 Use only machines or equipment which you are qualified to use

8 When lifting or carrying items is part of your job, it is your responsibility to use the following guidelines make sure there are no nails or other items protruding which may cause injury in the lifting and carrying procedure When lifting, crouch as close to the object as practical, get a good grip on it, keep your feet

apart and bend your knees Lift slowly by straightening your legs Keep your back relatively straight, your leg muscles, not your back, should do all the work

9 Warn a person in the immediate vicinity of unsafe conditions

10 Unsafe situations or areas shall be barricaded and posted with appropriate signs until corrective measures can be taken

11 No person shall proceed against or disregard any warning given by word of mouth, sign, or signal

12 Drive slowly in the vicinity of the company facilities (10 mph maximum) Park properly and within designated areas Watch for pedestrians and other vehicles

13 Walk, never run

14 Employees are not to get on or off moving vehicles at any time

15 No one shall ride on the running board of a truck, in the bucket of a loader, or on the forks of a fork-lift

16 Climbing or crossing between, under, or over machinery and equipment as a short cut is prohibited

17 Do not remove without authority, destroy, or tamper with safety devices, signals, or signs

18 Everyone is responsible for keeping his working place clean A clean and orderly site is safe and efficient Keep tripping hazards out of places where employees walk By keeping your working place clean, you will have a clear path of retreat in case of emergency A job is not complete until the working place is clean and orderly

19 Know what to do in case of general emergency such as a fire (see section on "Emergency Procedures")

20 Be familiar with and know the locations of fire extinguisher, emergency breathing equipment, first aid supplies, and safety showers

21 No person shall individually attempt to perform a task with which he is unfamiliar or uninstructed

22 No person shall individually use equipment with which he is unfamiliar or uninstructed

23 No person shall use tools or equipment that are defective or not suitable for the work being done

24 Report promptly to your supervisor any defective tools or equipment or unsafe conditions

25 Smoking is not allowed in or near oil, gasoline, volatile hydrocarbons, flammable compressed gas, or chemical storage areas "NO SMOKING" signs are to be strictly observed

26 All portable power tools must be grounded Do not use any electric portable power tools that are not grounded unless the tool is of a double insulated type

27 Unless your are an electrician, do not attempt any electrical repairs Only qualified electricians shall work on electrical equipment or maintain energized lines

28 Report all unusual electrical conditions, i e , blown fuses, sparking or smoking motors, and worn extension cords

29 Always wear comfortable and adequate clothing on the job This includes not only well - fitting clothing, but adequate shoes to protect your feet from hazardous materials which may be encountered on the job

30 It is each employee's responsibility to maintain personal hygiene, particularly when working with hazardous chemicals

31 Whenever stacking is part of your assigned task, it is your responsibility not only to stack material so there is no danger of its falling, but also to stack it within prescribed areas allowing all aisles and work spaces to remain free

32 Always use the handrails on stairs and never jump from platforms, scaffolds, loading docks, or other elevations

33 Keep out of areas which are barricaded or marked "Restricted" or "Dangerous" unless you have permission to enter the area and are familiar with the equipment or material

34 Always use a ladder to reach work or materials which you cannot normally reach from the floor

35 Before using a ladder, inspect it, use it with respect, and verify that is has anti-skid feet

36 If it is necessary to place a ladder near a door or aisle through which there is traffic, warning signs and barricades should be set up, and someone should hold the ladder

37 All air lines, except those used to operate equipment, shall be reduced to 30 psi A self-reducing gun may be used for this purpose, if not, then a reducer must be placed in the line ahead of the gun

38 Under no circumstances shall an air hose be used to engage in horseplay with another employee, nor shall it be used to clean clothing or part of the body

39 All compressed gas cylinders shall be handled as if full, and shall be kept secured to a stationary object or a cylinder truck whether in storage or in transit

40 The protective cap over the gas cylinder valve shall be screwed in place when not is use

41 Compressed gas cylinders, whether full or empty, shall only be transported in a secured, upright position Regulators must be removed and caps in place before transport

42 Compressed gas cylinders shall be stored in a place where they are not subject to excessive variations in temperature

43 Hoods, exhaust systems, or special enclosures shall be used wherever installed to reduce airborne contaminants

44 Chemical labels shall be read and followed, particularly those which contain instructions in the use of the chemical to avoid harmful exposure to the employee

45 All employees shall know the location of fire - fighting equipment and how to use it properly

6 2 1 2 Employee Conduct

1 Every employee and visitor is required to wear safety glasses with side shields at all times while on Company property The following exceptions to this rule are allowed

a In any building or part of building which houses only offices
b In offices which are separated form labs and plant areas by solid partitions
c Rescue work in certain cases

Employees working at a laboratory bench or at a fume hood must wear safety glasses with side shields

Employees working on ion exchange or solvent extraction columns must wear a face shield when making adjustments to the apparatus

2 Employees must use a face shield when handing or pouring bulk containers (carboys, drums, etc) of acid, caustics, or other corrosive liquids or when unloading such chemicals from tank trucks

3 Contact lenses are not to be worn by employees when on duty, except by personnel working in office areas

6 2 1 3 Laboratory Safety

Research and analytical laboratories provide a potential for the occurrence of physically injurious accidents In the course of one's work in the laboratory, materials are encountered which are toxic, corrosive, flammable, explosive, noxious, or suffocating, and equipment which is operated under extremes of pressure, temperature, voltage, and flow When handled improperly, these materials and equipment may cause an accident Personnel in contact with such hazardous materials and equipment must be knowledgeable in the procedures for their safe manipulation and also must know how to respond properly should an accident occur

When undertaking any action in the laboratory, one must first be fully aware of the possible results of that action and take all necessary precautions to prevent any accident from resulting It is the responsibility of each person using chemicals and laboratory equipment to determine the potential danger Each person who uses and handles chemicals must be familiar with their dangerous properties

1 Prior to performing test work, think through all reactants, intermediates, and products in terms of toxicity, flammability, and reactivity hazards

2 In an unknown reaction, always start with small quantities of material to determine reaction characteristics

3 Appropriate protective gear must be worn at all times.

4 Eating or drinking in the laboratory areas is absolutely prohibited Violation of this rule will be cause for immediate termination

5 At no time is a person to perform laboratory work while alone in the building

6 Do not leave potentially dangerous experiments unattended or overnight

7 Never use mouth suction to pipette

8 Avoid filling a burette above eye level

9 Exercise caution when opening stock bottles of concentrated liquid reagents or bottles of liquid having high vapor pressures Cool such containers prior to opening

10 All cylinders of compressed gases must be tied down securely to prevent tipping over or falling Cylinders must be transported only in the cylinder cart and be chained to cart with protective valve capped tightly

6 2 1 3 1 Housekeeping

1 Each worker is responsible for keeping his or her work area neat and orderly All workers using community areas such as hoods, ovens, and balances should share responsibility for keeping them clean.

2 Laboratory benches and aisles should not be used as storage areas but should be cleared upon completion of each experiment or job

3 Place rags, waste paper, and broken glass in the proper receptacle for disposal

4 Fire extinguisher, safety showers, and eye wash fountains are to be kept clear and readily accessible

5 Waste chemicals must be properly labeled as to contents Acids and/or wash solvents or volatiles must be kept in separate safety containers for disposal or neutralization For specific information, contact the Hazen Research Safety Engineer

6 2 1 3 2 Glassware

1 Do not use broken, cracked, chipped, or badly scratched glassware Broken pieces should be disposed of if they cannot be reworked or salvaged

2 Do not pick up broken glass with bare hands, use gloves or sweep it up Fine glass particles should be picked up with wet paper towels

3 The ends of all glass tubing and rods should be fire polished before using

4 Protect hands with gloves or towel when making a glass to rubber connection or when inserting glass tubing into a stopper Lubricate the tubing with water, glycerine, or stopcock grease

5 Extra protective care must be taken when attempting to remove frozen stoppers or freeing frozen ground glass joints

6 When heating glass vessels on a hot plate or oven burner, protect them from breakage due to excess localized heat by using heat - resistant pads or wire gauze having a heat - resistant center

7 All glassware should be emptied and rinsed before being set aside for cleaning, particularly if they contain toxic or highly reactive materials

8 Thick - walled glass apparatus should never be heated, nor should heat - generating reactions be allowed to take place in such containers

9 Vacuum desiccators, Dewar flasks, vacuum distillation apparatus, etc should be provided with metal gauze mantles

10 Apply vacuum only to glassware made for such services (e g , desiccators and filter flasks)

11 Be sure vacuum filter crucibles cannot slip through holders and that stoppers on Buchner funnels are not too small for the filter flasks

12 Do not subject glassware under vacuum to mechanical shock

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copies

13 Always wrap glass Dewar flasks with tap

14 Do not stopper glass flasks containing h

15. Relieve vacuum in all parts of system be

16 Use boiling chips or stirring to prevent bumping when boiling liquids.

17. Use heating mantle or hot plate when possible, rather than a burner.

6 2 1 3 3 Laboratory Electrical Equipment

1 Do not use electrical equipment if power cords are frayed or control switches and thermostats are not in good working order.

2 Keep all electrical equipment and hands dry while handling.

3 Do not try to repair equipment yourself. This should be done by qualified personnel Call the Electric Shop for all repairs.

4 Use grounded outlets only. If equipment does not have a three-prong plug, ground the equipment separately to a cold - water pipe.

5 Outputs from variable transformers (powerstat, Variac, etc.) are usually not grounded even though the input lines may be. Equipment regulated by a variable transformer should be grounded separately.

6. Do not use electrical equipment such as mixers or hotplates around flammable solvents.

7 Never try to bypass any safety device on a piece of electrical equipment.

8. In case of fire on or near any electrical equipment, use only carbon dioxide or dry chemical fire extinguisher.

6 2.1.4 Chemicals and Reagents

As the use of hazardous chemicals will not be required for this work, the sections in the Hazen Safety Manual on explosives and incompatible materials are not included here. This HSP assumes that the materials used during this project will be used in isolation from the rest of the research facility, therefore, storage of chemicals with incompatible materials will not occur. Only general rules for chemical storage and disposal are presented The reader is again referred to the complete Manual for further detail if needed

6 2 1.4.1 Storage and Handling of Chemicals

1. Generally, heavy items or large containers should be stored on or as near the floor as possible with smaller items and containers on the upper shelves

2. Large storage shelves should have ridges in the front to reduce danger of chemical spillage.

3 Chemicals which might react together to produce dangerous fumes, fire, or explosion must not be stored in the same location.

4 Large containers of liquid chemicals should be provided with a protective covering of sufficient strength to prevent damage to the containers.

5. Glass containers should be surrounded with shock-absorbing material for stockroom storage or transport.

6. Acids should never be stored on shelves directly above solvents.

7. Drums which are mounted horizontally should be securely braced to prevent rolling Sand should be placed under the taps to absorb drippings.

8 Manual transporting of large reagent containers should be eliminated wherever possible

9 All containers must be labeled plainly. A receptacle should never be filled with material other than that indicated on the label. Containers should be labeled <u>before</u> filling.

10. If exact information is not received with shipment of new or unfamiliar types and potencies of chemicals for special work, request the manufacturer to furnish his recommendations before proceeding with laboratory use or see the Hazen Research Safety Engineer for more information.

11 When diluting acid, always pour the acid into water; never pour water into acid.

12. Always flush the outside of acid bottles before opening them. Do not lay the stopper down on any surface where the next person may rest his hand or arm. Keep acid bottles stoppered tightly, and flush and dry them before replacement

on the reagent shelf Make certain that no spillage remains on tables, floor, or bottle

13 Never carry open containers of dangerous chemicals from place to place, containers should always be covered or sealed.

6 2 1 4 2 Disposal of Waste Chemicals

1 Each person using laboratory reagents is expected to know the proper methods of disposing of waste chemicals safely If you have any question, contact the Hazen Research Safety Engineer

2 Small quantities of acids or alkalies may be disposed of by slowly pouring into a stream of water and flushing down the drain with a large quantity of water

3 Alkali metal residues must be allowed to react completely in butyl alcohol before disposition Such residues should never be disposed of by reaction with water

4 Any unusual or special disposal problems should be referred to the Hazen Research Safety Engineer

5 Waste chemicals must be properly labeled as to contents for disposal

6 2 2 Specific Work Practices

In addition to work practices outlined above, the following will be required

- When columns are to be filled with activated carbon, other absorbents or ion exchange resins, work must be performed under a hood

6 2 3 Monitoring

It is not anticipated that concentrations in the samples or released to the air as tests are conducted will be sufficient to exceed and OSHA Permissible Exposure Limits Further evaluation of contaminant concentrations in samples will be conducted by the HSO as analyses are completed An addendum to this HSP will be prepared if there is evidence which indicates a need to institute health and safety monitoring

6 2 4 Personal Protective Equipment

Work is to be completed in Level D protective gear as follows

- Lab coat
- Shoes must have a closed toe and heel
- Goggles or safety glasses with side shields
- Nitrile or neoprene gloves (when handling column absorbents or samples)
- Rubber gloves and a rubber or plastic apron or lab coat (while handling acids, caustics or heated liquids)
- Heat resistant gloves (when handling hot objects)
- Gloves and safety glasses (when disposing of chemicals)

7.1 FIELD ACTIVITIES

7 1 1 Emergency Equipment

The following emergency equipment will be available at each site of intrusive activity

- First aid kit
- Eye wash
- Gatorade or equivalent
- Fire extinguisher (10-lb ABC)
- Long-handled shovel
- An extra full set of the appropriate PPE for each team member

7 1 2 Radio Communications

Field teams will have a method of communicating with both the field office trailer and other field teams

A communication center will be established at the Woodward-Clyde (WC) field trailer office This office will be equipped with telephone communications and shall be attended at all times during operations

7 1 3 Emergency Telephone

The closest accessible telephone during all working hours will be identified by the Site Safety Officer (SSO) before beginning field activities in case communication with the WC communications center is not possible All guard posts have telephones Emergency telephone numbers will be posted near the WC field office telephone

7 1 4 Emergency Medical Facilities

Telephone numbers for the Rocky Flats Plant medical facility are provided below (Building 122, Central Avenue See Figure 7-1)

- General Information 966-2594
- Ambulance Service 966-2911

7 1 5 Emergency Response Procedures

The Site Manager, with assistance from the SSO, has responsibility and authority for coordinating all emergency response activities until proper authorities arrive and assume control

7 1 5 1 Fire/Explosion

Any fire emergency will be handled by immediately notifying the fire department Only if the fire appears to be small and easily extinguishable will personnel attempt to control it with fire extinguishers available in the work area Otherwise, immediate evacuation of the area is indicated In the event of an explosion, all personnel shall be evacuated

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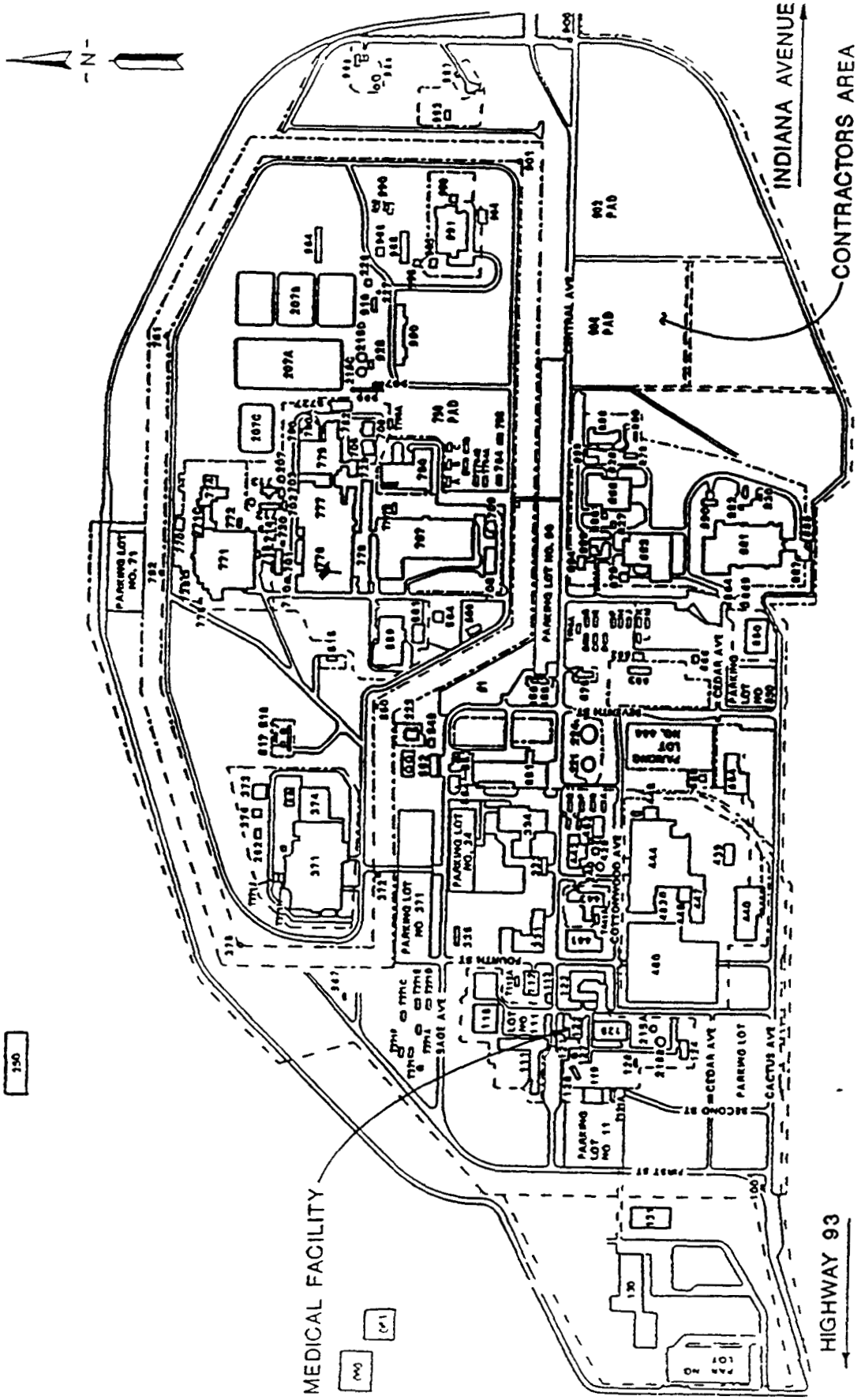

Job No	FIGURE 7-1 MEDICAL FACILITY MAP
Prepared by	

and the fire department notified No one shall re-enter the area until it has been cleared by explosives safety personnel

7 1 5 2 Physical Injury

In case of injuries to personnel, first aid treatment will be initiated immediately by trained personnel In case of serious injuries, the victim will be transported to the Rocky Flats Plant medical center as soon as possible Minor injuries may be treated on site, but all injuries will be examined by trained medical personnel Victims of serious bites or stings will be taken to the Rocky Flats Plant medical center In the event that an injured person is contaminated with chemicals or radionuclides, the person shall be taken to the Rocky Flats Plant medical center as soon as possible Decontamination shall be performed to prevent further exposure only if it will not aggravate the injury Treatment of life-threatening or serious injuries will always be considered first

7 1 5 3 Injury Due to Heat

If a person is suffering from heat exhaustion (profuse perspiration, normal body temperature), the following procedures will be taken

- Remove the person to a cooler, shaded area
- Give 8 ounces of Gatorade every 15 minutes for three or four doses
- Allow the person to rest
- If the person is suffering from cramps, press warm, wet towels over the cramped area

If a person is suffering from heat stroke (skin hot and dry, very high body temperature), the following procedures will be taken

- Decontaminate the victim

- Cool the victim quickly by soaking the person in cool but not cold water, sponging the body with rubbing alcohol or cool water, or pouring water on the body

- Reduce the body temperature to a safe level (about 102 to 105°F)

- Observe the victim for 10 minutes, if the body temperature starts to rise again, cool the victim again

- Transport the victim to a hospital for medical attention as quickly as possible

7 1 5 4 Injury Due to Cold

First aid for frostbite consists of the following procedures

- Decontaminate the victim

- Bring victim indoors and quickly rewarm the affected areas in water between 102 to 105°F

- Give victim a warm drink--NOT coffee, tea, or alcohol

- Do not permit the victim to smoke

- Keep the frozen parts in warm water or covered with warm cloths for 30 minutes, even though the tissue will be painful as it thaws

- Evaluate the injured areas and cover with sterile, soft, dry material
- Keep the victim warm and get immediate medical care
- Do not rub the frostbitten part
- Do not allow blisters to be broken
- Do not use ice, snow, gasoline, or anything cold on frostbite
- Do not use heat lamps or hot water bottles to rewarm the body part
- Do not place the affected part near a hot stove

First aid for improper exposure to cold (hypothermia) consists of the following procedures

- Decontaminate the victim
- Bring victim into a warm area as quickly as possible
- Remove wet or cold garments
- Dry the person thoroughly
- Provide warm, dry clothing or covering
- Provide rapid but gentle rewarming

- Give victim a warm drink--NOT coffee, tea, or alcohol

- Keep the victim warm and get immediate medical care

7 1 5 5 Emergency Services

Emergency telephone numbers are listed in Table 7-1

TABLE 7-1
EMERGENCY TELEPHONE NUMBERS - FIELD WORK

Site Health and Safety Officer	
Field Work	(303) 966-5874
WCFS Health and Safety Officer	
Karen Scudder	(303) 740-3837
William Sams	(303) 740-2700
24-Hour Installation Health/Safety Coordinator	(303) 966-2911
Fire	(303) 966-2911
Ambulance	(303) 966-2911
Poison Center	(303) 629-1123
Security	(303) 966-2911
Police	(303) 966-2911

YOU ARE LOCATED AT T903 (903 Pad Trailer)

NEAREST TELEPHONE IS AT: Guard Post

NEAREST EMERGENCY MEDICAL SERVICES ARE LOCATED AT: Building 122

Directions

From the Contractor's trailer compound, take a northbound street to Central Avenue, turn left onto Central Avenue, and Building 122 will be on the left side and slightly west of a guard building on the right after approximately 1 25 miles

From the RFP eastern boundary, upon entering RFP, you will be on Central Avenue Proceed approximately 3 5 miles, and Building 122 will be on the left side

ong the entrance road and through
nue, then turn left onto the first street
reet, but there is not a street sign Proceed
nich is on the left, and the next building on
ility (Building 122)

ents

nergency situations shall be carried out in accordance
Department of Energy (DOE) Order 5484 1 The Field Team
propriate emergency assistance personnel (for example, fire, police,
tension 2911 immediately, and then notify the Subcontractor Site
The Subcontractor Site Manager will notify the EG&G Environmental
(ER) Program Field Supervisor, Program Manager, and HSE Area Safety
er. The responsibility of the Subcontractor Site Health and Safety Coordinator
implement notification and reporting requirements of DOE Order 5484 1

7157 Spills

Current plans do not include handling the types or quantities of materials that, if spilled, would create a health hazard or generate environmental concerns However, the Site Safety Officer should be notified of all chemical spills for a determination of how to clean up and dispose of clean-up materials

7.2 LABORATORYACTIVITIES

7 2 1 Accident Involving an Injury

7 2 1 1 Minor Injury Requiring a Doctor

1 Render first aid, if qualified

2 Notify switchboard operator

3 Patient to be taken to Lutheran Hospital emergency room Supervisor shall notify hospital that an injury is being brought in

Lutheran Hospital
8300 W 38th Avenue
Wheat Ridge, Colorado
425-4500

4 Patient shall never be allowed to go the hospital alone Patient shall be driven by another Hazen or Woodward - Clyde employee

7 2 1 2 Major Injury

1 During normal working hours

a Render emergency first aid if qualified. Notify switchboard as to location of problem, nature of injury, extent of damage, etc **Give your name and extension you are calling from.**

b Send someone to main entrance on Indiana Street to direct ambulance

2 After normal working hours, weekends, and holidays

a Render emergency first aid, if qualified

b Have someone call for ambulance and paramedics.

Ambulance: 911

When phone is answered, give your name, address (4601 Indiana St, Golden) and telephone number (279-4501) Describe the nature and number of injuries

c Arrange for someone to meet ambulance at Hazen main entrance on Indiana St

d Notify your supervisor or

Steve Flaniken	Paul Snoddy
(Chemical Hygiene Officer)	452-2928
933-9309	

If no answer 890-6456

7 2 1 3 Injuries Involving WC Personnel

1 Handle as specified above, then notify

Karen Scudder	Mike Sams	JoAnn Tischler
740-3837	740-2600	740-2081

7 2 2 Fire

If possible, try to extinguish fire immediately Fire extinguishers are located inside each building and there is a large wheeled fire extinguisher outside Building 7

If it becomes necessary to call the Fire Department, follow the procedures below

1 During normal working hours

a Notify the switchboard operator as to location and type of fire **Give your name and extension you are calling from.**

b Send someone to main entrance on Indiana Street to direct fire crews

c Keep the fire area clear of spectators

2 After normal working hours, weekends, and holidays

a Call the Fire Department at **911**

b Send someone to main entrance on Indiana Street to direct fire crews

c Keep the fire area clear of spectators.

7 2 3 Building Evacuation

Building evacuation may be necessary for a variety of reasons Fire, gas leaks, release of toxic fumes may present a situation where evacuation is the only option The following procedures are to be used in the event of building evacuation

1 Leave the building by the nearest exit Move rapidly, but do not panic Once outside, continue to move away from the area to allow proper personnel and equipment to move in

2 Notify your supervisor or the switchboard that you have cleared the building safely and wait for an all-clear signal to return to work

8.1 GENERAL

Records shall be kept documenting the safety program Logs and records will be kept of training medicals, safety meetings, and injurious exposures

8.2 FIELD ACTIVITIES

8 2 1 Health and Safety Logbook

A separate health and safety logbook and sign in/sign out log shall be maintained by the SSO throughout the project and turned in to the HSO after the project is completed Logged information shall include (1) names of all WC and subcontract personnel entering and leaving the site each day, (2) daily listing of data collection site numbers to be visited by field teams, (3) description of unforeseen hazards and steps taken to mitigate hazards, (4) summary of telephone conversations regarding health and safety, (5) safety infractions, if any, (6) accidents and injuries, and (7) all other significant health and safety items

8 2 2 Personnel Records

Records shall be kept on each onsite individual Records include a medical clearance statement from a qualified physician, fit test, and training documentation When site safety meetings are conducted, an attendance sheet must be kept

ATTACHMENT A
SUMMARY OF ANALYTES

SURFACE WATER ANALYTES

VOLATILE ORGANICS

Chloromethane ug/l
Bromomethane ug/l
Vinyl Chloride ug/l
Chloroethane ug/l
Methylene Chloride ug/l
Acetone ug/l
Carbon Disulfide ug/l
1,1-Dichloroethene ug/l
1,1-Dichloroethane ug/l
Total-1,2-Dichloroethene ug/l
Chloroform ug/l
1,2-Dichloroethane ug/l
2-Butone ug/l
1,1,1-Trichloroethane ug/l
Carbon Tetrachloride ug/l
Vinyl Acetate ug/l
Bromodichloromethane ug/l
1,2-Dichloropropane ug/l
Cis-1,3-Dichloropropane ug/l
Trichloroethane ug/l
Dibromochlromethane ug/l
1,1,2-Trichloroethane ug/l
Benzene ug/l
Trans-1,3-Dichloropropane ug/l
Bromoform ug/l
4-Mehtlyl-2-pantanone ug/l
2-Hexanone ug/l
Tetrachloroethane ug/l
1,1,2,2-Tetrachloroethane ug/l
Toluene ug/l
Chlorobenzene ug/l
Ethylbenzene ug/l
Styrene ug/l
Total Xylenes ug/l

SUMMARY OF ANALYTES

SURFACE WATER ANALYTES
(continued)

SEMIVOLATILE ORGANICS

Phenol ug/l
bis(2-Chloroethyl)Ether ug/l
2-Chlorophenol ug/l
1,3-Dichlorobenzene ug/l
1,4-Dichlorobenzene ug/l
Benzyl Alcohol ug/l
1,2-Dichlorobenze ug/l
2-Methylphenol ug/l
bis(2-Chloroisopropyl)Ether ug/l
4-Methylphenol ug/l
N-Nitrosodi-n-propylamine ug/l
Hexachloroethane ug/l
Nitrobenzene ug/l
Isophorone ug/l
2-Nitrophenol ug/l
2,4-Dimethylphenol ug/l
Benzoic Acid ug/l
bis(2-Chloroethoxy) Methane ug/l
2,4-Dichlorophenol ug/l
1,2,4-Trichlorobenzene ug/l
Napthalene ug/l
4-Chloroaniline ug/l
Hexachlororbutadiene ug/l
4-Chloro-3-methylphenol ug/k
2-Methylnaphthalene ug/l
Hexachlorocyclopentadiene ug/l
2,4,6-Trichlorophenol ug/l
2,4,5-Trichlorophenol ug/l
2-Chloronaphthalene ug/l
2-Nitroaniline ug/l
Dimethyl Phthalate ug/l
Acenaphthylene ug/l
3-Nitroaniline ug/l
Acenaphthene ug/l
2,4-Dinitrophenol ug/l
4-Nitrophenol ug/l
Dibenzofuran ug/l
2,4-Dinitrotoluene ug/l

SUMMARY OF ANALYTES

SURFACE WATER ANALYTES
(continued)

SEMIVOLATILE ORGANICS (continued)

2,6-Dinitrotoluene ug/l
Diethylphthalate ug/l
4-Chlorophenyl-phenylether ug/l
Fluorene ug/l
4-Nitroaniline ug/l
4,6-Dinitro-2-methylphenol ug/l
N-Nitrosodiphenylamine ug/l
4-Bromophenyl-phenylether ug/l
Hexachlorobenzene ug/l
Pentachlorophenol ug/l
Phenanthrene ug/l
Anthracene ug/l
di-n-Butyl Phthalate ug/l
Fluoranthene ug/l
Pyrene ug/l
Butyl Benzyl Phthalate ug/l
3,3-Dichlorobenzidine ug/l
Benzo(a) Anthracene ug/l
bis(2-Ethylhexyl) Phthalate ug/l
Chrysene ug/l
di-n-Octyl Phthalate ug/l
Benzo(b) Fluoranthene ug/l
Benzo(k) Fluoranthene ug/l
Benzo(a) Pyrene ug/l
Indeno(1,2,3-cd) Pyrene ug/l
Dibenz(a,h) Anthracene ug/l
Benzo(g,h,i) Perylene ug/l

SUMMARY OF ANALYTES

SURFACE WATER ANALYTES
(continued)

METALS

Aluminum (Al), total mg/l
Antimony (Sb), total mg/l
Arsenic (As), total mg/l
Barium (Ba), total mg/l
Beryllium (Be), total mg/l
Cadmium (Cd), total mg/l
Calcium (Ca), total mg/l
Cesium (Cs), total mg/l
Chromium (Cr), total mg/l
Cobalt (Co), total mg/l
Copper (Cu), total mg/l
Iron (Fe), total mg/l
Lead (Pb), total mg/l
Lithium (Li), total mg/l
Magnesium (Mg), total mg/l
Manganese (Mn), total mg/l
Mercury (Hg), total mg/l
Molybdenum (Mo), total mg/l
Nickel (Ni), total mg/l
Potassium (K), total mg/l
Selenium (Se), total mg/l
Silver (Ag), total mg/l
Sodium (Na), total mg/l
Strontium (Sr), total mg/l
Thallium (Tl), total mg/l
Tin (Sn), total mg/l
Vanadium (V), total mg/l
Zinc (Zn), total mg/l

SUMMARY OF ANALYTES

SURFACE WATER ANALYTES
(continued)

PESTICIDE/PCB

Alpha-BHC ug/l
Beta-BHC ug/l
Delta-BHC ug/l
Gamma-BHC ug/l
Heptachlor ug/l
Aldrin ug/l
Heptachlor Epoxide ug/l
Endosulfan I ug/l
Dieldrin ug/l
4,4-DDE ug/l
Endrin ug/l
Endosulfan II ug/l
4,4-DDD ug/l
Endosulfan Sulfate ug/l
4,4-DDT ug/l
Methoxychlor ug/l
Endrin Ketone ug/l
Chlordane ug/l
Alpha Chlordane ug/l
Gamma Chlordane ug/l
Toxaphene ug/l
Aroclor-1016 ug/l
Aroclor-1221 ug/l
Arochlor-1232 ug/l
Aroclor-1242 ug/l
Arochlor-1248 ug/l
Aroclor-1254 ug/l
Arochlor-1260 ug/l

SUMMARY OF ANALYTES

SURFACE WATER ANALYTES
(continued)

RADIOCHEMISTRY

Gross Alpha pCi/l
Gross Beta pCi/l
Uranium 233,234 pCi/l
Uranium 235 pCi/l
Uranium 238 pCi/l
Strontium 89,90 pCi/l
Plutonium 239 pCi/l
Americium 241 pCi/l
Cesium 137 pCi/l
Tritium pCi/l
Radium 226 pCi/l
Radium 228 pCi/l

ATTACHMENT B
SUMMARY OF ANALYTICAL RESULTS AND TOXICITY INFORMATION

ATTACHMENT B
SUMMARY OF ANALYTICAL RESULTS AND TOXICITY INFORMATION

SURFACE WATER ANALYTES

VOLATILE ORGANICS	MAXIMUM AMOUNT PREVIOUSLY DETECTED
Chloromethane ug/l	
Bromomethane ug/l	
Vinyl Chloride ug/l	15
Chloroethane ug/l	
Methlylene Chloride ug/l	29
Acetone ug/l	180
Carbon Disulfide ug/l	
1,1-Dichloroethene ug/l	143
1,1-Dichloroethane ug/l	8
Total-1,2-Dichloroethene ug/l	56
Chloroform ug/l	82
1,2-Dichloroethane ug/l	
2-Butone ug/l	13
1,1,1-Trichloroethane ug/l	36
Carbon Tetrachloride ug/l	1005
Vinyl Acetate ug/l	
Bromodichloromethane ug/l	
1,2-Dichloropropane ug/l	
Cis-1,3-Dichloropropane ug/l	
Trichloroethene ug/l	180
Dibromochlromethane ug/l	
1,1,2-Trichloroethane ug/l	
Benzene ug/l	1
Trans-1,3-Dichloropropane ug/l	
Bromoform ug/l	15
4-Methyl-2-pantanone ug/l	
2-Hexanone ug/l	
Tetrachloroethane ug/l	280
1,1,2,2-Tetrachloroethane ug/l	440
Toluene ug/l	32
Chlorobenzene ug/l	
Ethlybenzene ug/l	12
Styrene ug/l	
Total Xylenes ug/l	12

SUMMARY OF ANALYTES

SURFACE WATER ANALYTES
(continued)

SEMIVOLATILE ORGANICS	MAXIMUM AMOUNT PREVIOUSLY DETECTED
Phenol ug/l	18
bis(2-Chloroethyl)Ether ug/l	
2-Chlorophenol ug/l	
1,3-Dichlorobenzene ug/l	
1,4-Dichlorobenzene ug/l	
Benzyl Alcohol ug/l	
1,2-Dichlorobenze ug/l	
2-Methylphenol ug/l	24
bis(2-Chloroisopropyl)Ether ug/l	
4-Methylphenol ug/l	43
N-Nitrosodi-n-propylamine ug/l	
Hexachloroethane ug/l	
Nitrobenzene ug/l	
Isophorone ug/l	
2-Nitrophenol ug/l	
2,4-Dimethylphenol ug/l	
Benzoic Acid ug/l	
bis(2-Chloroethoxy) Methane ug/l	
2,4-Dichlorophenol ug/l	
1,2,4-Trichlorobenzene ug/l	
Napthalene ug/l	
4-Chloroaniline ug/l	
Hexachlorobutadiene ug/l	
4-Chloro-3-methylphenol ug/k	
2-Methylnaphthalene ug/l	
Hexachlorocyclopentadiene ug/l	
2,4,6-Trichlorophenol ug/l	
2,4,5-Trichlorophenol ug/l	
2-Chloronaphthalene ug/l	
2-Nitroaniline ug/l	
Dimethyl Phthalate ug/l	
Acenaphthylene ug/l	
3-Nitroaniline ug/l	
Acenaphthene ug/l	
2,4-Dinitrophenol ug/l	
4-Nitrophenol ug/l	
Dibenzofuran ug/l	
2,4-Dinitrotoluene ug/l	

SUMMARY OF ANALYTES

SURFACE WATER ANALYTES
(continued)

SEMIVOLATILE ORGANICS (continued)	MAXIMUM AMOUNT PREVIOUSLY DETECTED
2,6-Dinitrotoluene ug/l	
Diethylphthalate ug/l	
4-Chlorophenyl-phenylether ug/l	
Fluorene ug/l	
4-Nitroaniline ug/l	
4,6-Dinitro-2-methylphenol ug/l	
N-Nitrosodiphenylamine ug/l	
4-Bromophenyl-phenylether ug/l	
Hexachlorobenzene ug/l	
Pentachlorophenol ug/l	
Phenanthrene ug/l	
Anthracene ug/l	
di-n-Butyl Phthalate ug/l	
Fluoranthene ug/l	
Pyrene ug/l	
Butyl Benzyl Phthalate ug/l	
3,3-Dichlorobenzidine ug/l	
Benzo(a) Anthracene ug/l	
bis(2-Ethylhexyl) Phthalate ug/l (2-Ehtylhexyl) Phthalate	17
Chrysene ug/l	
di-n-Octyl Phthalate ug/l	
Benzo(b) Fluoranthene ug/l	
Benzo(k) Fluoranthene ug/l	
Benzo(a) Pyrene ug/l	
Indeno(1,2,3-cd) Pyrene ug/l	
Dibenz(a,h) Anthracene ug/l	
Benzo(g,h,i) Perylene ug/l	

SUMMARY OF ANALYTES

SURFACE WATER ANALYTES
(continued)

METALS	MAXIMUM AMOUNT PREVIOUSLY DETECTED
Aluminum (Al), total mg/l	78 7
Antimony (Sb), total mg/l	0 142
Arsenic (As), total mg/l	1 03
Barium (Ba), total mg/l	4 49
Beryllium (Be), total mg/l	0 0574
Cadmium (Cd), total mg/l	0 124
Calcium (Ca), total mg/l	1 76
Cesium (Cs), total mg/l	2 53
Chromium (Cr), total mg/l	0 0971
Cobalt (Co), total mg/l	0 489
Copper (Cu), total mg/l	0 332
Iron (Fe), total mg/l	8 43
Lead (Pb), total mg/l	0 656
Lithium (Li), total mg/l	83 9
Magnesium (Mg), total mg/l	186
Manganese (Mn), total mg/l	27 7
Mercury (Hg), total mg/l	3 97
Molybdenum (Mo), total mg/l	0 199
Nickel (Ni), total mg/l	0 308
Potassium (K), total mg/l	4140
Selenium (Se), total mg/l	0 45
Silver (Ag), total mg/l	0 148
Sodium (Na), total mg/l	1,500,000
Strontium (Sr), total mg/l	10 8
Thallium (Tl), total mg/l	0 01
Tin (Sn), total mg/l	0 969
Vanadium (V), total mg/l	1 65
Zinc (Zn), total mg/l	6 05

SUMMARY OF ANALYTES

SURFACE WATER ANALYTES
(continued)

PESTICIDES/PCB	MAXIMUM AMOUNT PREVIOUSLY DETECTED
Alpha-BHC ug/l	
Beta-BHC ug/l	
Delta-BHC ug/l	
Gamma-BHC ug/l	
Heptachlor ug/l	
Aldrin ug/l	
Heptachlor Epoxide ug/l	
Endosulfan I ug/l	
Dieldrin ug/l	
4,4-DDE ug/l	
Endrin ug/l	
Endosulfan II ug/l	
4,4-DDD ug/l	
Endosulfan Sulfate ug/l	
4,4-DDT ug/l	
Methoxychlor ug/l	
Endrin Ketone ug/l	
Chlordane ug/l	
Alpha Chlordane ug/l	
Gamma Chlordane ug/l	
Toxaphene ug/l	
Aroclor-1016 ug/l	
Aroclor-1221 ug/l	
Arochlor-1232 ug/l	
Aroclor-1242 ug/l	
Arochlor-1248 ug/l	
Aroclor-1254 ug/l	1 1
Arochlor-1260 ug/l	

SUMMARY OF ANALYTES

SURFACE WATER ANALYTES
(continued)

RADIOCHEMISTRY	MAXIMUM AMOUNT PREVIOUSLY DETECTED
Gross Alpha pCi/l	990
Gross Beta pCi/l	1140
Uranium 233,234 pCi/l	703
Uranium 235 pCi/l	47 1
Uranium 238 pCi/l	304
Strontium 89,90 pCi/l	3 6
Plutonium 239 pCi/l	130
Americium 241 pCi/l	93
Cesium 137 pCi/l	14
Tritium pCi/l	12,960
Radium 226 pCi/l	48
Radium 228 pCi/l	35

SUMMARY OF ANALYTES

SEDIMENT ANALYTES

VOLATILE ORGANICS	MAXIMUM AMOUNT PREVIOUSLY DETECTED
1,1-Dichloroethene uG/kg	
1,1-Dichloroethane uG/kg	
Total 1,2-Dichloroethene uG/kg	
Chloroform uG/kg	
1,2-Dichloroethane uG/kg	
2-Butanone uG/kg	270
1,1,1-Trichloroethane uG/kg	
Chloromethane uG/kg	60
Bromomethane uG/kg	
Vinyl Chloride uG/kg	
Chloroethane uG/kg	
Methlylene Chloride uG/kg	90
Acetone uG/kg	240
Carbon Disulfide uG/kg	
Carbon Tetrachloride uG/kg	52
Vinyl Acetate uG/kg	
Bromodichloromethane uG/kg	
1,2-Dichloropropane uG/kg	
Cis-1,3-Dichloropropane uG/kg	
Trichloroethene uG/kg	17
Dibromochloromethane uG/kg	
1,1,2-Trichloroethane uG/kg	
Benzene uG/kg	
Trans-1,3-Dichloropropane uG/kg	
Bromoform uG/kg	
4-Methyl-2-pantanone uG/kg	
2-Hexanone uG/kg	
Tetrachloroethene uG/kg	39
1,1,2,2-Tetrachloroethane uG/kg	
Toluene uG/kg	500
Chlorobenzene uG/kg	
Ethylbenzene uG/kg	
Styrene uG/kg	
Total Xylenes uG/kg	

SUMMARY OF ANALYTES

SEDIMENT ANALYTES
(continued)

SEMIVOLATILE ORGANICS	MAXIMUM AMOUNT PREVIOUSLY DETECTED
Phenol uG/kg	
bis(2-Chloroethyl)Ether uG/kg	
2-Chlorophenol uG/kg	
1,3-Dichlorobenzene uG/kg	
1,4-Dichlorobenzene uG/kg	
Benzyl Alcohol uG/kg	
1,2-Dichlorobenze uG/kg	
2-Methylphenol uG/kg	
bis(2-Chloroisopropyl)Ether uG/kg	
4-Methylphenol uG/kg	
N-Nitrosodi-n-propylamine uG/kg	
Hexachloroethane uG/kg	
Nitrobenzene uG/kg	
Isophorone uG/kg	
2-Nitrophenol uG/kg	
2,4-Dimethylphenol uG/kg	
Benzoic Acid uG/kg	
bis(2-Chloroethoxy) Methane uG/kg	
2,4-Dichlorophenol uG/kg	
1,2,4-Trichlorobenzene uG/kg	
Napthalene uG/kg	
4-Chloroaniline uG/kg	
Hexachlorobutadiene uG/kg	
4-Chloro-3-methylphenol uG/kg	
2-Methylnaphthalene uG/kg	
Hexachlorocyclopentadiene uG/kg	
2,4,6-Trichlorophenol uG/kg	
2,4,5-Trichlorophenol uG/kg	
2-Chloronaphthalene uG/kg	
2-Nitroaniline uG/kg	
Dimethyl Phthalate uG/kg	
Acenaphthylene uG/kg	
3-Nitroaniline uG/kg	
Acenaphthene uG/kg	
2,4-Dinitrophenol uG/kg	
4-Nitrophenol uG/kg	
Dibenzofuran uG/kg	
2,4-Dinitrotoluene uG/kg	
2,6-Dinitrotoluene uG/kg	

SUMMARY OF ANALYTES

SEDIMENT ANALYTES
(continued)

SEMIVOLATILE ORGANICS (continued)	MAXIMUM AMOUNT PREVIOUSLY DETECTED
Diethylphthalate uG/kg	
4-Chlorophenyl-phenylether uG/kg	
Fluorene uG/kg	
4-Nitroaniline uG/kg	
4,6-Dinitro-2-methylphenol uG/kg	
N-Nitrosodiphenylamine uG/kg	
4-Bromophenyl-phenylether uG/kg	
Hexachlorobenzene uG/kg	
Pentachlorophenol uG/kg	
Phenanthrene uG/kg	1400
Anthracene uG/kg	400
di-n-Butyl Phthalate uG/kg	
Fluoranthene uG/kg	1600
Pyrene uG/kg	1300
Butyl Benzyl Phthalate uG/kg	
3,3-Dichlorobenzidine uG/kg	
Benzo(a) Anthracene uG/kg	
bis(2-Ethylhexyl) Phthalate uG/kg	57,000
Chrysene uG/kg	530
di-n-Octyl Phthalate uG/kg	1600
Benzo(b) Fluoranthene uG/kg	800
Benzo(k) Fluoranthene uG/kg	880
Benzo(a) Pyrene uG/kg	560
Indeno(1,2,3-cd) Pyrene uG/kg	560
Dibenz(a,h) Anthracene uG/kg	
Benzo(g,h,i) Perylene uG/kg	680

SUMMARY OF ANALYTES

SEDIMENT ANALYTES
(continued)

METALS	MAXIMUM AMOUNT PREVIOUSLY DETECTED
Aluminum (Al), total mg/kg	24,800
Antimony (Sb), total mg/kg	29
Arsenic (As), total mg/kg	10 6
Barium (Ba), total mg/kg	350
Beryllium (Be), total mg/kg	15 2
Cadmium (Cd), total mg/kg	17 2
Calcium (Ca), total mg/kg	132,000
Cesium (Cs), total mg/kg	8 5
Chromium (Cr), total mg/kg	50 2
Cobalt (Co), total mg/kg	12
Copper (Cu), total mg/kg	177
Iron (Fe), total mg/kg	33,300
Lead (Pb), total mg/kg	74 8
Lithium (Li), total mg/kg	27 8
Magnesium (Mg), total mg/kg	7400
Manganese (Mn), total mg/kg	1390
Mercury (Hg), total mg/kg	0 92
Molybdenum (Mo), total mg/kg	42
Nickel (Ni), total mg/kg	29 9
Potassium (K), total mg/kg	42,700
Selenium (Se), total mg/kg	21 3
Silver (Ag), total mg/kg	420
Sodium (Na), total mg/kg	715
Strontium (Sr), total mg/kg	168
Thallium (Tl), total mg/kg	90
Tin (Sn), total mg/kg	1080
Vanadium (V), total mg/kg	76 5
Zinc (Zn), total mg/kg	735

SUMMARY OF ANALYTES

SEDIMENT ANALYTES
(continued)

PESTICIDE/PCB	MAXIMUM AMOUNT PREVIOUSLY DETECTED
Alpha-BHC uG/kg	
Beta-BHC uG/kg	13
Delta-BHC uG/kg	
Gamma-BHC uG/kg	
Heptachlor uG/kg	
Aldrin uG/kg	
Heptachlor Epoxide uG/kg	
Endosulfan I uG/kg	
Dieldrin uG/kg	
4,4-DDE uG/kg	
Endrin uG/kg	
Endosulfan II uG/kg	
4,4-DDD uG/kg	
Endosulfan Sulfate uG/kg	
4,4-DDT uG/kg	
Methoxychlor uG/kg	
Endrin Ketone uG/kg	
Chlordane uG/kg	
Alpha Chlordane uG/kg	
Gamma Chlordane uG/kg	
Toxaphene uG/kg	
Aroclor-1016 uG/kg	
Aroclor-1221 uG/kg	
Arochlor-1232 uG/kg	
Aroclor-1242 uG/kg	
Arochlor-1248 uG/kg	
Aroclor-1254 uG/kg	1600
Arochlor-1260 uG/kg	

SUMMARY OF ANALYTES

SEDIMENT ANALYTES
(continued)

RADIOCHEMISTRY	MAXIMUM AMOUNT PREVIOUSLY DETECTED
Gross Alpha pCi/g	97
Gross Beta pCi/g	52
Uranium 233,234 pCi/g	2 5
Uranium 235 pCi/g	0 3
Uranium 238 pCi/g	3 1
Strontium 89,90 pCi/g	1 5
Plutonium 239 pCi/g	3 4
Americium 241 pCi/g	0 72
Cesium 137 pCi/g	1 5
Tritium pCi/g	1 9
Radium 226 pCi/g	1 4
Radium 228 pCi/g	2 5

Beta - BHC
MSDS/HAZCOM INFORMATION

Physical/Chemical Characteristics	
Boiling point	nf
Vapor pressure	nf
Solubility in water	nf
Specific gravity	nf
Evaporation rate	nf
Mol weight	290.82
Freezing point	nf
Appearance	nf
Odor	nf
Physical Hazards	
Fire	nf
Explosion	nf
Reactivity	nf
Health Hazards	
Signs/symptoms of exposure	nf
Medical conditions aggravated	nf
Primary routes of entry	nf
OSHA PEL	No OSHA PEL for this substance
ACGIH TLV	No ACGIH TLV for this substance
Carcinogen?	nf
Safe Handling Precaution	nf
Control Measures/Special Protection	nf
Spill Measures	nf
Special Precautions	nf
Other Information	nf

NOTE "nf" indicates that no information was found beyond that already presented

POTASSIUM
MSDS/HAZCOM INFORMATION

Physical/Chemical Characteristics	
Boiling point	nf
Vapor pressure	nf
Solubility in water	nf
Specific gravity	nf
Evaporation rate	nf
Mol weight	39 10
Freezing point	nf
Appearance	nf
Odor	nf
Physical Hazards	
Fire	nf
Explosion	nf
Reactivity	nf
Health Hazards	
Signs/symptoms of exposure	nf
Medical conditions aggravated	nf
Primary routes of entry	nf
OSHA PEL	No OSHA PEL for this substance
ACGIH TLV	No ACGIH TLV for this substance
Carcinogen?	nf
Safe Handling Precaution	nf
Control Measures/Special Protection	nf
Spill Measures	nf
Special Precautions	nf
Other Information	nf

NOTE "nf" indicates that no information was found beyond that already presented

BENZO(B) FLUORANTHENE
MSDS/HAZCOM INFORMATION

Physical/Chemical Characteristics	
Boiling point	nf
Vapor pressure	nf
Solubility in water	nf
Specific gravity	nf
Evaporation rate	nf
Mol weight	252.32
Freezing point	nf
Appearance	nf
Odor	nf
Physical Hazards	
Fire	nf
Explosion	nf
Reactivity	nf
Health Hazards	
Signs/symptoms of exposure	nf
Medical conditions aggravated	nf
Primary routes of entry	nf
OSHA PEL	No OSHA PEL for this substance
ACGIH TLV	No ACGIH TLV for this substance
Carcinogen?	Animal positive
Safe Handling Precaution	nf
Control Measures/Special Protection	nf
Spill Measures	nf
Special Precautions	nf
Other Information	nf

NOTE "nf" indicates that no information was found beyond that already presented

BENZO(K) FLUORANTHENE
MSDS/HAZCOM INFORMATION

Physical/Chemical Characteristics	
Boiling point	nf
Vapor pressure	nf
Solubility in water	nf
Specific gravity	nf
Evaporation rate	nf
Mol weight	252.32
Freezing point	nf
Appearance	nf
Odor	nf
Physical Hazards	
Fire	nf
Explosion	nf
Reactivity	nf
Health Hazards	
Signs/symptoms of exposure	nf
Medical conditions aggravated	nf
Primary routes of entry	nf
OSHA PEL	No OSHA PEL for this substance
ACGIH TLV	No ACGIH TLV for this substance
Carcinogen?	nf
Safe Handling Precaution	nf
Control Measures/Special Protection	nf
Spill Measures	nf
Special Precautions	nf
Other Information	nf

NOTE "nf" indicates that no information was found beyond that already presented

INDENO(1,2,3-Cd) PYRENE
MSDS/HAZCOM INFORMATION

Physical/Chemical Characteristics	
Boiling point	nf
Vapor pressure	nf
Solubility in water	nf
Specific gravity	nf
Evaporation rate	nf
Mol weight	276.34
Freezing point	nf
Appearance	nf
Odor	nf
Physical Hazards	
Fire	nf
Explosion	nf
Reactivity	nf
Health Hazards	
Signs/symptoms of exposure	nf
Medical conditions aggravated	nf
Primary routes of entry	nf
OSHA PEL	No OSHA PEL for this substance
ACGIH TLV	No ACGIH TLV for this substance
Carcinogen?	nf
Safe Handling Precaution	nf
Control Measures/Special Protection	nf
Spill Measures	nf
Special Precautions	nf
Other Information	nf

NOTE "nf" indicates that no information was found beyond that already presented

BENZO(g,h,i)PERYLENE
MSDS/HAZCOM INFORMATION

Physical/Chemical Characteristics	
Boiling point	nf
Vapor pressure	nf
Solubility in water	nf
Specific gravity	nf
Evaporation rate	nf
Mol weight	290.37
Freezing point	nf
Appearance	nf
Odor	nf
Physical Hazards	
Fire	nf
Explosion	nf
Reactivity	nf
Health Hazards	
Signs/symptoms of exposure	nf
Medical conditions aggravated	nf
Primary routes of entry	nf
OSHA PEL	No OSHA PEL for this substance
ACGIH TLV	No ACGIH TLV for this substance
Carcinogen?	nf
Safe Handling Precaution	nf
Control Measures/Special Protection	nf
Spill Measures	nf
Special Precautions	nf
Other Information	nf

NOTE "nf" indicates that no information was found beyond that already presented

DI-N-OCTYL PHTHALATE
MSDS/HAZCOM INFORMATION

Physical/Chemical Characteristics	
Boiling point	nf
Vapor pressure	nf
Solubility in water	nf
Specific gravity	nf
Evaporation rate	nf
Mol weight	nf
Freezing point	nf
Appearance	nf
Odor	nf
Physical Hazards	
Fire	nf
Explosion	nf
Reactivity	nf
Health Hazards	
Signs/symptoms of exposure	nf
Medical conditions aggravated	nf
Primary routes of entry	nf
OSHA PEL	No OSHA PEL for this substance
ACGIH TLV	No ACGIH TLV for this substance
Carcinogen?	nf
Safe Handling Precaution	nf
Control Measures/Special Protection	nf
Spill Measures	nf
Special Precautions	nf
Other Information	nf

NOTE "nf" indicates that no information was found beyond that already presented

FLUORANTHENE
MSDS/HAZCOM INFORMATION

Physical/Chemical Characteristics	
Boiling point	367°
Vapor pressure	0 01 mm Hg at 20°
Solubility in water	nf
Specific gravity	nf
Evaporation rate	nf
Mol weight	nf
Freezing point	nf
Appearance	Colorless solid
Odor	nf
Physical Hazards	
Fire	nf
Explosion	nf
Reactivity	nf
Health Hazards	
Signs/symptoms of exposure	nf
Medical conditions aggravated	nf
Primary routes of entry	nf
OSHA PEL	No OSHA PEL for this substance
ACGIH TLV	No ACGIH TLV for this substance
Carcinogen?	nf
Safe Handling Precaution	nf
Control Measures/Special Protection	nf
Spill Measures	nf
Special Precautions	nf
Other Information	When heated to decomposition it emits acrid smoke and fumes

NOTE "nf" indicates that no information was found beyond that already presented

Material Safety Data Sheet

from Genium's Reference Collection
Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8855

GENIUM PUBLISHING CORP

No 300

ACETONE
(Revision E)
Issued September 1985
Revised November 1988

SECTION 1. MATERIAL IDENTIFICATION

27

Material Name ACETONE

Description (Origin/Uses) Used as a solvent for fats, oils, waxes, resins, rubber, plastics, varnishes, and rubber cements, also used in the manufacture of methyl isobutyl ketone, mesityl oxide, acetic acid, diacetone alcohol, chloroform, iodoform, bromoform, explosives, rayon, photographic films, and isoprene Used to store acetylene gas Widely used in the chemical process industry (CPI)

Other Designations Dimethylformaldehyde, Dimethylketal, Dimethyl Ketone, Ketone Propane, Pyroacetic Acid, Pyroacetic Ether; C_3H_6O, CAS No 0067-64-1

Manufacturer Contact your supplier or distributor Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref 73) for a list of suppliers

NFPA: 3 / 1 / 0 / -

HMIS	
H 1	R 1
F 3	I 1
R 0	S 2
PPG*	K 4

*See sect. 8

SECTION 2. INGREDIENTS AND HAZARDS

	%	EXPOSURE LIMITS
Acetone, CAS No 0067-64-1	Ca 100	**OSHA PELs** 8-Hr TWA 750 ppm, 1800 mg/m³ STEL 1000 ppm, 2400 mg/m³ **ACGIH TLVs, 1988-89** TLV-TWA 750 ppm, 1780 mg/m³ TVL-STEL 1000 ppm, 2375 mg/m³ **Toxicity Data*** Man, Inhalation, TD_{Lo} 440 µg/m³ (6 Mins) Man, Inhalation, TD_{Lo} 10 mg/m³ (6 Hrs)

*See NIOSH, *RTECS* (AL3150000), for additional data with references to reproductive, mutagenic, and irritative effects

SECTION 3 PHYSICAL DATA

Boiling Point 134°F (56°C)
Melting Point -137°F (-94°C)
Vapor Density (Air = 1) 2
Vapor Pressure 180 Torrs at 68°F (20°C)
Evaporation Rate Faster than That of *n*-Butyl Acetate

Molecular Weight. 58 Grams/Mole
Solubility in Water (%). Complete
Specific Gravity (H_2O = 1) 0 778 at 77°F (25°C)
% Volatile by Volume 100

Appearance and Odor A clear, colorless, highly flammable, volatile liquid with a characteristic, pleasant, sweetish odor

SECTION 4 FIRE AND EXPLOSION DATA

Flash Point. 1 4°F (-17°C) CC	Autoignition Temperature 869°F (465°C)	LEL. 2.9% v/v	UEL. 12 8% v/v

Extinguishing Media Use "alcohol" foam, dry chemical, or carbon dioxide Use a blanketing effect to smother flames Use water spray to reduce the rate of burning and to cool containers Water will probably not be effective in directly extinguishing an acetone fire

Unusual Fire or Explosion Hazards. Acetone vapor is heavier than air and may travel a considerable distance to a low-lying source of ignition and flash back

Special Fire-fighting Procedures Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive pressure mode

SECTION 5. REACTIVITY DATA

Stability/Polymerization Acetone is stable in closed containers during routine operations Hazardous polymerization cannot occur

Chemical Incompatibilities Acetone can react dangerously with strong oxidizing agents such as nitrates, perchlorates, permanganates, concentrated sulfuric acid, chromic anhydride, chromyl chloride, hydrogen peroxide, hexachloromelamine, nitrosyl chloride, permonosulfuric acid, mixtures of sulfuric acid and nitric acid, mixtures of nitric acid and acetic acid, and potassium *tert*-butoxide

Conditions to Avoid Do not expose acetone to sources of ignition and incompatible chemicals

Hazardous Products of Decomposition Carbon monoxide and carbon dioxide can be produced during acetone fires

SECTION 6 HEALTH HAZARD INFORMATION

Carcinogenicity Acetone is not listed as a carcinogen by the NTP, IARC, or OSHA

Summary of Risks Inhalation of high concentrations of acetone vapor can cause dryness of the mouth and throat, dizziness, nausea, incoordination, slurred speech, drowsiness, and, in severe exposures, coma. Inhalation of small quantities of acetone vapor for an extended period causes irritation of the respiratory tract, coughing, and headache Prolonged or repeated skin contact with acetone has a defatting effect causing dryness, irritation, and mild dermatitis Under routine operating conditions the amount of acetone absorbed through the skin is small. Ingestion of acetone may cause irritation of the gastrointestinal tract and narcosis Acetone acts primarily as a depressant to the central nervous system (CNS) when exposures are severe or prolonged **Medical Conditions Aggravated by Long-Term Exposure.** None reported **Target Organs** Skin, eyes, respiratory system, and CNS **Primary Entry:** Inhalation, skin contact. **Acute Effects:** See Summary of Risks, above **Chronic Effects** None reported **FIRST AID** **Eyes.** Immediately flush eyes, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 minutes **Skin** Rinse the affected area with flooding amounts of water, then wash it with soap and water **Inhalation** Remove the exposed person to fresh air; restore and/or support his or her breathing as needed. Have qualified medical personnel administer oxygen as required. Monitor the exposed person for symptoms of depression of the CNS such as incoordination and drowsiness **Ingestion.** Unlikely * If a small amount is ingested, dilute it slowly with 1 to 2 glasses of water or milk. Get medical help (in plant, paramedic, community) for all exposures. Seek prompt medical assistance for further treatment, observation, and support after first aid *Note to Physician. Treatment for accidental ingestion of a small amount of acetone is unnecessary If a large amount has been ingested, administer a charcoal slurry, either aqueous or mixed with a saline cathartic or sorbital

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak. Notify safety personnel, evacuate unnecessary personnel, eliminate all sources of ignition immediately, and provide adequate ventilation Cleanup personnel need protection against this liquid's contact with skin or eyes as well as inhalation of its vapor (see sect. 8) Contain large spills and collect waste or absorb it with an inert material such as sand, earth, or vermiculite Use nonsparking tools to place waste liquid or absorbent into closable containers for disposal. Keep waste out of sewers, watersheds, and waterways.
Waste Disposal Contact your supplier or a licensed contractor for detailed recommendations Follow Federal, state, and local regulations Consider saving the waste hydrochloric acid for use as a neutralizing agent during cleanup operations of basic materials.

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910 1000 Subpart Z)
EPA Designations (40 CFR 302 4)
RCRA Hazardous Waste, No U002
CERCLA Hazardous Substance, Reportable Quantity 5000 lbs (2270 kg), per the Resource Conservation and Recovery Act, § 3001

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles. Always wear protective eyeglasses or chemical safety goggles Where splashing is possible, wear a full face shield Follow OSHA eye- and face-protection regulations (29 CFR 1910 133) **Respirator** Use a NIOSH-approved respirator per Genium reference 88 for the maximum use concentrations and/or the exposure limits cited in section 2 Follow OSHA respirator regulations (29 CFR 1910 134) For emergency or nonroutine operations (spills or cleaning reactor vessels and storage tanks), wear an SCBA **Warning** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres **Other** Wear impervious butyl or natural rubber gloves, boots, aprons, and gauntlets, etc., to prevent prolonged or repeated contact with this material **Ventilation** Install and operate general and local maximum, explosion-proof ventilation systems powerful enough to maintain airborne levels of acetone below the OSHA PEL standard cited in section 2 Local exhaust ventilation is preferred because it prevents dispersion of the contaminant into the general work area by eliminating it at its source Consult the latest edition of Genium reference 103 for detailed recommendations **Safety Stations** Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work areas **Contaminated Equipment** Contact lenses pose a special hazard, soft lenses may absorb irritants, and all lenses concentrate them. Do *not* wear contact lenses in any work area Remove contaminated clothing and launder it before wearing it again, clean this material from your shoes and equipment **Other** Automatic sprinkler systems for fire protection are desirable in work areas **Comments** Practice good personal hygiene, always wash thoroughly after using this material Keep it off your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking Do *not* eat, drink, or smoke in any work area. Do not inhale acetone vapor

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation Store acetone in closed containers (carbon steel is recommended) in a cool, dry, well-ventilated area away from sources of ignition and strong oxidizers Protect containers from physical damage **Engineering Controls** Make sure all engineering systems (production, transportation) are of maximum explosion-proof design Electrically ground and bond all containers and pipelines, etc., used in shipping, transferring, reacting, production, and sampling operations to prevent generating static sparks **Other Precautions** Use labeled safety cans when handling small amounts of acetone Acetone presents a dangerous fire hazard, perform all work operations involving it carefully and in a way that will prevent exposing the liquid or its vapor to sources of ignition

Transportation Data (49 CFR 172 101-2)

DOT Shipping Name Acetone	IMO Hazard Class. 3 1
DOT Hazard Class Flammable Liquid	IMO Label Flammable Liquid
ID No UN1090	IMDG Packaging Group II
DOT Label Flammable Liquid	

References 1, 26, 38 84-94, 100, 116, 117, 120, 122

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MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
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GENIUM PUBLISHING CORP

NO 100

ALUMINUM METAL/POWDER

Revision A
DATE May 1984

SECTION I MATERIAL IDENTIFICATION

MATERIAL NAME ALUMINUM METAL/POWDER
DESCRIPTION Soft, malleable, ductile metal bars, sheet, wire, foil, flake & powder
OTHER DESIGNATIONS Pyro Powder, Al, CAS #007 429 905, GE Materials B10B5, B12B2, B12B23
MANUFACTURER Available from several suppliers

SECTION II INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Aluminum	>98	8-hr TWA* 10 mg/m^3 (as aluminum metal and oxide)

*Current ACGIH (1983) TLV, STEL is 20 mg/m^3 Aluminum pyro powder has an 8-hr TWA of 5 mg/m^3 No specific OSHA PEL, "nuisance dust" may be applicable.
NOTE Processing and finishing of aluminum metal can generate respirable particulate, i e , grinding, buffing, polishing, and some metal spraying operations (See also NFPA, No 65)

SECTION III PHYSICAL DATA

Boiling point, deg C ---------- 2467
Vapor pressure, 2080 deg C, mm Hg --- 100
1284 deg C, mm Hg --- 1
Solubility in water ---------- Insoluble
Specific gravity (20/4C) ------ 2 7
Melting point, deg C ---------- 660
Atomic weight ---------- 26 97

Appearance & Odor Silvery-white, metallic solid, foil, particulate No odor

Index of explosibility (powdered aluminum) (<0 1 weak, >10 severe) ---------- >10
(See Sections IV and V)

SECTION IV FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp	Flammability Limits in Air	Lower	Upper
N/A	650C* (Cloud) 760C* (Dust Layer)	Dust cloud explosion*	>0 04 oz/ft^3	-

Extinguishing media Special mixtures of dry chemical, clean, dry sand, mat Do not use water, CCl_4 or halon' When exposed to heat or ignition sources, powdered Al can be a severe fire and explosion hazard Particle size, coating and disperson in air determine reactivity Ring small fires with dry extinguishing material using nonsparking shovels Do not create dust clouds Eliminate drafts. Self-extinguishment can result as a hard crust of oxide is formed At high temperature molten aluminum can be ignited and burn Firefighters should wear self-contained breathing apparatus and protective clothing
*100% of dust goes thru a 44 µm sieve, this dust cloud ignited by a 0 05 J spark

SECTION V REACTIVITY DATA

Bulk aluminum is not combustible, but when finely divided, it can readily burn or explode if ignited (Surface Al_2O_3 formation can protect bulk metal against oxidation and reduce particulate combustibility) 1 mil thick Al foil, while carrying a current of 120 amps at 2 volts (surface <600F), ignited and burned
A pile of Al powder can heat spontaneously in air with moisture present, especially if appreciable new surface is present Water/Al powder or granule mixture slowly forms H_2, can be hazardous if confined. Al rapidly oxidized by water at 180C Molten Al can be violently reactive Al oxide & nitride form on high temp reaction with air
Al reacts with dil HCl or H_2SO_4 or with KOH or NaOH soln with H_2 evolution, also is reactive with halogens, oxidizing agents and certain halogenated hydrocarbons Al fines can be a hazard with trichloroethylene in a vapor degreaser if inhibitor depleted Do not use aluminum containers with 1,1,1-trichloroethane

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NO 100

SECTION VI HEALTH HAZARD INFORMATION

TLV (See Sect II)

Al metal in most forms is not toxic It is not readily absorbed through the skin or GI tract and only poorly through the lungs Filings or splinters of metal embedded in the skin are not sensitizing Chronic inhalation of massive levels of fine powder reported to cause pulmonary fibrosis and emphysema*. A single case reported of fibrosis occuring with encephalopathy after 13 5 yr working with fine powder (In animal testing and in US industry no fibrosis, emphysema or encephalopathy has been reported from Al powder inhalation) *

Aluminum powder can be irritating in the eyes and respiratory system

FIRST AID

Eye Contact Flush well with running water to remove particulate Get medical help if irritation persists

Skin Contact For cuts, abrasive irritation or thermal burns get medical attention

Inhalation Remove to fresh air Get medical help for coughing or breathing difficulty

Ingestion Get medical help if large amounts have been ingested

* It has been proposed "stamped foil powder" is fibrogenic while granular powder is not

SECTION VII SPILL LEAK AND DISPOSAL PROCEDURES

Notify safety personnel of powder spills Institute previously developed plan Remove sources of heat or ignition Trained clean-up personnel to use protection against airborne dust and threat of fire Promptly clean-up spill using conductive, nonsparking scoops and soft brushes (natural bristle) Approved, grounded vacuum cleaners to be used only in final clean-up Place picked-up powder in closed, pressure vented, dry, metal containers Mix dry sand with scrap and tightly seal

DISPOSAL Deposit unsalvageable waste in approved landfill Wetted powder sludge which is not completely covered with water may be flammable Fine Al dross cannot be shipped if hot or if wet and likely to generate heat Follow Federal, State, and Local regulations

EPA (RCRA) HW No (Consider D001 or D003 for Al powder) Also see 48 FR 49126, 7/12/83 - effluent standard for Al forming

SECTION VIII SPECIAL PROTECTION INFORMATION

Provide general and local exhaust ventilation (explosion-proof) to meet TLV requirements where Al powder is used or generated or where Al metal is heated to high temperature Approved dust collection system is needed for airborne Al particulate Properly dispose of collected Al dust or wet sludge Protect against static sparks where dust is collected or transported Where Al dust/fume occurs, use of an approved respirator may be indicated

Prevent eye contact with dust by use of safety goggles Use tight-weave, nonstatic generating, protective clothing (no metallic fasteners, cuffs or pockets) and nonsparking safety shoes when working with Al powder Special protective clothing needed for work with hot or molten aluminum

Eyewash stations and deluge showers should be accessible outside powder use areas

Preplacement and periodic medical examinations are recommended for those regularly exposed to Al powder, including a chest x-ray

SECTION IX SPECIAL PRECAUTIONS AND COMMENTS

Store Al powder in sealed containers in a dry, low fire risk area away from sources of heat or ignition, oxidizing agents, combustibles, acids, alkalis, halogens, carbon disulfide and halogenated hydrocarbons Protect containers from physical damage, exclude moisture and humid air Use non-sparking tools and equipment. Meet electrical code requirements. No smoking.

Follow approved cleaning techniques for Al powder, good housekeeping needed to prevent fine or thin machining residues or dust accumulation Avoid generation of airborne dust.

Facilities for handling Al powder require special design, approved procedures, grounding, informed personnel, caution and vigilance, and plans for fires and spills (See NFPA, No 651 and Industrial Fire Hazard Handbook, 1979)

DOT Classification (Al powder) - FLAMMABLE SOLID I.D No UN1309 (Coated)
UN1396 (Uncoated)
UN1383 (Pyro)

DATA SOURCE(S) CODE 2,4-11,14-20,26,37,38,41

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APPROVALS MIS/CRD J. M. Nielsen

INDUST HYGIENE/SAFETY [illegible] 5/29/84

MEDICAL REVIEW 15 June 1984

AMERICIUM
MSDS/HAZCOM INFORMATION

Physical/Chemical Characteristics	
Vapor pressure	nf
Solubility in water	nf
Specific gravity	nf
Evaporation rate	nf
Atomic weight	243
Freezing point	nf
Boiling point	2607°F
Appearance	Silvery, somewhat mallable metal
Odor	nf
Physical Hazards	
Fire	nf
Explosion	nf
Reactivity	nf
Health Hazards	
Signs/symptoms of exposure	nf
Medical conditions aggravated	nf
Primary routes of entry	Inhalation, injestion
OSHA PEL	No OSHA PEL for this substance
ACGIH TLV	No ACGIH TLV for this substance
Carcinogen?	yes
Safe Handling Precaution	nf
Control Measures/Special Protection	nf
Spill Measures	nf
Special Precautions	nf
Other Information	nf

NOTE "nf" indicates that no information was found beyond that already presented

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NO. 70

ANTIMONY METAL/POWDER

Date September 1980

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME ANTIMONY METAL/POWDER
OTHER DESIGNATIONS Stibium, Sb, ASTM B237, GE Material B10F2, CAS #007 440 360
MANUFACTURER Available from several suppliers

SECTION II. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Antimony	> 99	8-hr TWA 0.5 mg/m^3* (as Sb)
*Current OSHA Standard and ACGIH (1980) TLV NIOSH has proposed a 10-hr TWA of 0 5 mg/m^3 with an Action level at 0 25 mg/m^3		Rat, intraperitoneal LDLo 100 mg/kg
TLV was establish at a level to prevent irritation and systemic effects		Rat, oral LD_{50} 100 mg/kg

SECTION III. PHYSICAL DATA

Boiling point, @ 1 atm, deg C ---- 1750
Vapor pressure @ 886 deg C, mm Hg - 1
Solubility in water ------- Insoluble
Specific gravity, @ 25 C --------- 6 68
Melting point, deg C ---------- 630.5
Mohs hardness ---------- 3-3.5
Molecular weight ---------- 121.76

Appearance A brittle, flaky, crystalline solid with a lustrous blue-white color, an amorphous gray allotrope is also known The powder form is dark gray, lustrous

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp	Flammability Limits In Air	LOWER	UPPER
--	420 C* (cloud) 330 C* (dust layer)	Dust cloud explosion*	0.42 oz/ft^3	--

Extinguishing Media. (Obtain detailed fire-fighting information from supplier.)
Antimony bulk metal is combustible in air at high temperature. When ignited it burns with a brilliant flame, giving off dense white fumes (Sb_2O_3).
When powdered antimony is exposed to heat or ignition sources it is a moderate fire and explosion hazard Particle size and dispersion in air determine reactivity.
Firefighters should use self-contained breathing equipment and eye protection.
*91% of dust goes thru a 74 micron sieve. Sb dust cloud can be ignited by a 1.92 J spark

SECTION V. REACTIVITY DATA

Antimony metal (bulk) is stable in dry air at room temperature. It slowly tarnishes in moist air. It is not very reactive with cold, dilute acids, but reacts readily with aqua regia and hot, concentrated sulfuric acid. Nascent hydrogen can react with Sb or its alloys with Mg or Zn to form stibine (SbH_3), a colorless, highly toxic gas with a disagreeable odor (TLV 0.1 ppm). Sb can react vigorously or violently with oxidizing agents, such as nitrate salts, halogens, nitric acid, perchloric acids, ClF_3, $KMnO_4$, etc.
Powdered antimony reacts more vigorously than the bulk material and forms dangerous mixtures with oxidizing agents. Reactivity is further increased on heating.

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SECTION VI. HEALTH HAZARD INFORMATION

TLV 0.5 mg/m^3

Antimony is an irritant of the mucous membranes, eyes, and skin
Exposures to dust/powder can cause eye inflammation, nasal irritation, chronic dermatitis ranging from mild rashes to blemishes resembling chicken pox, and muscle pain and weakness Chronic inhalation of subtoxic doses of dust or fume above the TLV may result in chemical pneumonia, intraalveolar lipid deposits, liver and cardiac involvement, and possible kidney disease Acute ingestion may cause violent vomiting, diarrhea, slow pulse and low blood pressure, shallow breathing, and death.

FIRST AID

Eye Contact Flush with running water for 15 minutes, including under the eyelids.
Skin Contact: Wash area with soap and water. Treat burns as usual.
Inhalation* Remove to fresh air.
Ingestion*. Contact physician! Gastric lavage followed by saline catharsis.
In all cases of excessive exposure get prompt medical help for further treatment, support, and observation

*Chelation therapy with Dimercaprol (BAL) under a physician's care will increase Sb elimination rate in urine

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety personnel of powder spills. Small spills can be removed by vacuuming or wet sweeping in order to keep airborne dust at a minimum. Clean up personnel should use protective equipment

DISPOSAL Scrap metal can be returned to supplier. Unsalvageable waste may be buried in an approved secure landfill Follow Federal, State, and Local regulations.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide general and local exhaust ventilation to meet TLV requirements in the workplace where Sb powder is used or where Sb-containing metal is heated.
Respirators should be available for nonroutine or emergency use above the TLV High efficiency dust respirator below 5 mg/m^3 and self-contained or air-supplied respirators with full facepiece above 5 mg/m^3
Avoid eye contact by use of chemical safety goggles where dusty conditions occur. Wear protective clothing appropriate for the work situation to minimize skin contact Clothing to be changed daily and laundered. Showering after work with a complete change to street clothing is desirable (Separate lockers for street clothes).
Eyewash stations and washing facilities should be readily accessible
Provide preplacement and periodic medical examinations for those regularly exposed to antimony, with emphasis directed to skin and mucous membranes and the pulmonary, cardiac, and reproductive systems Provide suitable training to those working with antimony Monitor the workplace. Keep records

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store in a dry, well-ventilated, low-fire risk area Avoid heat and direct sunlight.
Use good housekeeping practices to prevent accumulation of dust and follow sound cleaning techniques that will keep airborne particulate at a minimum .
Avoid breathing dust or fume. Minimize skin contact by using barrier creams, rubber gloves and aprons, and good personal hygiene. Keep Sb dust off clothing. Wash hands and face before eating, drinking or smoking after handling this material.

DATA SOURCE(S) CODE: 2-12,24,26,27,31,37,41

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APPROVALS.	MIS CRD	J. M. Nielsen
Industrial Hygiene and Safety		JW 10-9-80
MEDICAL REVIEW		10/22/80

MATERIAL SAFETY DATA SHEET

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GENIUM PUBLISHING CORP

NO 1200

AROCLOR 1254

Date May 1980

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME AROCLOR 1254
DESCRIPTION Distillation cut of polychlorinated biphenyl (or diphenyl), containing 54% Cl
OTHER DESIGNATIONS· PCB, an Askarel, PYRANOL, GE Material A13B1, CAS # 027 323 188
MANUFACTURER: Material was a product of Monsanto Co., but dropped in 1977. Except for uses specifically exempted and regulated by EPA (for example power transformers), legal manufacture, distribution in commerce, and use of PCB's in USA ended in 1979 under TSCA.

SECTION II. INGREDIENTS AND HAZARDS

SECTION II. INGREDIENTS AND HAZARDS	%	HAZARD DATA
Mixture of Chlorinated Biphenyls, $C_{12}H_{10-x}Cl_x$	ca 100	EPA exemption or authorization needed for any measurable exposure*
		Rat, Oral LD_{50} Adult 4-10 g/kg Weaning 1 2 g/kg
		Rat, Intravenous LD_{50} 358 mg/kg
		Rat, Oral, TDLo 1220 mg/kg/35 wk (neoplastic effect)

x	Approx %
2	0 5
3	1
4	21
5	48
6	23
7	6

Includes 69 or more compounds with average of 4.98 Cl atom/molecule. Mixture may contain 0-2 ppm chlorinated dibenzofurans.

*Current ACGIH 8-hr TWA is 0 5 mg/m^3 NIOSH has proposed a 10-hr TWA of 1 0 µg/m^3 Materials with over 50 ppm PCB content are regulated for handling, storage, records, and waste disposal. EPA criterion in navigable waters is 0.001 µg/L. PCB's.

SECTION III. PHYSICAL DATA

Boiling range at 1 atm, deg C	ca 360-390	Specific gravity (65/15 5 C)	1 5
Vapor pressure at 150 C, mm Hg	<1	Pour point, deg C	10
Water solubility at 25 C, ppm	ca 0 01	Molecular weight (Av)	327
Viscosity at 100 F, cstk	ca 460	Partition Coef (octanol/water)	$>10^4$

Appearance & Odor A light yellow, viscous fluid

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp	Flammability Limits In Air	LOWER	UPPER
None to boiling point				

Extinguishing Media Use media appropriate to the surrounding fire conditions This material has very low combustibility, but it can undergo thermal-oxidative degradation in a fire situation.
Firefighters should use full protective clothing and self-contained breathing equipment when fighting fire where any PCB's are involved.

SECTION V. REACTIVITY DATA

AROCLOR 1254 and other PCB's are nearly inert materials with very high chemical stability, the higher chlorine levels usually give the greater stability At about 300 to 600 C some PCB's can oxidize to produce chlorinated dibenzofurans which are much greater in toxicity than the PCB's For complete incineration of PCB's a 2-second dwell time above 2000 F (1090 C) with 3% excess oxygen in the stack is suitable (see Sect I)
AROCLOR 1254 shows very little degradation after 3 weeks exposure to direct sunlight
PCB's are strongly absorbed on particulates or sediments in aquatic systems (streams lakes, ocean, etc)
Mixed in activated sludge, biodegradation occurs slowly, but only very slowly or almost not at all with compounds above Cl_4

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SECTION VI. HEALTH HAZARD INFORMATION

TLV (See Sect. II)

PCBs show high levels of bioaccumulation in fatty tissue and very slow metabolism, especially for Cl_5 compounds and above. They have become widely dispersed in world-wide environment and in the food chain (much like DDT) since their introduction in 1929 Effective control of PCB discharge into the environment began after 1970.

AROCLOR 1254 has a low vapor pressure, but it can be irritating to the eyes, nose, and throat if misted or heated to produce vapors Excessive acute and chronic exposures may cause liver damage Chronic exposure to or ingestion of PCB's (especially when thermally oxidized) can result in chloracne after 1-6 months. There is some evidence of possible carcinogenic risk and adverse reproductive effects with this material. PCB's may appear in the breast milk of an exposed mother.

FIRST AID

Skin Contact Clean exposed skin with waterless cleaner, wipe with a disposable towel, then wash with soap and water. Promply remove contaminated clothing. (Control separate disposal of PCB-contaminated materials.)

Eye Contact Flush promptly & thoroughly with lots of running water for 15 minutes

Inhalation Remove to fresh air. Get medical help if symptoms continue

Ingestion Get medical help NIOSH has recommended that vomiting be induced.

Get medical help in all cases of severe exposure, repeated exposures, or persistent symptoms

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety personnel of all PCB spills or leaks Promptly contain spilled material' Prevent its release into the environment' Restrict PCB spill area to trained clean-up personnel, use proper protective gear; follow an established emergency plan

Stop leakage if possible Pick up spill Absorb small spills and residues using a powdered, dry clay Place leaking containers, picked-up PCBs, and PCB-contaminated materials and refuse into approved, properly labeled, closed containers for storage under controlled, EPA regulated conditions prior to disposal EPA allows approved storage to 1/1/84 (See Sect IX) Storage 40CFR761 42, Annual report 40CFR761 45

DISPOSAL Destroy PCB-containing material by burning in an EPA approved facility Liquid 50-500 ppm PCB material can be burned as above or landfilled if not ignitable Non-flowing, PCB-contaminated debris can be disposed of in an EPA approved landfill (See 40CFR 761, Federal Register, Vol 44, 31551-4, 66989, Vol 45, 20473)

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide highly effective local exhaust ventilation (trap for exhaust vapors) especially if this material is heated or misted Unless authorized by EPA an isolated system must be used for PCBs

For nonroutine and emergency conditions of exposure use an approved canister respirator or self-contained breathing equipment

Prevent skin contact for those who work with PCBs Use neoprene or polyethylene gloves and apron, safety glasses and/or face shield, and other protective clothing as determined by use conditions An eyewash station and washing facilities should be available to the work area

Provide for special handling and disposal of PCB-contaminated materials, including paper towels and clothing (see Sect VII) Provide locker and shower facilities Workers must be trained for PCB work, and they must follow good hygienic practice

Provide pre-placement medical exams for workers with emphasis on liver function, skin condition, and reproductive history Provide annual medical exams for exposed workers

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

PCB materials in containers and in equipment must have proper labeling including the date of storage Short term (up to 30 days) storage of non-leaking PCBs can be done. Long term storage requires an EPA approved facility, including such criteria as roof and walls to shield from rain, impervious base and diking which will contain 25% of stored volume or twice the volume of the largest container, no drains or openings to allow flow loss, and the base must be located above the 100-year flood water elevation. Prevent physical damage to containers Inspect storage frequently

Prevent skin contact with PCBs, or with solid products contaminated with PCBs Prevent inhalation of airborne PCBs Properly contain PCBs until legally disposed of, do not allow them to escape into the environment'

PCBs, and especially used PCBs, can contain higher toxicity contaminants

DATA SOURCE(S) CODE 1-6,20,26 31,36

APPROVALS	MIS CRD	J.M. Nielsen
Industrial Hygiene and Safety		5 29-80
MEDICAL REVIEW		June 1980

ARSENIC[1/]

Summary

Arsenic is a metal that is present in the environment as a constituent of organic and inorganic compounds, it also occurs in a number of valence states. Arsenic is generally rather mobile in the natural environment, with the degree of mobility dependent on its chemical form and the properties of the surrounding media. Arsenic is a human carcinogen, it causes skin tumors when it is ingested and lung tumors when it is inhaled Arsenic compounds are teratogenic and cause adverse reproductive effects in animals. Chronic exposure to arsenic is associated with polyneuropathy (disorders of the nervous system) and skin lesions It is acutely toxic to some early life stages of aquatic organisms at levels as low as 40 µg/liter

Arsenic can be found in the environment in any of four valence states (-3, 0, +3,, and +5) depending on the pH, Eh, and other factors It can exist as either inorganic or organic compounds and often will change forms as its moves through the various media The chemical and physical properties depend on the state of the metalloid Only the properties of metallic arsenic are presented below, properties of other arsenic compounds are often quite different

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1/ Compiled from U.S. Environmental Protection Agency, Office of Waste Program Enforcement. September 1985. Chemical, physical, and biological properties of compounds present at hazardous waste sites A Final Report Prepared by Clement Associates, Inc., Arlington, Virginia.

Also: United States Army Medical Bioengineering Research and Development Laboratory (USAMBRDL). 1985. Physical, Chemical, and Toxicological Data Summaries of 62 Compounds Present at Rocky Mountain Arsenal. USAMBRDL. Fort Detrick, Frederick, MD.

CAS Number 7440-38-2

Chemical Formula As

IUPAC Name Arsenic

Chemical and Physical Properties

Atomic Weight 74.91

Boiling Point 613°C

Melting Point 817°C

Specific Gravity 5 72 at 20°C

Solubility in Water Insoluble, some salts are soluble

Transport and Fate

In the natural environment arsenic has four different oxidation states, chemical speciation is important in determining arsenic's distribution and mobility Interconversions of the +3 and +5 states as well as organic complexation do occur and can be mediated by microorganisms. Arsenic is generally quite mobile in the environment and is mainly transported by water (WHO 1981). In oxygenated water, arsenic usually occurs as arsenate, but under reducing conditions, (i.e., deep well waters) arsenite predominates. In the aquatic environment, volatilization is important when biological activity or highly reducing conditions produce arsenine or methyl-arsenics. Sedimentation of arsenic in association with iron and aluminum does occur frequently (WHO 1981).

In oxygenated soil, inorganic arsenic is prevalent in the pentavalent (+5) form Under reducing conditions, the trivalent form predominates (WHO 1981) Leaching of arsenates and arsenites occurs

slowly due to binding with hydrous oxides of iron and aluminum Biomethylation in soil does occur and may be associated with the release of methylarsines into the air (WHO 1981). Plant uptake of arsenic from treated soils can occur, however, accumulation is not excessive.

Freshwater residue data for arsenic (organic and inorganic) indicate that arsenic is not bioconcentrated to a high degree but that lower forms of aquatic life may accumulate higher residues than fish (USEPA 1984a, 1986).

Health Effects

Arsenic has been implicated in the production of skin cancer in humans There is also extensive evidence that inhalation of arsenic compounds causes lung cancer in occupationally exposed workers. Arsenic compounds also cause noncancerous (possibly precancerous) skin changes in exposed individuals However, arsenic has not definitively been found to be a carcinogen in animal studies (USEPA 1984). EPA and the International Agency for Research on Cancer (IARC) have established that sufficient evidence exists to classify arsenic as a human carcinogen (USEPA 1984), it is therefore classified as a Group A carcinogen (i.e., human carcinogen) based upon evidence of human carcinogenicity through inhalation and ingestion exposure. Arsenic compounds have been observed to cause chromosome damage in animals Humans exposed to arsenic compounds have been reported to have an elevated incidence of chromosome aberrations.

Arsenic compounds have been reported to be teratogenic, fetotoxic, and embryotoxic in several animal species, and an increased incidence of multiple malformations among children born to women occupationally exposed to arsenic has been reported. Several cases of progressive polyneuropathy involving motor and sensory nerves and particularly affecting the extremities and myelinated long-axon neurons have been reported in individuals occupationally exposed to inorganic arsenic. Polyneuropathies have also been reported following the ingestion of arsenic-contaminated foods.

Toxicity to Wildlife and Domestic Animals

Various inorganic forms of arsenic appear to have similar levels of toxicity Inorganic arsenic appears to be more toxic than organic forms Acute toxicity to adult freshwater animals occurs at levels of arsenic trioxide as low as 812 µg/liter and at levels at low as 40 µg/liter in early life stages of aquatic organisms Acute toxicity to saltwater fish occurs at levels around 15 mg/liter, while some invertebrates are affected at much lower levels (508 µg/liter) Arsenic toxicity does not appear to increase greatly with chronic exposure, and it does not seem that arsenic is bioconcentrated to a great degree

Arsenic poisoning is an uncommon but not a rare toxic syndrome among domestic animals Arsenic causes hyperemia (site specific congestion) and edema (swelling) of the gastrointestinal tract, hemorrhage of the cardiac serosal surfaces and peritoneum, and pulmonary congestion and edema It may also cause liver necrosis Information on arsenic toxicity to terrestrial wildlife was not reported in the literature reviewed

Regulations and Standards

Ambient Water Quality Criteria (USEPA 1986a)

Aquatic Life (Freshwater)

Acute toxicity (As^{+3}). 360 µg/liter
Chronic toxicity (As^{+3}). 190 µg/liter

Aquatic Life (Saltwater)

Acute toxicity (As^{+3}): 69 µg/liter
Chronic toxicity (As^{+3}): 36 µg/liter

Human Health

Due to the carcinogenicity of arsenic the ambient water criterion is set at zero. However, estimates of the carcinogenic risks from the ingestion of contaminated water and contaminated aquatic organisms are.

Risk	Concentration
10^{-5}	22 ng/liter
10^{-6}	2.2 ng/liter
10^{-7}	0.22 ng/liter

CAG Potency Slope for Oral Exposure (USEPA 1986b) 15 (mg/kg/day)

CAG Potency Slope for Inhalation Exposure (USEPA 1984b) 50 $(mg/kg/day)^{-1}$

National Primary Drinking Water Standard (USEPA) 50 µg/liter (Proposed RMCL, 50 Federal Register 46961, Wednesday November 13, 1985)

NIOSH Recommended Standard (air). Ceiling Level 2 $\mu g/m^3$

OSHA Standard (air) TWA[1/]. 500 $\mu g/m^3$ (organic arsenic compounds)

ACGIH Threshold Limit Value 200 $\mu g/m^3$ (arsenic and soluble compounds)

D_T Value

The D_T value is defined as that contaminant intake rate (mg/kg/day) that should not induce an adverse effect to human health or should not pose a risk of cancer occurrence greater than a predetermined risk level.

1/ Time Weighted Average.

For carcinogens such as arsenic, the D_T value is based on the USEPA Cancer Assessment Group's cancer potency slopes. The potency slopes are intended to be a plausible upper bound of the potency of a carcinogen in inducing cancer at low doses The cancer potency slopes have been estimated for oral exposure routes and for inhalation exposure for arsenic.

The D_T value for arsenic is based on the oral potency slope. The inhalation slope is not considered appropriate for assessing exposure to arsenic inhaled on suspended soil particulates because it has been developed from industrial emission data which are applicable to particulates smaller than 10 microns. Additionally, a substantial portion of large inhaled particulates are eventually swallowed as a result of mucocilliary transport processes ongoing in the respiratory tract.

Calculation of a D_T using a cancer potency slope requires selection of an acceptable cancer risk level A range of risk levels from 10^{-4} to 10^{-7} is considered for all carcinogens, therefore a range of D_T values is presented Derivation of the D_T values for arsenic is as follows

$$D_T = \frac{\text{Risk Level}}{\text{Potency Slope (mg/kg/day)}^{-1}}$$

$$= \frac{1 \times 10^{-4}}{15 \text{ (mg/kg/day)}^{-1}}$$

$$= 6.7 \times 10^{-6} \text{ mg/kg/day}$$

The range of D_T values for arsenic is presented below.

Risk Level	D_T (mg/kg/day)
10^{-4}	6.7×10^{-6}
10^{-5}	6.7×10^{-7}
10^{-6}	6.7×10^{-8}
10^{-7}	6.7×10^{-9}

3695a

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Material Safety Data Sheet

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(518) 377-8855

GENIUM PUBLISHING CORP

No 316

BENZENE
(Revision D)
Issued November 1978
Revised April 1988

SECTION 1 MATERIAL IDENTIFICATION

25

Material Name BENZENE

Description (Origin/Uses) Used in the manufacture of medicinal chemicals, dyes, linoleum, airplane dopes, varnishes, and lacquers, and as a solvent for waxes, resins, and oils

Other Designations Benzol, Phene, Phenylhydride, C_6H_6, NIOSH *RTECS* No CY1400000, CAS No 0071-43-2

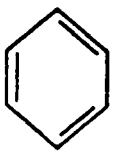
Manufacturer Contact your supplier or distributor Consult the latest edition of the *Chemicalweek Buyers Guide* (Genium ref 73) for a list of suppliers

HMIS
H 2
F 3
R 0
PPG*
*See sect. 8

R 1
I 4
S 2
K 4

SECTION 2 INGREDIENTS AND HAZARDS

	%	EXPOSURE LIMITS
Benzene, CAS No 0071-43-2	Ca 100	**OSHA PEL** 8-Hr TWA 1 ppm 15-Min Ceiling 5 ppm Action Level 0.5 ppm **ACGIH TLV, 1987-88** TLV-TWA 10 ppm, 30 mg/m³ **Toxicity Data*** Human, Inhalation, LC_{Lo} 2000 ppm/5 Min Human, Oral, TD_{Lo} 130 mg/kg Human, Inhalation, TC_{Lo} 210 ppm



*See NIOSH, *RTECS*, for additional data with references to irritative, mutagenic, tumorigenic, and reproductive effects

SECTION 3. PHYSICAL DATA

Boiling Point 176°F (80°C)
Melting Point 42°F (5 5°C)
Vapor Pressure 75 Torrs at 68°F (20°C)
Vapor Density (Air = 1) >1

Water Solubility (%) Slight
% Volatile by Volume 100
Molecular Weight 78 Grams/Mole
Specific Gravity (H_2O = 1) 0 87865 at 68°F (20°C)

Appearance and Odor A colorless liquid, characteristic aromatic odor

SECTION 4 FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air % by Volume	LOWER	UPPER
12°F (-11 1°C) CC	928°F (498°C)		1 3%	7 1%

Extinguishing Media Use dry chemical, foam, or carbon dioxide to put out benzene fires Water may be ineffective as an extinguishing agent because it can scatter and spread the fire Use water to cool fire-exposed containers, flush spills away from exposures, disperse benzene vapor, and protect personnel attempting to stop an unignited benzene leak.

Unusual Fire or Explosion Hazards Benzene vapor is heavier than air and can collect in low-lying areas such as sumps or wells Eliminate all sources of ignition there to prevent a dangerous flashback to the original liquid benzene **Danger** Explosive and flammable benzene vapor-air mixtures can easily form at room temperature, always use this material in a way that minimizes dispersion of its vapor into general work areas

Special Fire-fighting Procedures Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode

SECTION 5 REACTIVITY DATA

Benzene is stable in closed containers during routine operations It does not undergo hazardous polymerization

Chemical Incompatibilities Hazardous chemical reactions involving benzene and the following materials are reported in Genium reference 84 bromine pentafluoride, chlorine, chlorine trifluoride, chromic anhydride, nitryl perchlorate, oxygen, ozone, perchlorates, perchloryl fluoride and aluminum chloride, permanganates and sulfuric acid, potassium peroxide, silver perchlorate, and sodium peroxide

Conditions to Avoid Avoid all exposure to sources of ignition and to incompatible chemicals

Hazardous Products of Decomposition Toxic gases like carbon monoxide (CO) may be produced during benzene fires

SECTION 6 HEALTH HAZARD INFORMATION

Benzene is listed as a suspected human carcinogen by the ACGIH

Summary of Risks Prolonged skin contact with benzene or excessive inhalation of its vapor may cause headache, weakness, loss of appetite, and lassitude Continued exposure can cause collapse, bronchitis, and pneumonia The most important health hazards are cancer (leukemia), bone marrow effects, and injuries to the blood-forming tissue from chronic low-level exposure

Medical Conditions Aggravated by Long-Term Exposure: Ailments of the heart, lungs, liver, kidneys, blood, and central nervous system (CNS) may be worsened by exposure Administer preplacement and periodic medical exams emphasizing these organs' functions and reassign workers who test positive **Target Organs:** Blood, CNS, bone marrow, eyes, and upper respiratory tract (URT) **Primary Entry** Skin contact, inhalation **Acute Effects·** Dizziness, mental dullness, nausea, headache, fatigue, and giddiness. **Chronic Effects** Possible cancer (leukemia)

FIRST AID

Eyes Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes

Skin Immediately wash the affected area with soap and water

Inhalation. Remove the exposed person to fresh air; restore and/or support his or her breathing as needed

Ingestion: Never give anything by mouth to someone who is unconscious or convulsing Do not induce vomiting because of the possibility of aspiration.

GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES. Seek prompt medical assistance for further treatment, observation, and support after first aid

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak Notify safety personnel, provide ventilation, and eliminate all sources of ignition immediately Cleanup personnel need protection against contact with and inhalation of vapor (see sect. 8) Contain large spills and collect waste or absorb it with an inert material such as sand, earth, or vermiculite Use nonsparking tools to place waste liquid or absorbent into closable containers for disposal Keep waste out of sewers, watersheds, and waterways

Waste Disposal Contact your supplier or a licensed contractor for detailed recommendations for disposal. Follow Federal, state, and local regulations

OSHA Designations

Air Contaminant (29 CFR 1910 1000 Subpart Z)

EPA Designations (40 CFR 302 4)

RCRA Hazardous Waste, No U019

CERCLA Hazardous Substance, Reportable Quantity 1000 lbs (454 kg)

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles Always wear protective eyeglasses or chemical safety goggles Where splashing is possible, wear a full face shield Follow the eye and face protection guidelines in 29 CFR 1910 133 **Respirator·** Wear a NIOSH-approved respirator per the *NIOSH Pocket Guide to Chemical Hazards* for the maximum-use concentrations and/or the exposure limits cited in section 2 Follow the respirator guidelines in 29 CFR 1910 134 For emergency or nonroutine use (e g , cleaning reactor vessels or storage tanks), wear an SCBA with a full facepiece operated in the pressure-demand or positive-pressure mode **Warning** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres **Other** Wear impervious gloves, boots, aprons, gauntlets, etc., to prevent any possibility of skin contact with this suspected human carcinogen **Ventilation** Install and operate general and local ventilation systems powerful enough to maintain airborne levels of benzene below the OSHA PEL standard cited in section 2

Safety Stations Make eyewash stations, washing facilities, and safety showers available in use and handling areas **Contaminated Equipment** Contact lenses pose a special hazard, soft lenses may absorb irritants and all lenses concentrate them. Do *not* wear contact lenses in any work area Remove contaminated clothing and launder it before wearing it again, clean this material from shoes and equipment. **Comments** Practice good personal hygiene, always wash thoroughly after using this material Keep it off of your clothing and equipment Avoid transferring it from your hands to your mouth while eating, drinking, or smoking Do *not* eat, drink, or smoke in any work area Do not inhale benzene vapor!

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation Store benzene in a cool, dry, well-ventilated area away from sources of ignition and incompatible chemicals

Special Handling/Storage Protect containers from physical damage Electrically ground and bond all metal containers used in shipping or transferring operations Follow all parts of 29 CFR 1910 1028

Engineering Controls All engineering systems (production, transportation, etc) must be of maximum explosion-proof design (non-sparking, electrically grounded and bonded, etc)

Comments If possible, substitute less toxic solvents for benzene, use this material with extreme caution and only if it is absolutely essential

Transportation Data (49 CFR 172 101-2)

DOT Shipping Name Benzene	DOT Label Flammable Liquid	IMO Label Flammable Liquid
DOT Class Flammable Liquid	DOT ID No UN1114	IMO Class 3.2

References 1, 2, 12, 73, 84-94, 100, 103

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MATERIAL SAFETY DATA SHEET

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NO 59

BERYLLIUM
METAL/POWDER

Date April 1980

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME BERYLLIUM METAL/POWDER
OTHER DESIGNATIONS Glucinium, Glucinum, Be, CAS #007 440 417
MANUFACTURER Material is available from several suppliers, including.

CERAC, Inc.
P.O. Box 1178
Milwaukee, WI 53201
Phone (414) 289-9800

Brush Wellman
Metal & Oxide Div
Elmore, OH 43416
Phone· (419) 862-2745

SECTION II. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Beryllium	> 97	8-hr TWA 2 μg/m³*(as Be)
Beryllium Oxide	< 3	Ceiling Level 5 μg/m³
		Peak 25 μg/m³/30 min
*Current (1979) OSHA and ACGIH TLV In 1975 OSHA proposed an 8-hr TWA of 1 μg/m³ with a ceiling of 5 μg/m³ (15 min sample), OSHA believes that beryllium and its compounds should be treated as a carcinogenic threat to man (The proposed OSHA standard is still under review, but is expected to issue in 1980.)		Human, inhalation TCLo 300 mg/m³, pulmonary effects
		Rabbit, intravenous TDLo 20 mg/kg, neoplastic effects

SECTION III. PHYSICAL DATA

Boiling point at 1 atm, deg C	2970	Specific gravity at 20 C	1.848
Vapor pressure at 1910 C, mm Hg	7.6	Melting point, deg C	1278±5
Water solubility, hot water	Slight	Atomic weight	9.01
cold water	Insol.		

Appearance & Odor· A grayish-white metal (hexagonal crystal structure) also as powdered metal, no odor.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
N/A	Powder ca. 1200 F	Dust explosion hazard		

Extinguishing Media Do not use water or CO_2. Smother fire with approved dry powder extinguisher.* Beryllium can be a moderate fire hazard if exposed to flame. The hazard increases as particle size decreases. A cloud of Be dust in air can be explosive (areas where dusting may occur require Class II, Group E electrical services, 29 CFR 1910.309). Combustion products of this material are highly toxic.
Firefighters should use full protective clothing, eye protection, and self-contained breathing apparatus. After exposure to a beryllium fire, they should clean equipment and clothing thoroughly and bathe carefully. *Sand, graphite, powder, and sodium chloride have also been recommended.

SECTION V. REACTIVITY DATA

Beryllium is stable at room temperature and resists oxidation at ordinary temperatures.* When heated in air or in mixed CO_2 and nitrogen, it can be ignited.
It is acid and alkali soluble, it reacts with strong bases to evolve hydrogen.
Mixtures of the powdered metal with CCl_4 or trichloroethylene will flash on heavy impact.
Warm beryllium will react incandescently with phosphorus, fluorine or chlorine.
Molten lithium metal (180 C) severely attacks beryllium metal.

*Will form oxide on solid surfaces when moist.

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SECTION VI. HEALTH HAZARD INFORMATION

TLV 2 μg/m³ (See Sect. II)

Be is highly toxic by inhalation of fume or dust. Prolonged or repeated skin contact can cause skin irritation or dermatitis Eye contact can produce conjunctivitis.

Implantation under the skin (via a chip or sliver or by particles entering a wound) can produce hard lesions with central non-healing areas which must be surgically removed.

Acute inhalation can produce pneumonitis with non-productive cough, chest pain, shortness of breath, weakness, and pulmonary edema Chronic exposures can produce berylliosis (progressive lung damage) and systemic beryllium disease, including pneumonitis (as above), joint pain, skin lesions, chills & fever, & damage to liver, spleen & heart.

Present studies have indicated that Be is so poorly absorbed through the gut that ingestion is not an important hazard (Hamilton, Industrial Toxicology, 3rd Edition). Animal studies have shown beryllium to produce lung and bone tumors, it is a suspected carcinogen for man

FIRST AID

Eye Contact Flush eyes thoroughly with running water for 15 minutes, including under the eyelids Get medical attention

Skin Contact Wash affected area thoroughly with soap and water after removing contaminated clothing If skin is broken, get medical attention.

Inhalation Remove to fresh air. Restore breathing and support with oxygen as needed. Keep warm and at rest Get medical attention.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

If powdered metal is spilled, notify safety personnel. Exclude all from area except clean-up personnel with protective equipment against contact or inhalation hazards Provide ventilation and remove sources of heat or ignition. Pick up powder spills by methods such as vacuuming or wet mopping, prevent dusting conditions. Collect particulate scrap in sealed container for recovery or disposal.

DISPOSAL Scrap or waste material disposal is best accomplished by arranging to return to the supplier in a mutually acceptable form Beryllium waste unsuitable for recycle must be handled in accordance with Federal, State, and Local regulations Burying in an approved landfill, or burning in an approved incinerator with a scrubber, followed by burying the residues in an approved landfill, have been used in the past.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Isolate workplaces where beryllium dust and fume are generated Provide adequate general and local exhaust ventilation (with filtration to purify recycled air and to protect the external environment) to meet TLV requirements Provide approved respirators for emergency and nonroutine use above the TLV High efficiency filter masks are suitable as high as 50 μg/m³, use air-supplied or self-contained respirators above 50 μg/m³ A full-facepiece respirator is needed above 10 μg/m³.

Workers may require body-covering protective clothing, gloves and safety goggles When exposed above the TLV, a change of clean protective clothing and a shower at the end of the day is required (Wash protective clothing with suitable protection for the launderer) Avoid carrying beryllium particulate outside the workplace on hair or clothing

Eyewash stations and safety showers should be available.

Monitor the workplace to properly determine and control exposure to beryllium.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Use only with adequate ventilation where Be can become airborne. When Be or its alloys is heated (as in welding or sintering processes) hazardous levels of fume can be generated Store in clean, dry place away from incompatible materials (see Sect V) in low fire-hazard area. Protect containers from physical damage. Label clearly.

Use good housekeeping practices to prevent accumulation of Be-containing deposits Give preplacement and annual medical exams to those who may be exposed above the TLV. Preclude from exposure those with pulmonary disease, chronic skin, liver, heart, or kidney conditions, abnormal chest X-ray or blood count, or vital capacity depression greater than 10% Provide worker training.

DOT Classification of powder - POISON B

DATA SOURCE(S) CODE 1-12, 18-20, 24-26

APPROVALS. MIS, CRD J. M. [illegible]

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Occupational Health Guideline for Cadmium Dust (as Cadmium)*

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information It does not attempt to present all data, rather, it presents pertinent information and data in summary form

APPLICABILITY

The general guidelines contained in this document apply to all cadmium dust Physical and chemical properties of several specific compounds are provided for illustrative purposes

SUBSTANCE IDENTIFICATION

Cadmium metal dust

- Formula Cd
- Synonyms None
- Appearance and odor Odorless, gray powder

Cadmium oxide dust

- Formula CdO
- Synonyms None
- Appearance and odor Odorless, brown solid or blue-black solid

Cadmium sulfide dust

- Formula CdS
- Synonyms Greenockite
- Appearance Yellow-orange solid

Cadmium chloride dust

- Formula $CdCl_2$
- Synonyms None
- Appearance White solid

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for cadmium dust is 0 2 milligram of cadmium dust per cubic meter of air (mg/m³) averaged over an eight-hour work shift, with a ceiling level of 0 6 mg/m³ NIOSH has recommended that the permissible exposure limit be reduced to 40 micrograms of cadmium per cubic meter of air (μg/m³) averaged over a work shift of up to 10 hours per day, 40 hours per week, with a ceiling level of 200 μg/m³ averaged over a 15-minute period The recommendations in this guideline supplement the recommendations in the NIOSH Criteria Document for Cadmium, which should be consulted for more detailed information

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Cadmium dust can affect the body if it is inhaled It can also affect the body if it is swallowed

- **Effects of overexposure**

1 Short-term Exposure Cadmium dust may cause irritation of the nose and throat If enough has been inhaled, after a delay of several hours, a person may also develop cough, chest pain, sweating, chills, shortness of breath, and weakness Death may occur Ingestion of cadmium dust may cause nausea, vomiting, diarrhea, and abdominal cramps

2 Long-term Exposure Repeated or prolonged exposure to cadmium dust may cause loss of sense of smell, ulceration of the nose, shortness of breath (emphysema), kidney damage, and mild anemia Exposure to cadmium has also been reported to cause an increased incidence of cancer of the prostate in man Injections of cadmium sulfate in animals have been reported to cause malformation in their offspring

3 Reporting Signs and Symptoms. A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to cadmium dust

- **Recommended medical surveillance**

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations

U S DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U S DEPARTMENT OF LABOR
Occupational Safety and Health Administration

The following medical procedures should be made available to each employee who is exposed to cadmium dust at potentially hazardous levels

1 Initial Medical Examination

—A complete history and physical examination The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring Examination of the respiratory system, liver, kidneys, prostate, and blood should be stressed

—Urinalysis Since kidney damage has been observed in humans exposed to cadmium, a urinalysis should be obtained to include, at a minimum, specific gravity, albumin, glucose, and a microscopic on centrifuged sediment In addition, the urine should be examined for low molecular weight proteins by use of 3% sulfosalicylic or other acceptable techniques

—14" x 17" chest roentgenogram Cadmium causes human lung damage Surveillance of the lungs is indicated

—Liver function tests Cadmium may cause liver damage A profile of liver function should be obtained by utilizing a medically acceptable array of biochemical tests

—FVC and FEV (1 sec) Cadmium is reported to cause decreased pulmonary function Periodic surveillance is indicated

2 Periodic Medical Examination The aforementioned medical examinations should be repeated on an annual basis, except that an x-ray is considered necessary only when indicated by the results of pulmonary function testing, or by signs and symptoms of respiratory disease Urine protein measurements should be made available every four months

• **Summary of toxicology**

Cadmium dust causes both acute and chronic effects It is less toxic than cadmium fume, because dust has a larger particle size than fume, at high concentrations of the dust, physiologic effects similar to those arising from fume exposure could be expected The acute effects primarily involve the lungs but may also affect other organ systems Most acute intoxications have been caused by inhalation of cadmium fume at concentrations which did not provide warning symptoms of irritation The average concentrations of fume responsible for fatalities have been 40 to 50 mg/m³ for 1 hour, or 9 mg/m³ for 5 hours Non-fatal pneumonitis has been reported from concentrations of 0 5 to 2 5 mg/m³, while relatively mild cases have been attributed to even lower concentrations Following an asymptomatic latent period of 4 to 10 hours, there is characteristical nasopharyngeal irritation followed by a feeling of chest constriction or substernal pain, with persistent cough and dyspnea, there may also be headache, chills, muscle aches, nausea, vomiting, and diarrhea Pulmonary edema may then develop and progress rapidly, with decreased vital capacity and markedly reduced carbon monoxide diffusing capacity Cyanosis may be intense In about 20% of the cases the dyspnea is progressive, accompanied by wheezing or hemoptysis, and may result in death within 7 to 10 days after exposure, at autopsy the lungs are markedly congested, and there is an intra-alveolar fibrinous exudate, as well as alveolar cell metaplasia Among survivors, the subsequent course is unpredictable most cases resolve slowly, but respiratory symptoms may linger for several weeks, while impairment of pulmonary function may persist for months In experimental animals, cadmium exposure has caused pulmonary fibrosis, but this has not been documented in humans In one fatal human case, in addition to lung abnormalities, there was renal cortical necrosis Absorbed cadmium is retained to a large extent by the body, and excretion is very slow Continued exposure to low levels of cadmium in air has resulted in chronic poisoning characterized by irreversible lung injury of an emphysematous type, with abnormal lung function and urinary excretion of a specific low-molecular-weight protein which may be associated with renal dysfunction Clinical evidence of the cumulative effects of cadmium may appear after exposure has terminated, the disease then tends to be progressive The frequency of occurrence of proteinuria increases with length of exposure those exposed to cadmium compounds for less than 2 years had no proteinuria, whereas most of those exposed for 12 years or more had proteinuria with little other evidence of renal damage The urinary excretion of cadmium bears no known relationship to the severity or duration of exposure and is only a confirmation of absorption Other consequences of cadmium exposure are rhinitis, occasional ulceration of the nasal septum, damage to the olfactory nerve, and anosmia The long-term ingestion of water, beans, and rice contaminated with cadmium has been proposed as the probable cause of a crippling condition among Japanese women who have had multiple pregnancies, severe pain in the back and joints, a waddly gait, osteomalacia, spontaneous fractures, and occasional fatal renal failure are characteristics of the disorder, which has been termed "itai-itai" Subcutaneous injection of cadmium metal suspended in fowl serum produced rhabdomyosarcomata in rats, cadmium sulfate in sterile distilled water produced sarcomata, and cadmium chloride solution produced pleomorphic sarcomata at the injection site Increased incidence of prostatic cancer has been reported following occupational exposure to cadmium Cadmium sulfate injected into the lingual vein of female hamsters on day 8 of pregnancy caused a high incidence of resorption and malformed offspring, acute necrosis of rat testes follows large doses orally or parenterally, but testicular effects have not been reported in humans

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data—Cadmium metal dust**

1 Molecular weight 112 4

2 Boiling point (760 mm Hg) 767 C (1412 F)

3 Specific gravity (water = 1) 8 642

4 Vapor density (air = 1 at boiling point of cadmium metal dust) Not applicable

5 Melting point 321 C (609 F)

6 Vapor pressure at 20 C (68 F) Essentially zero

7 Solubility in water, g/100 g water at 20 C (68 F) Insoluble

8 Evaporation rate (butyl acetate = 1) Not applicable

- **Physical data—Cadmium oxide dust**

1 Molecular weight 128 4

2 Boiling point (760 mm Hg) 900 C (1652 F) (sublimes and decomposes)

3 Specific gravity (water = 1) 6 95 or 8 15

4 Vapor density (air = 1 at boiling point of cadmium oxide dust) Not applicable

5 Melting point 900 C (1652 F) (sublimes and decomposes)

6 Vapor pressure at 20 C (68 F) Essentially zero

7 Solubility in water, g/100 g water at 20 C (68 F) 0 0005

8 Evaporation rate (butyl acetate = 1) Not applicable

- **Physical data—Cadmium sulfide dust**

1 Molecular weight 144 5

2 Boiling point (760 mm Hg) Sublimes in N_2 at 980 C (1796 F)

3 Specific gravity (water = 1) 4 82

4 Vapor density (air = 1 at boiling point of cadmium sulfide dust) Not applicable

5 Melting point 1750 C (3182 F) at 100 atm

6 Vapor pressure at 20 C (68 F) Essentially zero

7 Solubility in water, g/100 g water at 20 C (68 F) 0 0001

8 Evaporation rate (butyl acetate = 1) Not applicable

- **Physical data—Cadmium chloride dust**

1 Molecular weight 183

2 Boiling point (760 mm Hg) 960 C (1760 F)

3 Specific gravity (water = 1) 4 047

4 Vapor density (air = 1 at boiling point of cadmium chloride dust) Not applicable

5 Melting point 568 C (1054 F)

6 Vapor pressure at 20 C (68 F) Essentially zero

7 Solubility in water, g/100 g water at 20 C (68 F) 140

8 Evaporation rate (butyl acetate = 1) Not applicable

- **Reactivity**

1 Conditions contributing to instability None hazardous

2 Incompatibilities Contact of cadmium metal dust with strong oxidizers or with elemental sulfur, selenium, and tellurium may cause fires and explosions

3 Hazardous decomposition products Toxic gases and vapors (such as cadmium oxide fume) may be released in a fire involving cadmium dust

4 Special precautions None

- **Flammability**

1 Flash point Not applicable

2 Autoignition temperature 250 C (482 F) (layer) (cadmium metal dust)

3 Minimum explosive dust concentration Data not available

4 Extinguishant Dry powder for metal fires

- **Warning properties**

Grant states that "cadmium is a very toxic metal which gives off fumes when burned or heated strongly Characteristically these fumes cause dryness and irritation of the throat, followed in a few hours by nausea and diarrhea Smarting of the eyes occurs relatively infrequently, and no injury to the eyes of human beings has been reported Neither eye nor respiratory irritation is enough to prevent exposures which may cause serious systemic poisoning and damage to the lungs "

MONITORING AND MEASUREMENT PROCEDURES

- **Eight-Hour Exposure Evaluation**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee)

- **Ceiling Evaluation**

Measurements to determine employee ceiling exposure are best taken during periods of maximum expected airborne concentrations of cadmium dust Each measurement should consist of a fifteen (15) minute sample or series of consecutive samples totalling fifteen (15) minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee) A minimum of three (3) measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure

- **Method**

Sampling and analyses may be performed by collection of cadmium dust on a filter, followed by treatment with nitric acid, solution in hydrochloric acid, and atomic absorption spectrophotometric analysis An analytical method for cadmium dust is in the *NIOSH Manual of Analytical Methods*, 2nd Ed , Vol 3, 1977, available from the Government Printing Office, Washington, D C 20402 (GPO No 017-033-00261-4)

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level However, there are some exceptions where respirators may be used to control exposure Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation

PERSONAL PROTECTIVE EQUIPMENT

• If employees' clothing has had any possibility of being contaminated with cadmium dust, employees should change into uncontaminated clothing before leaving the work premises

• Clothing which has had any possibility of being contaminated with cadmium dust should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of cadmium dust from the clothing If the clothing is to be laundered or otherwise cleaned to remove the cadmium dust, the person performing the operation should be informed of cadmium dust's hazardous properties

• Employees should be provided with and required to use dust-resistant safety goggles where there is any possibility of cadmium chloride dust contacting the eyes

• Where there is any possibility that employees' eyes may be exposed to cadmium chloride dust, an eye-wash fountain should be provided within the immediate work area for emergency use

SANITATION

• Workers subject to skin contact with cadmium dust should wash with soap or mild detergent and water any areas of the body which may have contacted cadmium dust at the end of each work day

• Eating and smoking should not be permitted in areas where cadmium dust is handled, processed, or stored

• Employees who handle cadmium dust should wash their hands thoroughly with soap or mild detergent and water before eating or smoking

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to cadmium dust may occur and control methods which may be effective in each case

Operation	Controls
Liberation from fabrication of cadmium-plated marine, aircraft, and motor vehicle equipment for corrosion-resistant coatings	Local exhaust ventilation, personal protective equipment
Liberation during processing of cadmium metal	Process enclosure, local exhaust ventilation, personal protective equipment
Liberation in synthesis of cadmium compounds	Process enclosure, local exhaust ventilation
Liberation in manufacture and fabrication of cadmium alloys, recovery from flue dusts during smelting of lead and zinc operations	Local exhaust ventilation, personal protective equipment
Liberation during manufacture of nuclear reactor rods	Process enclosure, local exhaust ventilation

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance

• **Eye Exposure**

If cadmium dust gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally If irritation is present after washing, get medical attention Contact lenses should not be worn when working with this chemical

• **Skin Exposure**

If cadmium dust gets on the skin, wash the contaminated skin using soap or mild detergent and water Be sure to wash the hands well before eating or smoking and at the close of work

• **Breathing**

If a person breathes in large amounts of cadmium dust, move the exposed person to fresh air at once If breathing has stopped, perform artificial respiration Keep the affected person warm and at rest Get medical attention as soon as possible

• **Swallowing**

When cadmium dust or liquids containing cadmium dust have been swallowed and the person is conscious, give the person large quantities of water immediately After the water has been swallowed, try to get the

person to vomit by having him touch the back of his throat with his finger Do not make an unconscious person vomit Get medical attention immediately

• **Rescue**

Move the affected person from the hazardous exposure If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures Do not become a casualty Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises

SPILL AND DISPOSAL PROCEDURES

• Persons not wearing protective equipment and clothing should be restricted from areas of releases until cleanup has been completed

• If cadmium dust is released in hazardous concentrations, the following steps should be taken

1 Remove all ignition sources

2 Ventilate area of release

3 Collect released material in the most convenient and safe manner for reclamation or for disposal in sealed containers in a secured sanitary landfill

• Waste disposal method

Cadmium dust may be disposed of in sealed containers in a secured sanitary landfill

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* SPECIAL NOTE

The International Agency for Research on Cancer (IARC) has evaluated the data on these chemicals and has concluded that they cause cancer See *IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man*, Volume 2, 1973, and Volume 11, 1976

RESPIRATORY PROTECTION FOR CADMIUM DUST (AS CADMIUM)

Condition	Minimum Respiratory Protection* Required Above 0 2 mg/m³
Dust Concentration	
1 mg/m³ or less	Any dust respirator, except single-use
2 mg/m³ or less	Any dust respirator, except single-use or quarter-mask respirator Any high efficiency particulate filter respirator Any supplied-air respirator Any self-contained breathing apparatus
10 mg/m³ or less	A high efficiency particulate filter respirator with a full facepiece Any supplied-air respirator with a full facepiece, helmet, or hood Any self-contained breathing apparatus with a full facepiece
40 mg/m³ or less	A powered air-purifying respirator with a high efficiency particulate filter A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode
Greater than 40 mg/m³ or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode
Escape	Any dust respirator, except single-use Any escape self-contained breathing apparatus

*Only NIOSH-approved or MSHA-approved equipment should be used

Material Safety Data Sheet

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No 221

CALCIUM METAL

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SECTION 1 MATERIAL IDENTIFICATION

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Material Name CALCIUM METAL

Description (Origin/Uses) Produced by electrolysis of calcium chloride Used in alloys of aluminum, copper, and lead

Other Designations Calcical, Calcium, Ca, NIOSH *RTECS* No EV8040000, CAS No 7440-70-2

Manufacturer/Supplier Contact your supplier or distributor Consult the latest edition of the *Chemicalweek Buyer's Guide* (Genium ref 73) for a list of suppliers

HMIS
H 1
F 1 R 2
R 2 I NA
PPG* S 3
*See sect 8 K 0

SECTION 2. INGREDIENTS AND HAZARDS

SECTION 2. INGREDIENTS AND HAZARDS	%	EXPOSURE LIMITS
Calcium Metal, CAS No 7440-70-2 Calcium plus water yields calcium hydroxide, $Ca(OH)_2$, having the CAS No 1305-62 0 and the NIOSH *RTECS* No EW2800000 with the following data ACGIH TLV 1987 88 TLV TWA 5 mg/m³	100	Element Calcium No Exposure Limits Established Artificial Isotopes ^{45}Ca and ^{47}Ca pose a radiation hazard, they emit gamma radiation

SECTION 3 PHYSICAL DATA

Boiling Point 2703 F (1484 C)
Water Solubility Reacts Violently with Water*
Specific Gravity (H_2O = 1) 1 5
Melting Point 1542°F (839°C)
Molecular Weight 40 08 Grams/Mole
pH. Water Solution Alkaline (pH >7)

*Soluble in water forming the hydroxide, soluble in acids forming salts

Appearance and Odor Silver-white, crystalline, lustrous metal, tarnishes to blue-gray-white on exposure to air Odorless

Comments Calcium metal is soluble in alcohol, ammonia, and dilute acids

SECTION 4 FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air	LOWER	UPPER
Flammable Solid	Not Applicable	Not Applicable	Not Applicable	Not Applicable

Extinguishing Media Do *not* use water, foam, or halogenated hydrocarbons such as Halon® or carbon tetrachloride to extinguish fires involving calcium metal Carbon dioxide and dry chemical are ineffective Use only graphite powder, soda ash, powdered sodium chloride, or an appropriate metal-fire-extinguishing dry powder such as Met-L-X® For large fires, withdraw from the area and let the fire burn (see Genium ref 85) **Unusual Fire/Explosion Hazards** Calcium metal is a flammable solid It is extremely dangerous when wet, keep it dry This material forms calcium hydroxide and hydrogen gas (explosion hazard) when wet. It may form toxic fumes of calcium oxide This substance can also develop explosive pressures in closed containers. It reacts with wet extinguishing agents (water, alcohol, halogens, and possibly carbon dioxide) Its contact with alkali hydroxides or carbonates may result in detonation **Special Fire-fighting Procedures** Wear a self contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode Fire fighters should move containers from the fire area if this can be done without risk Do not use water or foam! Use dry powders only Fire fighters should wear full protective gear This kind of fire may produce irritating or poisonous gases **Comments** Finely divided calcium metal particles may ignite spontaneously in air or oxygen at room temperature Fires may reignite after they have been extinguished Runoff of waste material into a sewer or drain may create an additional fire or explosion hazard

SECTION 5 REACTIVITY DATA

Calcium metal is not stable Hazardous polymerization is not known to occur

Chemical Incompatibilities Hazardous reactions involving this material occur with air, moist air, water, acids, strong oxidizing agents, alcohols and halogens Contact with alkali hydroxides or carbonates may cause detonation

Conditions to Avoid This material may ignite spontaneously if exposed to air or kept in the presence of moisture Store in airtight containers or under oil (see sect 9) Calcium metal can develop explosive pressures in containers, keep them dry at all times

Hazardous Products of Decomposition Toxic calcium oxide fumes, which can react with water to produce heat, calcium hydroxide (corrosive) and flammable hydrogen gas (explosion hazard)

Comments Calcium metal reacts with water considerably less than sodium metal does

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SECTION 6 HEALTH HAZARD INFORMATION

Calcium metal is not listed as a carcinogen by the NTP, IARC, or OSHA

Summary of Risks This material is harmful or fatal if swallowed, inhaled as a mist (calcium hydroxide), dust, or fume, or absorbed through the skin or mucous membranes Solid calcium metal will cause skin and eye burns because it reacts with moisture to form corrosive calcium hydroxide Fumes from burning calcium metal (calcium oxide) are highly irritating to skin, eyes, and mucous membranes including the upper respiratory tract **Medical Conditions Aggravated by Long-Term Exposure** None reported **Target Organs** Eyes skin, mucous membranes (upper respiratory tract) **Primary Entry** Inhalation, ingestion, skin and eye contact **Acute Effects** Corrosive and irritating to body tissue May cause skin burns and corneal damage Inhalation of dust or fume may cause respiratory irritation, cough, difficulty in breathing (dyspnea), and chemical pneumonitis **Chronic Effects** Prolonged inhalation of dust or fume may cause severe mucous membrane irritation, chemical pneumonitis

FIRST AID **Eye Contact** Flush eyes, including under the eyelids, promptly and gently with plenty of running water for 15 minutes If burns are present seek medical help immediately **Skin Contact** Remove calcium metal-contaminated material immediately with a dry cloth Wash with large amounts of water until all of the chemical is removed In case of chemical burn, treat as indicated **Inhalation** Remove victim to fresh air, restore and/or support his breathing as needed Keep him warm and at rest. **Ingestion** If swallowed, and victim is conscious, give him large amounts of water to dilute the alkali Do not induce vomiting A gastric lavage can be used by trained staff Never give anything by mouth to someone who is unconscious

GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES Seek prompt medical assistance for further treatment, observation, and support after first aid

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak Do not touch spilled calcium metal Wear protective apparel Do not smoke or place flame or ignition sources near a spill area Do not allow water to touch spilled material or to get inside containers Use a cover (plastic sheet) to prevent water or rain from dissolving spilled material or to prevent its spreading Isolate hazard area and keep nonessential personnel away from spill or leak site Shovel small dry spills into a dry container and cover it tightly Move containers away from spill to a safe area. Take up small spills with sand or an absorbent material and contain it as described above Dike the flow of large calcium metal and water spills with soil, sandbags, or concrete Keep the waste from entering drains or open sewers Wear fully protective gear

Waste Disposal You may dilute residual spilled material with water jets Contact your supplier or a licensed contractor for detailed recommendations Follow Federal, state, and local regulations

OSHA Designations
Air Contaminant (20 CFR 1910 1000 Subpart Z) Not Listed
EPA Designations (40 CFR 302 4)
RCRA Hazardous Waste, No D003 (Reactivity)
CERCLA Hazardous Substance Not Listed

SECTION 8 SPECIAL PROTECTION INFORMATION

Goggles Follow the eye and face-protection guidelines of 29 CFR 1910 133 Wear chemical splash-proof and dust-resistant safety goggles and/or a faceshield (8" minimum) with approved safety glasses to prevent eye and face contact with calcium metal

Gloves Wear appropriate heavy-duty chemical resistant gloves **Respirator** Where uncomfortable or nuisance levels of calcium metal dust or fume are present a dust/mist respirator can be used Where high levels of calcium metal dust or fume or calcium hydroxide, calcium oxide, or hydrogen may exist (as in a fire situation or spill), use only an SCBA with a full facepiece operated in the pressure-demand or positive-pressure mode

Special Considerations Wear protective clothing, a rubber apron may be appropriate for the particular work situation

Ventilation Work with this material only under a chemical fume hood with localized ventilation or where general dilution ventilation is adequate

Safety Stations Make eyewash stations, washing facilities, and safety showers available in areas of use and handling because calcium metal is corrosive to eyes and body tissue

Contaminated Equipment Contact lenses pose a special hazard, soft lenses may absorb irritants, and all lenses concentrate them. Particles may cling to contact lens surfaces, causing corneal injury

SECTION 9 SPECIAL PRECAUTIONS AND COMMENTS

Storage Segregation Store calcium metal away from sources of heat, ignition (sparks and open flame), water, combustible material, acids halogens alcohols, and other liquid chemicals Store it away from oxidizers

Special Handling/Storage Protect containers against physical damage Store this material in airtight containers under an inert atmosphere such as nitrogen or argon or under liquid hydrocarbons (naphtha kerosene, or coal oil) *Never store it under halogenated hydrocarbons* such as Freon® Avoid high temperatures An isolated, well ventilated, fire-resistant building is recommended for large-quantity storage Do not store material near automatic water sprinklers or where water or steam is present. Provide enough heat in the storage area to keep material sufficiently dry **Comments** Calcium metal is air sensitive Keep it in tightly closed containers at all times when not in use Remove only the amount of calcium metal from its storage container that is immediately necessary Use a metal container with a tightly fitting lid or well stoppered glass bottles for storage and transport Scrupulously avoid water contamination of storage tanks, reactor vessels testing areas etc

Transportation Data (49 CFR 172 101-2)
DOT Hazard Class Flammable Solid **DOT Shipping Name** Calcium Metal **DOT ID No** UN1401
DOT Label Flammable Solid, Dangerous When Wet **IMO Label** Dangerous When Wet **IMO Class** 4 3
Additional DOT Requirements Keep Cold and Dry Segregation is the same as for flammable solids labeled Dangerous When Wet.

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GENIUM PUBLISHING CORP

No 350

CARBON DISULFIDE
(Revision C)
Issued November 1977
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SECTION 1. MATERIAL IDENTIFICATION

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Material CARBON DISULFIDE

Description (Origin/Uses) Used in the manufacture of soil disinfectants, electronic vacuum tubes, rayon, and carbon tetrachloride, used also as a solvent.

Other Designations Carbon Bisulfide, Carbon Sulfide, Dithiocarbonic Acid, CS_2, CAS No 0075-15-0

Manufacturer Contact your supplier or distributor Consult the latest edition of *Chemicalweek Buyers Guide* (Genium ref 73) for a list of suppliers

HMIS		NFPA	
H	2	R	1
F	3	I	4
R	0	S	3
PPG*		K	4
*See sect. 8			

SECTION 2. INGREDIENTS AND OCCUPATIONAL EXPOSURE LIMITS

Carbon Disulfide, ca 100%

OSHA PELs (Skin*)
8-hr TWA 4 ppm, 12 mg/m³
15-min STEL 12 ppm, 36 mg/m³

ACGIH TLV (Skin*), 1988-89
TLV-TWA 10 ppm, 30 mg/m³

Toxicity Data†
Human, Oral, LD_{Lo} 14 mg/kg
Human, Inhalation, LC_{Lo} 4000 ppm (30 min)

NIOSH RELs, 1977
10-hr TWA 1 ppm, 3 mg/m³
15-min Ceiling 10 ppm, 30 mg/m³

*This material can be absorbed through intact skin, and this contributes to overall exposure
†See NIOSH, *RTECS* (FF6650000), for additional data with references to reproductive and mutagenic effects

SECTION 3 PHYSICAL DATA

Boiling Point 115 °F (45 °C)
Melting Point -170 °F (-112 °C)
Vapor Pressure 300 Torr at 68 °F (20 °C)
Vapor Density (Air = 1) 2.6

Molecular Weight. 76 g/mol
Specific Gravity (H_2O = 1): 1.2632 at 68 °F (20 °C)
Solubility in Water (%): 220 mg CS_2/100 cc H_2O at 72 °F (22 °C)
% Volatile by Volume: 100

Appearance and Odor A clear, colorless or faintly yellow, mobile liquid, almost odorless when pure Technical grades of CS_2 have a strong, unpleasant odor of the contaminant hydrogen sulfide (rotten eggs), the odor threshold has been reported as 0 1 to 0 2 ppm.

Comments The very high vapor pressure of this liquid at room temperature indicates that airborne concentrations can quickly build up to dangerous levels, from both a health effects and a fire/explosion perspective Its properties, health effects (see sect. 6), and explosive properties (see sect. 4) make it dangerous to work with unless appropriate precautions are taken (see sect. 8)

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point -22 °F (-30 °C) CC	Autoignition Temperature. 212 °F (100 °C)	LEL. 1% v/v	UEL: 50% v/v

Extinguishing Media Foams are more effective than water in extinguishing carbon disulfide fires. Four foams tested and ranked in order of increasing effectiveness are high-expansion, aqueous-film-forming, fluoroprotein, and protein Cool fire-exposed containers with water spray, continue cooling them after the fire has been extinguished to prevent spontaneous reignition of the carbon disulfide Dry chemical agents are ineffective in extinguishing carbon disulfide fires **Unusual Fire or Explosion Hazards:** Carbon disulfide vapor is denser than air, and it can flow along surfaces, collect in low-lying areas, reach distant ignition sources, and flash back to its liquid source The low flash point, wide range of explosibility, and dangerously low autoignition temperature of this material present dangerous fire and explosion risks that must be carefully considered during fire-fighting operations *Carbon disulfide vapor can be ignited by contact with an ordinary light bulb* **Special Fire-fighting Procedures** Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode

SECTION 5. REACTIVITY DATA

Stability/Polymerization Carbon disulfide is stable in closed containers during routine operations at room temperature. Hazardous polymerization cannot occur **Chemical Incompatibilities:** Carbon disulfide can react dangerously with aluminum, azides, chlorine, chlorine monoxide, ethylene diamine, fluorine, nitric oxide potassium, zinc, and oxidizing agents such as permanganates and sulfuric acid, etc **Conditions to Avoid** Do not expose this material to any source of heat or ignition or to incompatible chemicals **Hazardous Products of Decomposition** Thermal oxidative degradation of carbon disulfide can produce toxic gases and vapors such as chloroform, chlorine, hydrogen chloride, and carbon monoxide

SECTION 6 HEALTH HAZARD INFORMATION

Carcinogenicity Carbon disulfide is not listed as a carcinogen by the NTP, IARC, or OSHA.
Summary of Risks Eye contact with this liquid causes immediate, severe irritation Absorption through the skin is particularly dangerous because it can lead to damage of the peripheral nervous system (PNS) Carbon disulfide has definite effects on the central nervous system (CNS) such as convulsions, respiratory paralysis, narcosis, and even death Cardiovascular system problems (heart, lungs, blood) are also associated with long-term exposure to this material **Medical Conditions Aggravated by Long-Term Exposure** Persons with diseases of the CNS, CVS, gastrointestinal tract, liver, and kidneys may be at increased risk from exposure to carbon disulfide **Target Organs** Skin, eyes, respiratory system, CNS, PNS, liver, kidneys **Primary Entry** Inhalation, skin contact/absorption (*cont d*)

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SECTION 6 HEALTH HAZARD INFORMATION, continued

Acute Effects Dizziness, nausea, vomiting, headache, euphoria, unconsciousness, and convulsions Chronic Effects Repeated exposure to carbon disulfide can cause neurotoxic effects characterized by nervousness, irritability, tremors, indigestion, headache, bizarre dreams leading to insomnia, loss of appetite, polyneuritis, and psychosis Damage to the CNS, CVS, and eyes are also possible Conflicting evidence of effects on the reproductive function have been cited **FIRST AID. Eyes.** Immediately flush eyes, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 minutes. **Skin.** Rinse the affected area with flooding amounts of water; wash it with soap and water **Inhalation.** Treat any substantial inhalation exposure as an emergency Remove the exposed person to fresh air; restore and/or support his or her breathing as needed Have qualified medical personnel administer oxygen as required Keep him or her warm and at rest until medical help is available. **Ingestion** Unlikely Should accidental ingestion occur, have the exposed person drink 1 to 2 glasses of water to dilute the material. Do not induce vomiting unless directed to do so by an occupational physician or poison control center Get in-plant, paramedic, or community medical help for all exposures. Seek prompt medical assistance for further treatment, observation, and support after first aid **Note to Physician** Inhalation exposure is potentially life threatening, direct efforts toward maintaining, supporting, or restoring adequate respiration.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak. *It is necessary to plan and design prior appropriate emergency-response procedures for carbon disulfide spills or leaks* Notify safety personnel, evacuate unnecessary workers, immediately extinguish all sources of ignition, and provide optimum explosion-proof ventilation, preferably at floor level All cleanup operations must be done with nonsparking tools and equipment. Do not flush carbon disulfide to sewers or other surface waters Flush the spilled liquid to a special retention basin where it can be collected below a layer of water for eventual disposal. **Waste Disposal** Contact your supplier or a licensed contractor for detailed recommendations Follow Federal, state, and local regulations.

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910 1000 Subpart Z)
EPA Designations
Listed as RCRA Hazardous Waste No P022 (40 CFR 261.33)
Listed as a CERCLA Hazardous Substance* (40 CFR 302 4) Reportable Quantity (RQ) 100 lb (45 4 kg), [*per CWA, §311 (b)(4) and RCRA, §3001]
Listed as a SARA Extremely Hazardous Substance (40 CFR 355), Threshold Planning Quantity (TPQ) 10,000 lb
Listed as a SARA Toxic Chemical* (40 CFR 372 65) [*EPA Form R may apply to your facility, see 40 CFR 372.85 for instructions]

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles Always wear protective eyeglasses or chemical safety goggles Wear a full face shield where splashing of carbon disulfide is possible Follow OSHA eye- and face-protection regulations (29 CFR 1910 133) **Respirator** Wear a NIOSH-approved respirator per Genium reference 88 for the maximum-use concentrations and/or exposure limits cited in section 2 Follow OSHA respirator regulations (29 CFR 1910 134) For emergency or nonroutine operations (leaks or cleaning reactor vessels and storage tanks), wear an SCBA. **Warning** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres **Other** Wear impervious gloves, boots, aprons, and gauntlets to prevent any contact of carbon disulfide with your skin **Ventilation** Install and operate general and local maximum explosion-proof ventilation systems powerful enough to maintain airborne concentrations of this material below the OSHA PEL standard cited in section 2. Local exhaust ventilation is preferred because it prevents dispersion of the contaminant into the general work area by eliminating it at its source Consult the latest edition of Genium reference 103 for detailed recommendations **Safety Stations** Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work areas **Contaminated Equipment** Contact lenses pose a special hazard, soft lenses may absorb irritants, and all lenses concentrate them. Do *not* wear contact lenses in any work area. Remove contaminated clothing and launder it before wearing it again, clean this material from your shoes and equipment. **Other** Carbon disulfide presents serious fire and explosion hazards (see sect. 4), these dangers are heightened by this material s physical properties (see sect. 3) Using carbon disulfide requires specific engineering controls such as an automatic monitoring-detection system for the airborne concentration of this material and a thorough inspection of all production and storage facilities to eliminate all possible sources of ignition **Comments** Practice good personal hygiene, always wash thoroughly after using this material and before eating, drinking, smoking, using the toilet, or applying cosmetics Keep it off your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking Do *not* eat, drink, or smoke in any work area

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation Store carbon disulfide in closed containers in a cool, dry, well-ventilated area (at floor level) away from all sources of heat and ignition and incompatible chemicals (see sect. 5) Protect these containers from physical damage and shield them from direct sunlight. Outside, isolated, remote, or detached storage is recommended for bulk quantities of carbon disulfide **Special Handling/Storage** Equip storage facilities with automatic sprinklers (test them regularly), preferably, the storage building itself should be noncombustible In storage tanks, fill voids above the carbon disulfide with water or nitrogen gas as the tank is emptied Tanks should be submerged in water or located above concrete basins large enough to hold all of the tanks contents **Engineering Controls.** Electrically ground and bond all containers and equipment used in shipping, receiving, sampling, or producing operations to prevent static sparks Prepare safe grounding routes for lightning strikes Electrical installations and heating facilities must be prohibited in or near storage areas **Other Precautions** Spark-proof tools are required for work operations Carbon disulfide must never be transferred by means of air pressure, use pump, water, or inert gas Use wooden measuring sticks (no spark potential) to measure the contents of carbon disulfide tanks and containers A sustained, conscientious effort to work carefully and safely is required of all workers who handle carbon disulfide

Transportation Data (49 CFR 172 101-2)

DOT Shipping Name Carbon Disulfide *or* Carbon Bisulfide
DOT Hazard Class Flammable Liquid
DOT ID No. UN1131
DOT Label Flammable Liquid
DOT Packaging Requirements 49 CFR 173 121
References 1, 6, 26, 38, 84-94, 100, 116, 118, 119, 122

IMO Shipping Name Carbon Disulphide
IMO Hazard Class. 3 1
IMO Label Flammable Liquid, Poison
IMDG Packaging Group 1

Prepared by PJ Igoe, BS, Industrial Hygiene Review DJ Wilson, CIH, Medical Review W Silverman, MD

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GENIUM PUBLISHING CORP

NO 410

CARBON TETRACHLORIDE

Revision A

Date December 1980

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME CARBON TETRACHLORIDE
OTHER DESIGNATIONS Tetrachlormethane, Perchlormethane, Methane Tetrachloride, CCl_4. GE Material D5B50, CAS #000 056 235
MANUFACTURER Available from several suppliers, including
Linden Chemicals & Plastics
PO Drawer J,
Moundsville, WV 26041 Phone (314) 843-1310

SECTION II. INGREDIENTS AND HAZARDS	%	HAZARD DATA
Carbon Tetrachloride *ACGIH (1980 Intended Changes List) OSHA 8-hr TWA is 10 ppm NIOSH has proposed a 10-hr TWA of 2 ppm ACGIH and NIOSH recommend labeling as a suspected human carcinogen (skin) notation indicates absorption through the skin can contribute significantly to overall exposure	ca 100	8-hr TWA 5 ppm (skin) or 30 mg/m^3* Human, oral LDlo 43 mg/kg Human, inhalation LCLo 1000 ppm TCLo 20 ppm (CNS) Hamsters and mice have developed cancer on long term feeding

SECTION III. PHYSICAL DATA

Boiling point at 1 atm, deg C ---	76 7	Specific gravity, 25/4 C ---	1 585
Vapor pressure @ 20 C, mm Hg ----	ca 91	Melting point, deg C -------	-23
Vapor density (Air=1) ----------	5 3	Volatiles, % ----------	ca 100
Solubility in water @ 20 C, wt % -	0 08	Molecular weight ----------	153 8

Appearance & Odor A clear, colorless liquid with a characteristic sweetish odor
Odor recognition threshold (100% of test panel). 21.4 ppm in air when prepared from CS_2, 100 ppm in air when prepared from CH_4 Odor may not be objectionable at acutely toxic levels

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp	Flammability Limits In Air	LOWER	UPPER

Extinguishing Media It is nonflammable Use that which is appropriate for the surrounding fire. Use water spray to cool fire-exposed containers.
When involved in a fire situation, this material will emit highly toxic and irritating fumes and gases. Metals, such as aluminum and magnesium, can react violently with carbon tetrachloride when hot or burning.
Firefighters must wear self-contained breathing apparatus and full protective gear to fight fires involving this material.

SECTION V. REACTIVITY DATA

This material is stable under normal conditions of handling and use It does not polymerize
Thermal-oxidative decomposition will produce toxic, corrosive fumes, including phosgene and hydrogen chloride.
Violent reactions or explosions can occur with incompatible materials, such as barium, lithium, sodium, and potassium metal, powdered aluminum, magnesium, dimethylformamide (above 65 C), fluorine, etc (See NFPA, "Manual of Hazardous Chemical Reactions")

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SECTION VI. HEALTH HAZARD INFORMATION

TLV 5 ppm (skin) (See Sect II)

Carbon tetrachloride is highly toxic and irritating by inhalation and ingestion (mean lethal dose is 5-10 ml). It is toxic by skin absorption. Excessive exposure may result in CNS depression and/or gastrointestinal symptoms.* It is irritating to skin and eyes. Eye contact or systemic effects can produce visual disturbances (haze, blind spots, narrowing of visual field, etc.). Skin contacts can cause defatting & dermatitis

Kidney & liver damage can occur from severe acute or chronic exposure It is a suspected carcinogen in humans

FIRST AID

Eye Contact Flush eyes with running water for 15 minutes, including under the eyelids Get medical help if irritation persists or when visual disturbances occur.

Skin Contact. Remove contaminated clothing promptly. Wash exposed skin with soap and water. Get medical help for repeated or gross exposures.

Inhalation: Remove to fresh air. Restore and/or support breathing; have qualified person administer oxygen if needed. Get medical help.

Ingestion Contact physician for gastric lavage. (If medical help and advice is not readily available, give water to drink and induce vomiting.)

*Also cardic arrhythmias.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety personnel when large spills occur Evacuate area. Provided maximum exhaust ventilation. Clean-up personnel must use protection against contact and inhalation (see Sect VIII) Contain spill, pick up liquid for disposal. Small spills and residues can be absorbed on paper, vermiculite, etc and allowed to evaporate in a hood Prevent release of CCl_4 to surface water or sewers Spills or discharges in 24 hours of 5000 lb or more (proposed RQ* is 1000 lb) must be reported to U S Government

DISPOSAL Consider recovery and reuse, if feasible Scrap may be burned in approved, high temperature incinerator with scrubber or it may be disposed of as hazardous waste (EPA number U211 or F001 as a spent degreasing solvent under RCRA). Follow Federal, State and Local regulations.

*Reportable Quantity

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide general and local exhaust ventilation to meet TLV Exhaust hoods need 100 lfm min face velocity Ventilate sumps and low lying areas. Use air-supplied or self-contained respirators above TLV, with full face piece above 100 ppm

PVA or neoprene gloves and protective clothing needed to prevent skin contact Wear safety goggles and/or face shield for eye protection

An eyewash station and chemical safety shower should be readily accessible

Provide preplacement and twice a year medical exams. Workers with obesity, diabetes, alcoholism or pulmonary problems should have a physician's approval before working with CCl_4 Retain medical records for 30 years after termination of employment

Provide training to those exposed to CCl_4 in the workplace Monitor vapor levels in the workplace

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store in closed containers in a cool, dry, well-ventilated, low fire-risk area. Protect containers against physical damage Keep away from sources of heat, direct sunlight, and incompatible materials (see Sect V). Prevent exposure of vapors to high temperature to prevent decomposition to toxic and corrosive gases and vapors. No smoking in areas where vapors may be present.

Prevent contact with the skin or eyes. Avoid exposure to vapors. Use good personal hygiene

CCl_4 toxicity is markedly increased by the synergistic effects of alcohol When possible, substitute a less hazardous solvent for CCl_4. DOT Classification - ORM-A

DATA SOURCE(S) CODE 1-12,15,16,21-26,31,37,38,41

APPROVALS	MIS CRD	J. M. Nielsen
Industrial Hygiene and Safety		12-9 80
MEDICAL REVIEW	16 Dec 1980	

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CESIUM
MSDS/HAZCOM INFORMATION

Physical/Chemical Characteristics	
Vapor pressure	1 0 mm at 279°F
Solubility in water	nf
Specific gravity	nf
Evaporation rate	nf
Mol weight	nf
Freezing point	nf
Boiling point	705°F
Appearance	Silver-white ductile metal
Odor	nf
Physical Hazards	
Fire	Flammable solid, may ignite in moist air
Explosion	May explode by chemical reaction with Cl_2, O_2, or P
Reactivity	nf
Health Hazards	
Signs/symptoms of exposure	Hyperirritability
Medical conditions aggravated	nf
Primary routes of entry	Inhalation, injestion
OSHA PEL	No OSHA PEL for this substance
ACGIH TLV	No ACGIH TLV for this substance
Carcinogen?	yes
Safe Handling Precaution	nf
Control Measures/Special Protection	nf
Spill Measures	nf
Special Precautions	nf
Other Information	nf

NOTE "nf" indicates that no information was found beyond that already presented

MATERIAL SAFETY DATA SHEET

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GENIUM PUBLISHING CORP

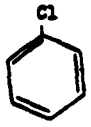
NO 366

CHLOROBENZENE
Revision A

DATE November 1982

SECTION I MATERIAL IDENTIFICATION

MATERIAL NAME CHLOROBENZENE
OTHER DESIGNATIONS Chlorobenzol, Monochlorobenzene, Phenyl Chloride, C_6H_5Cl, CAS #000 108 907
MANUFACTURER Available from several suppliers.



SECTION II INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Chlorobenzene	ca 100	8-hr TWA 75ppm or 350 mg/m^3*
*Current OSHA PEL and ACGIH (1982) TLV Long term bioassay was underway at NCI in 1980		Rat, Oral LD_{50} 2910 mg/kg Mouse, Inhalation LCLo 15 gm/m^3

SECTION III PHYSICAL DATA

Boiling point, 1 atm, deg C	132	Specific gravity (H_2O=1)	1 11
Vapor pressure at 25 C, mm Hg	11.8	Melting point, deg C	ca -45
Vapor density (Air=1)	3 9	Evaporation rate (n-BuAc=1)	1 0
Water solubility, 25C, g/100g H_2O	0.049	Volatiles, %	ca 100
Log Octanal/water Partition	2 83	Molecular weight	112 56

Appearance & Odor A clear, colorless, volatile liquid with a faint, almond-like odor
Threshold odor conc 100% recognition, 0.21 ppm. Good warning properties

SECTION IV FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp	Flammability Limits in Air	Lower	Upper
29C (84F) (TCC)	638 C (1180F)	% by Volume	1 3%	7 1% 9 6% @150C

Extinguishing Media CO_2, dry chemical, or foam. A water spray can be used to control small fires or cool fire-exposed containers. A layer of water can be used to blanket chlorobenzene and may be useful for extinguishing fire in an open tank.
Vapors of this material may flow along surfaces for a considerable distance, reach an ignition source, and flash back. A dangerous fire hazard when exposed to heat or flame.
Firefighters should use eye protection and self-contained breathing apparatus in fighting fires in which this material is involved.

SECTION V REACTIVITY DATA

This is a stable material in closed containers at room temperature under normal storage and handling conditions It does not polymerize It is incompatible with oxidizing agents
Chlorobenzene can react violently with dimethyl sulfoxide. Silver perchlorate will form a solvated salt with chlorobenzene which is shock sensitive (explosion)
Thermal-oxidative degradation products can include soot, hydrogen chloride, phosgene, and carbon monoxide.

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NO 366

SECTION VI HEALTH HAZARD INFORMATION

TLV 75 ppm (See Sect II)

Chlorobenzene is a fairly strong narcotic and can cause CNS depression Overexposure is irritating to the eyes, nasal passages, and upper respiratory tract. It is moderately toxic by inhalation or ingestion and can be absorbed slowly through the skin Short exposures to liquid may cause skin irritation and defatting, while prolonged or repeated skin contact may result in dermatitis or skin burns.

Repeated inhalation exposures to animals at 1,000 ppm over a period of 44 days resulted in lung, liver, and kidney changes, at 475 ppm slight liver changes were observed; no abnormal effects noted at 200 ppm. Symptoms to be expected from acute exposure are headache, dizziness, drowsiness, cyanosis, spastic contractions of extremities, and loss of consciousness, depending on conc. and time of exposure.

FIRST AID

Eye Contact· Flush thoroughly with running water for 15 min. including under eyelids

Skin Contact Remove contaminated clothing Wash area promptly with soap & water.

Inhalation Remove to fresh air. Restore and/or support breathing as required.

Ingestion Contact physician and/or transport for gastric lavage.

Seek prompt medical help for treatment, observation and support after first aid.

SECTION VII SPILL, LEAK AND DISPOSAL PROCEDURES

Make prior plans to handle emergencies Suppliers can be helpful.

Eliminate ignition sources, notify safety personnel Provide ventilation (explosion proof) Clean up workers need protection against inhalation of vapors and contact with liquid Collect spill with absorbent solid, such as paper or sawdust, or as a liquid and place in sealed metal container for disposal. Use non-sparking tools

DISPOSAL Dispose of scrap by burning in an approved incinerator with a scrubber, or dispose of through a licensed waste disposal company. Follow Federal, State and Local regulations

AQUATIC TOXICITY TLm 96 100-1ppm

EPA (RCRA) HW No. U037 (40CFR261), EPA(CWA) RQ 100 lb (40 CFR 117)

SECTION VIII SPECIAL PROTECTION INFORMATION

Provide adequate general and local exhaust ventilation (explosion-proof equipment') to meet TLV requirements Use a chemical cartridge respirator with a full facepiece and and an organic vapor cartridge for vapor conc. < 1000 ppm. A self-contained breathing apparatus with full facepiece is suitable to use up to 2400 ppm

Use impervious (VITON is best; neoprene, "fair") gloves, aprons, protective clothing, etc to avoid skin contact with liquid Use chemical safety goggles where splashing is possible. Clothing soiled with liquid to be removed promptly and laundered before reuse

Provide an eyewash station and safety shower in area of use and handling

Preplacement and periodic medical examinations should emphasize skin, liver, lung, and kidney disorders. Those with such problems may be at an increased risk from exposure

SECTION IX SPECIAL PRECAUTIONS AND COMMENTS

Store in tightly closed containers in a well-ventilated, fire-resistant area away from heat, sources of ignition, and oxidizing agents. Outside or detached area preferred Storage and handling must be suitable for an OSHA Class IC Flammable Liquid Protect containers from physical damage

Ground and bond containers and equipment for transfers to avoid static sparks. Use non-sparking tools Electrical services must meet code. Use safety cans for small amounts

Avoid breathing vapors' Avoid contact with liquid. Do not ingest.

DOT Classification FLAMMABLE LIQUID I D No. UN1134 Label FLAMMABLE LIQUID

DATA SOURCE(S) CODE 2-12,14,16,23,25-27,31,34,37,38,45-47,49

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APPROVALS MIS/CRD J. M. Nielsen

INDUST HYGIENE/SAFETY DJW 11-17-82

MEDICAL REVIEW 27 November 1982

Material Safety Data Sheet

From Genium's Reference Collection
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GENIUM PUBLISHING CORP

No 315

CHLOROFORM
(Revision D)
Issued August 1979
Revised April 1988

SECTION 1. MATERIAL IDENTIFICATION

25

Material Name CHLOROFORM

Description (Origin/Uses) Used as a solvent for fats, oils, rubber, alkaloids, waxes, and resins, as a cleansing agent.

Other Designations Trichloromethane, $CHCl_3$, NIOSH *RTECS* No FS9100000, CAS No 0067-66-3

Manufacturer Contact your supplier or distributor Consult the latest edition of the *Chemicalweek Buyers Guide* (Genium ref 73) for a list of suppliers

HMIS
H 2
F 0
R 0
PPG*
*See sect. 8

R 1
I 3
S 2
K 0

SECTION 2 INGREDIENTS AND HAZARDS

SECTION 2 INGREDIENTS AND HAZARDS	%	EXPOSURE LIMITS
Chloroform, CAS No 0067-66-3	Ca 100	**OSHA PEL** Ceiling 50 ppm, 240 mg/m³ **ACGIH TLV, 1987-88** TLV-TWA 10 ppm, 50 mg/m³ **NIOSH REL** Ceiling 2 ppm, 9 78 mg/m³ **Toxicity Data*** Human, Oral, LD_{Lo} 140 mg/kg Rat, Oral, LD_{50} 908 mg/kg
*See NIOSH, *RTECS*, for additional toxicity data with references to mutagenic, reproductive, tumorigenic, and irritative effects		

SECTION 3. PHYSICAL DATA

Boiling Point 142 F (61°C)
Melting Point -82.3 F (-63 5°C)
Vapor Pressure 158 4 Torrs at 68°F (20°C)
Vapor Density (Air = 1) 4 13

Water Solubility (%) 0 822 ml of $CHCl_3$ per 100 ml of H_2O at 68°F (20°C)
% Volatile by Volume 100
Molecular Weight 119 Grams/Mole
Specific Gravity (H_2O = 1) 1 484 at 68°F (20°C)

Appearance and Odor A heavy, colorless, clear, volatile liquid, characteristic, pleasant, ethereal, sweet odor (recognition threshold 0 3 mg/m³), sweet taste

SECTION 4 FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air % by Volume	LOWER	UPPER
•	•		•	•

Extinguishing Media *Chloroform does not burn Use an agent that will put out the surrounding fire

Unusual Fire or Explosion Hazards None reported

Special Fire-fighting Procedures. Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

SECTION 5 REACTIVITY DATA

Chloroform is stable if kept in closed containers and protected from air and sunlight It does not undergo hazardous polymerization, however, even when stabilized with ethanol, this material develops acidity from prolonged exposure to air and light.

Chemical Incompatibilities This material is incompatible with strong alkalies

Conditions to Avoid *Avoid prolonged exposure to air and light and to strong alkalies*

Hazardous Products of Decomposition Toxic and corrosive gases like hydrochloric acid (HCl), chlorine (Cl_2), carbon monoxide (CO) and oxides of chlorine (ClO_2) can be produced during fires

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SECTION 6 HEALTH HAZARD INFORMATION

Chloroform is listed as a suspected human carcinogen by ACGIH

Summary of Risks Exposure to this material affects the central nervous system (anesthesia) heart (arrhythmia, ventricular tachycardia, bradycardia), liver (necrosis, hepatoma), kidney (necrosis), and it is an embryonic toxin Fatalities are associated with cardiovascular depression and ventricular fibrillation
Medical Conditions Aggravated by Long-Term Exposure. Ailments of the heart, liver, and kidneys may be worsened by exposure to chloroform **Target Organs** Liver, kidneys, heart, skin, eyes. **Primary Entry** Skin contact, inhalation
Acute Effects Dizziness, mental dullness, nausea, headache, fatigue, and anesthesia. **Chronic Effects** Possible cancer
FIRST AID
Eyes Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes
Skin Immediately wash the affected area with soap and water **Inhalation** Remove the exposed person to fresh air, restore and/or support his or her breathing as needed
Ingestion Never give anything by mouth to someone who is unconscious or convulsing If the exposed person is responsive, give him or her several glasses of milk or water to drink and induce vomiting Repeat if large quantities were ingested.
Comments. Workers who are regularly exposed to chloroform require preplacement and periodic medical exams emphasizing kidney, liver, skin, and central nervous system functions Carefully evaluate each exposure that produces a noticeable effect to determine the extent to which factors like alcohol or drugs have affected it.

GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES **Seek prompt medical assistance for further treatment, observation, and support after first aid.**

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak Notify safety personnel of a chloroform spill or leak Provide ventilation Cleanup personnel need protection against contact with and inhalation of vapor (see sect. 8) Chloroform vapor is heavier than air and will collect in low-lying areas Contain large spills and collect waste or absorb it with an inert material such as sand, earth, or vermiculite Place waste liquid or absorbent into closable containers for disposal Keep waste out of sewers, watersheds, and waterways
Waste Disposal. Contact your supplier or a licensed contractor for detailed recommendations Follow Federal, state, and local regulations
OSHA Designations
Air Contaminant (29 CFR 1910 1000 Subpart Z)
EPA Designations (40 CFR 302 4)
RCRA Hazardous Waste, No U044
CERCLA Hazardous Substance, Reportable Quantity 5000 lbs (2270 kg)

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles Always wear protective eyeglasses or chemical safety goggles Where splashing is possible, wear a full face shield as a supplementary protective measure Follow the eye- and face-protection guidelines in 29 CFR 1910 133 **Respirator.** Wear a NIOSH-approved respirator per the *NIOSH Pocket Guide to Chemical Hazards* for the maximum-use concentrations and/or the exposure limits cited in section 2 Follow the respirator guidelines in 29 CFR 1910 134 For emergency or nonroutine use (e g , cleaning reactor vessels or storage tanks), wear an SCBA with a full facepiece operated in the pressure-demand or positive-pressure mode **Warning** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres **Other.** To prevent contact with skin, wear impervious gloves, boots, aprons, gauntlets, etc , as required by the specific work environment **Ventilation** Install and operate general and local ventilation systems that are powerful enough to maintain airborne levels of chloroform below the OSHA PEL standard cited in section 2
Safety Stations Make eyewash stations, washing facilities, and safety showers available in use and handling areas **Contaminated Equipment** Contact lenses pose a special hazard, soft lenses may absorb irritants and all lenses concentrate them Do *not* wear contact lenses in any work area Remove contaminated clothing and launder it before wearing it again, clean this material from shoes and equipment **Comments** Practice good personal hygiene, always wash thoroughly after using this material Keep it off of your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking Do *not* eat, drink, or smoke in any work area Avoid inhalation of vapor!

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation Store chloroform in closed containers away from light and alkalies

Special Handling/Storage Protect containers from physical damage Do not transfer chloroform through plastic or rubber hoses or pipes

Transportation Data (49 CFR 172 101-2)

DOT Shipping Name Chloroform	**DOT Label** None	**IMO Label** Poison
DOT Class ORM A	**DOT ID No** UN1888	**IMO Class** 6 1

References 1 2 12 73 84-94 100 103

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Occupational Health Guideline for Chromium Metal and Insoluble Chromium Salts*

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information It does not attempt to present all data, rather, it presents pertinent information and data in summary form

APPLICABILITY

The general guidelines contained in this document apply to all chromium metal and insoluble chromium salts Physical and chemical properties of some specific compounds are provided for illustrative purposes

SUBSTANCE IDENTIFICATION

Metallic chromium

- Formula Cr
- Synonyms None
- Appearance and odor Shiny, odorless metal

Copper chromite

- Formula $Cu_2Cr_2O_4$
- Synonyms Cuprous chromite
- Appearance and odor Greenish-blue, odorless solid

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for chromium metal or insoluble chromium salts is 1 milligram of chromium metal or insoluble chromium salts per cubic meter of air (mg/m^3) averaged over an eight-hour work shift Certain forms of chromium (VI) have been found to cause increased respiratory cancer among workers Certain other forms of chromium (VI) are currently believed to be non-carcinogenic The non-carcinogenic forms are the monochromates and bichromates (dichromates) of hydrogen, lithium, sodium, potassium, rubidium, cesium, and ammonium, and chromium (VI) oxide (chromium acid anhydride) NIOSH has not conducted an in-depth study of the toxicity of chromium metal or compounds containing chromium in an oxidation state other than 6 NIOSH recommends that the permissible exposure limit for carcinogenic chromium (VI) compounds be reduced to 0 001 Cr (VI) mg/m^3 and that these compounds be regulated as occupational carcinogens NIOSH also recommends that the permissible exposure limit for non-carcinogenic chromium (VI) be reduced to 0 025 Cr (VI) mg/m^3 averaged over a work shift of up to 10 hours per day, 40 hours per week, with a ceiling level of 0 05 Cr (VI) mg/m^3 averaged over a 15-minute period It is further recommended that chromium (VI) in the workplace be considered carcinogenic, unless it has been demonstrated that only the non-carcinogenic chromium (VI) compounds mentioned above are present The NIOSH Criteria Documents for Chromic Acid and Chromium (VI) should be consulted for more detailed information

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Chromium metal or insoluble chromium salts can affect the body if they are inhaled They can also affect the body if they are swallowed

- **Effects of overexposure**

Ferro chrome alloys have been associated with lung changes in workers exposed to these alloys Chromite dust exposure may cause minor lung changes

- **Reporting signs and symptoms**

A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to chromium metal or insoluble chromium salts

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to chromium metal or insoluble chromium salts at potentially hazardous levels

---

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations

U S DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U S DEPARTMENT OF LABOR
Occupational Safety and Health Administration

1 Initial Medical Examination

—A complete history and physical examination The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring Examination of the respiratory system should be stressed

—14" x 17" chest roentgenogram Chromium and its insoluble salts may cause human lung damage Surveillance of the lungs is indicated

—FVC and FEV (1 sec) Insoluble chromium salts are reported to cause decreased pulmonary function Periodic surveillance is indicated

2 Periodic Medical Examination The aforementioned medical examinations should be repeated on an annual basis

• **Summary of toxicology**

The dusts of chromium metal and its insoluble salts, chiefly the chromites, are usually reported to be relatively nontoxic, this is debatable, since exposures associated with toxic effects are usually mixed exposures involving several hexavalent chromium compounds Ferrochrome alloys have been associated with pulmonary disease in humans Four workers engaged in the production of ferrochrome alloys developed a nodular type of pulmonary disease with impairment of pulmonary function, air conce rations of chromium in this study averaged 0 26 mg/m^3, although other fumes and dusts were also present This pulmonary problem may be one of hypersensitivity and thus reversible Other reports state that chest roentgenograms have revealed only "exaggerated pulmonic markings" in workers exposed to chromite dust The lungs of groups of workers exposed to chromite dust have been shown to be the seat of pneumoconiotic changes consisting of slight thickening of interstitial tissue and interalveolar septa, with histologic fibrosis and hyalinization Chromite ore roast mixed with sheep fat implanted intrapleurally in rats produced squamous cell carcinomata coexisting with sarcomata of the lungs, the same material implanted in the thighs of rats produced fibrosarcomata A refractory plant using chromite ore to make chromite brick had no excess of lung cancer deaths over a 14-year period, and it was concluded that chromite alone probably is not carcinogenic

CHEMICAL AND PHYSICAL PROPERTIES

• **Physical data—Metallic chromium**

1 Molecular weight 52

2 Boiling point (760 mm Hg) 2640 C (4784 F)

3 Specific gravity (water = 1) 7 2

4 Vapor density (air = 1 at boiling point of metallic chromium) Not applicable

5 Melting point 1900 C (3452 F)

6 Vapor pressure at 20 C (68 F) Essentially zero

7 Solubility in water, g/100 g water at 20 C (68 F) Insoluble

8 Evaporation rate (butyl acetate = 1) Not applicable

• **Physical data—Copper chromite**

1 Molecular weight 295 1

2 Boiling point (760 mm Hg) Data not available

3 Specific gravity (water = 1) 5 24

4 Vapor density (air = 1 at boiling point of copper chromite) Not applicable

5 Melting point Data not available

6 Vapor pressure at 20 C (68 F) Essentially zero

7 Solubility in water, g/100 g water at 20 C (68 F) Insoluble

8 Evaporation rate (butyl acetate = 1) Not applicable

• **Physical data—Basic potassium zinc chromate**

1 Molecular weight 873 8

2 Boiling point (760 mm Hg) Decomposes at red heat

3 Specific gravity (water = 1) 3 47

4 Vapor density (air = 1 at boiling point of basic potassium zinc chromate) Not applicable

5 Melting point Loses water slowly above 100 C (212 F)

6 Vapor pressure at 20 C (68 F) Essentially zero

7 Solubility in water, g/100 g water at 20 C (68 F) Insoluble

8 Evaporation rate (butyl acetate = 1) Not applicable

• **Reactivity**

1 Conditions contributing to instability None

2 Incompatibilities Chromium metal in contact with strong oxidizers may cause fires and explosions

3 Hazardous decomposition products None listed

4 Special precautions None listed

• **Flammability**

1 Flash point Not applicable

2 Minimum ignition temperature (metal) 400 C (752 F) (layer), 580 C (1076 F) (cloud)

3 Minimum explosive dust concentration (metal) 230 grams/m^3

4 Extinguishant Dry sand, dry dolomite, dry graphite

• **Warning properties**

Chromium metal and insoluble salts are not known to be eye irritants

MONITORING AND MEASUREMENT PROCEDURES

• **Eight-Hour Exposure Evaluation**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee)

• **Ceiling Evaluation**

Measurements to determine employee ceiling exposure are best taken during periods of maximum expected

airborne concentrations of chromium metal or insoluble chromium salts Each measurement should consist of a fifteen (15) minute sample or series of consecutive samples totalling fifteen (15) minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee) A minimum of three (3) measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure

• **Method**

Sampling and analyses may be performed by collection of chromium metal or insoluble chromium salts on a filter, followed by treatment with acid and atomic absorption spectrophotometric analysis An analytical method for chromium metal and insoluble chromium salts is in the *NIOSH Manual of Analytical Methods*, 2nd Ed, Vol 6, 1980, available from the Government Printing Office, Washington, D C 20402 (GPO No 017-033-00369-6)

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level However, there are some exceptions where respirators may be used to control exposure Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation

PERSONAL PROTECTIVE EQUIPMENT

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with solids or liquids containing insoluble chromium salts

• Clothing contaminated with insoluble chromium salts should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of insoluble chromium salts from the clothing If the clothing is to be laundered or otherwise cleaned to remove the insoluble chromium salts, the person performing the operation should be informed of insoluble chromium salts's hazardous properties

• Non-impervious clothing which becomes contaminated with insoluble chromium salts should be removed promptly and not reworn until the insoluble chromium salts are removed from the clothing

• Employees should be provided with and required to use dust- and splashproof safety goggles where solids or liquids containing insoluble chromium salts may contact the eyes

SANITATION

• Skin that becomes contaminated with insoluble chromium salts should be promptly washed or showered with soap or mild detergent and water to remove any insoluble chromium salts.

• Eating and smoking should not be permitted in areas where solids or liquids containing insoluble chromium salts are handled, processed, or stored

• Employees who handle solids or liquids containing insoluble chromium salts should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to chromium metal or insoluble chromium salts may occur and control methods which may be effective in each case

Operation	Controls
Use in fabrication of alloys	Local exhaust ventilation, general dilution ventilation, personal protective equipment
Use in preparation of alloy steels to enhance corrosion- and heat-resistance	Local exhaust ventilation, general dilution ventilation
Use in fabrication of plated products for decoration or increased wear-resistance	Local exhaust ventilation, general dilution ventilation, personal protective equipment
Use in production of non-ferrous alloys to impart special qualities to the alloys	Local exhaust ventilation, general dilution ventilation
Use in production and processing of insoluble salts	Local exhaust ventilation, general dilution ventilation, personal protective equipment

Operation	Controls
Use as chemical intermediates, use in textile industry in dyeing, silk treating, printing, and moth-proofing wool	Local exhaust ventilation, general dilution ventilation, personal protective equipment
Use in leather industry in tanning, use in photograhic fixing baths	Local exhaust ventilation, general dilution ventilation, personal protective equipment
Use as catalysts for halogenation, alkylation, and catalytic cracking of hydrocarbons	Local exhaust ventilation, general dilution ventilation
Use as fuel additives and propellant additives, in photogaphic fixing baths and in ceramics	Local exhaust ventilation, general dilution ventilation, personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance

- **Eye Exposure**

If chromium metal or solids or liquids containing insoluble chromium salts get into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally If irritation is present after washing, get medical attention Contact lenses should not be worn when working with these chemicals

- **Skin Exposure**

If solids or liquids containing insoluble chromium salts get on the skin, wash the contaminated skin using soap or mild detergent and water If solids or liquids containing insoluble chromium salts penetrate through the clothing, remove the clothing and wash the skin using soap or mild detergent and water If irritation persists after washing, get medical attention

- **Breathing**

If a person breathes in large amounts of chromium metal or insoluble chromium salts, move the exposed person to fresh air at once If breathing has stopped, perform artificial respiration Keep the affected person warm and at rest Get medical attention as soon as possible

- **Swallowing**

When solids or liquids containing insoluble chromium salts have been swallowed, give the person large quantities of water immediately After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger Do not make an unconscious person vomit Get medical attention immediately

- **Rescue**

Move the affected person from the hazardous exposure If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures Do not become a casualty Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises

SPILL, LEAK, AND DISPOSAL PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of spills until cleanup has been completed
- If chromium metal or insoluble chromium salts are spilled, the following steps should be taken

1 Remove all ignition sources where metallic chromium has been spilled
2 Ventilate area of spill
3 Collect spilled material in the most convenient and safe manner and deposit in sealed containers for reclamation or for disposal in a secured sanitary landfill Liquid containing chromium metal or insoluble chromium salts should be absorbed in vermiculite, dry sand, earth, or a similar material

- Waste disposal method

Chromium metal or insoluble chromium salts may be disposed of in sealed containers in a secured sanitary landfill

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* SPECIAL NOTE

The International Agency for Research on Cancer (IARC) has evaluated the data on these chemicals and has concluded that they cause cancer See *IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man*, Volume 2, 1973, and Volume 23, 1980

• **Method**

Sampling and analyses may be performed by collection of chromium metal or insoluble chromium salts on a filter, followed by treatment with acid and atomic

RESPIRATORY PROTECTION FOR CHROMIUM METAL AND INSOLUBLE CHROMIUM SALTS (AS CHROMIUM)

Condition	Minimum Respiratory Protection* Required Above 1 mg/m³
Particulate Concentration	
5 mg/m³ or less	Any dust and mist respirator
10 mg/m³ or less	Any dust and mist respirator, except single-use or quarter-mask respirator Any fume respirator or high efficiency particulate respirator Any supplied-air respirator Any self-contained breathing apparatus
50 mg/m³ or less	A high efficiency particulate filter respirator with a full facepiece Any supplied-air respirator with a full facepiece, helmet, or hood Any self-contained breathing apparatus with a full facepiece
500 mg/m³ or less	A powered air-purifying respirator with a high efficiency particulate filter A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode
Greater than 500 mg/m³ or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode

*Only NIOSH-approved or MSHA-approved equipment should be used

Occupational Health Guideline for Coal Tar Pitch Volatiles

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information It does not attempt to present all data, rather, it presents pertinent information and data in summary form

SUBSTANCE IDENTIFICATION

Anthracene

- Formula $C_{14}H_{10}$
- Synonyms None
- Appearance and odor Pale green solid with a faint aromatic odor

Phenanthrene

- Formula $C_{14}H_{10}$
- Synonyms None
- Appearance and odor Colorless solid with a faint aromatic odor

Pyrene

- Formula $C_{16}H_{10}$
- Synonyms None
- Appearance Bright yellow solid

Carbazole

- Formula $C_{12}H_9N$
- Synonyms None
- Appearance and odor Colorless solid with a faint aromatic odor

Benzo(a)pyrene

- Formula $C_{20}H_{12}$
- Synonyms BaP, 3,4-benzopyrene
- Appearance and odor Colorless solid with a faint aromatic odor

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for coal tar pitch volatiles is 0 2 milligram of coal tar pitch volatiles per cubic meter of air (mg/m³) averaged over an eight-hour work shift NIOSH has recommended that the permissible exposure limit for coal tar products be reduced to 0 1 mg/m³ (cyclohexane-extractable fraction) averaged over a work shift of up to 10 hours per day, 40 hours per week, and that coal tar products be regulated as occupational carcinogens The NIOSH Criteria Document for Coal Tar Products and NIOSH Criteria Document for Coke Oven Emissions should be consulted for more detailed information

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Coal tar pitch volatiles can affect the body if they are inhaled or if they come in contact with the eyes or skin

- **Effects of overexposure**

Repeated exposure to coal tar pitch volatiles has been associated with an increased risk of developing bronchitis and cancer of the lungs, skin, bladder, and kidneys Pregnant women may be especially susceptible to exposure effects associated with coal tar pitch volatiles Repeated exposure to these materials may also cause sunlight to have a more severe effect on a person's skin In addition, this type of exposure may cause an allergic skin rash

- **Reporting signs and symptoms**

A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to coal tar pitch volatiles

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to coal tar pitch volatiles at potentially hazardous levels

---

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program However they may not be sufficient to achieve compliance with all requirements of OSHA regulations

U S DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U S DEPARTMENT OF LABOR
Occupational Safety and Health Administration

1 Initial Medical Examination

—A complete history and physical examination The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring Examination of the oral cavity, respiratory tract, bladder, and kidneys should be stressed The skin should be examined for evidence of chronic disorders, for premalignant and malignant lesions, and evidence of hyperpigmentation or photosensitivity

—Urinalysis Coal tar pitch volatiles are associated with an excess of kidney and bladder cancer A urinalysis should be obtained to include at a minimum specific gravity, albumin, glucose, and a microscopic on centrifuged sediment, as well as a test for red blood cells

—Urinary cytology Coal tar pitch volatiles are associated with an excess of kidney and bladder cancer Employees having 5 or more years of exposure or who are 45 years of age or older should have a urinary cytology examination

—Sputum cytology Coal tar pitch volatiles are associated with an excess of lung cancer Employees having 10 or more years of exposure or who are 45 years of age or older should have a sputum cytology examination

—14" x 17" chest roentgenogram Coal tar pitch volatiles are associated with an excess of lung cancer Surveillance of the lungs is indicated

—FVC and FEV (1 sec) Coal tar pitch volatiles are reported to cause an excess of bronchitis Periodic surveillance is indicated

—A complete blood count Due to the possibility of benzene exposure associated with coal tar pitch volatiles, a complete blood count is considered necessary to search for leukemia and aplastic anemia

—Skin disease Coal tar pitch volatiles are defatting agents and can cause dermatitis on prolonged exposure Persons with pre-existing skin disorders may be more susceptible to the effects of these agents

2 Periodic Medical Examination The aforementioned medical examinations should be repeated on an annual basis, and semi-annually for employees 45 years of age or older or with 10 or more years' exposure to coal tar pitch volatiles

- **Summary of toxicology**

Coal tar pitch volatiles (CTPV) are products of the destructive distillation of bituminous coal and contain polynuclear aromatic hydrocarbons (PNA's) These hydrocarbons sublime readily, thereby increasing the amounts of carcinogenic compounds in working areas Epidemiologic evidence suggests that workers intimately exposed to the products of combustion or distillation of bituminous coal are at increased risk of cancer at many sites These include cancer of the respiratory tract, kidney, bladder, and skin In a study of coke oven workers, the level of exposure to CTPV and the length of time exposed were related to the development of cancer Coke oven workers with the highest risk of cancer were those employed exclusively at topside jobs for 5 or more years, for whom the increased risk of dying from lung cancer was 10-fold, all coke oven workers had a 7-½-fold increase in risk of dying from kidney cancer Although the causative agent or agents of the cancer in coke oven workers is unidentified, it is suspected that several PNA's in the CTPV generated during the coking process are involved Certain industrial populations exposed to coal tar products have a demonstrated risk of skin cancer Substances containing PNA's which may produce skin cancer also produce contact dermatitis, examples are coal tar, pitch, and cutting oils Although allergic dermatitis is readily induced by PNA's in guinea pigs, it is only rarely reported in humans from occupational contact with PNA's, these have resulted largely from the therapeutic use of coal tar preparations Components of pitch and coal tar produce cutaneous photosensitization, skin eruptions are usually limited to areas exposed to the sun or ultraviolet light Most of the phototoxic agents will induce hypermelanosis of the skin, if chronic photodermatitis is severe and prolonged, leukoderma may occur Some oils containing PNA's have been associated with changes of follicular and sebaceous glands which commonly take the form of acne There is evidence that exposures to emissions at coke ovens and gas retorts may be associated with an increased occurrence of chronic bronchitis Coal tar pitch volatiles may be associated with benzene, an agent suspected of causing leukemia and known to cause aplastic anemia.

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data—Anthracene**

1 Molecular weight 178 2
2 Boiling point (760 mm Hg) 340 C (644 F)
3 Specific gravity (water = 1) 1 24
4 Vapor density (air = 1 at boiling point of anthracene) 6 15
5 Melting point 217 C (423 F)
6 Vapor pressure at 20 C (68 F) Less than 1 mm Hg
7 Solubility in water, g/100 g water at 20 C (68 F) Insoluble
8 Evaporation rate (butyl acetate = 1) Not applicable

- **Physical data—Phenanthrene**

1 Molecular weight 178 2
2 Boiling point (760 mm Hg) 340 C (644 F)
3 Specific gravity (water = 1) 1 18
4 Vapor density (air = 1 at boiling point of phenanthrene) 6 15
5 Melting point 100 5 C (213 F)
6 Vapor pressure at 20 C (68 F) Less than 1 mm Hg
7 Solubility in water, g/100 g water at 20 C (68 F) Insoluble
8 Evaporation rate (butyl acetate = 1) Not applicable

- **Physical data—Pyrene**

1 Molecular weight 202 3
2 Boiling point (760 mm Hg) Greater than 360 C (greater than 680 F)

3 Specific gravity (water = 1) 1 28
4 Vapor density (air = 1 at boiling point of pyrene) 6 9
5 Melting point 150 4 C (303 F)
6 Vapor pressure at 20 C (68 F) Less than 1 mm Hg
7 Solubility in water, g/100 g water at 20 C (68 F) Insoluble
8 Evaporation rate (butyl acetate = 1) Not applicable

• **Physical data—Carbazole**
1 Molecular weight 167 2
2 Boiling point (760 mm Hg) 355 C (671 F)
3 Specific gravity (water = 1) Greater than 1
4 Vapor density (air = 1 at boiling point of carbazole) 5 8
5 Melting point 246 C (475 F)
6 Vapor pressure at 20 C (68 F) Less than 1 mm Hg
7 Solubility in water, g/100 g water at 20 C (68 F) Insoluble
8 Evaporation rate (butyl acetate = 1) Not applicable

• **Physical data—Benzo(a)pyrene**
1 Molecular weight 252 3
2 Boiling point (760 mm Hg) Greater than 360 C (greater than 680 F)
3 Specific gravity (water = 1) Greater than 1
4 Vapor density (air = 1 at boiling point of benzo(a)pyrene) 8 7
5 Melting point 179 C (354 F)
6 Vapor pressure at 20 C (68 F) Less than 1 mm Hg
7 Solubility in water, g/100 g water at 20 C (68 F) Insoluble
8 Evaporation rate (butyl acetate = 1) Not applicable

• **Reactivity**
1 Conditions contributing to instability None hazardous
2 Incompatibilities Contact with strong oxidizers may cause fires and explosions
3 Hazardous decomposition products None
4 Special precautions None

• **Flammability**
1 Flash point Anthracene 121 C (250 F) (closed cup), Others Data not available
2 Autoignition temperature Anthracene 540 C (1004 F), Others Data not available
3 Flammable limits in air, % by volume Anthracene Lower 0 6, Others Data not available
4 Extinguishant Foam, dry chemical, and carbon dioxide

• **Warning properties**
Grant states that "coal tar and its various crude fractions appear principally to cause reddening and squamous eczema of the lid margins, with only small erosions of the corneal epithelium and superficial changes in the stroma, which disappear in a month following exposure Chronic exposure of workmen to tar fumes and dust has been reported to cause conjunctivitis and discoloration of the cornea in the palpebral fissure, either near the limbus or, in extreme cases, across the whole cornea Occasionally, epithelioma of the lid margin has been attributed to contact with coal tar"

MONITORING AND MEASUREMENT PROCEDURES

• **General**
Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee)

• **Method**
Coal tar products may be sampled by collection on a glass fiber filter with subsequent ultrasonic extraction and weighing An analytical method for coal tar pitch volatiles is in the *NIOSH Manual of Analytical Methods*, 2nd Ed , Vol 1, 1977, available from the Government Printing Office, Washington, D C 20402 (GPO No 017-033-00267-3)

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level However, there are some exceptions where respirators may be used to control exposure Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation

PERSONAL PROTECTIVE EQUIPMENT

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent skin contact with condensed coal tar pitch volatiles, where skin contact may occur

• If employees' clothing may have become contaminated with coal tar pitch volatiles, employees should change into uncontaminated clothing before leaving the work premises

• Clothing contaminated with coal tar pitch volatiles

should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of coal tar pitch volatiles from the clothing If the clothing is to be laundered or otherwise cleaned to remove the coal tar pitch volatiles, the person performing the operation should be informed of coal tar pitch volatiles's hazardous properties

• Employees should be provided with and required to use splash-proof safety goggles where condensed coal tar pitch volatiles may contact the eyes

SANITATION

• Workers subject to skin contact with coal tar pitch volatiles should wash with soap or mild detergent and water any areas of the body which may have contacted coal tar pitch volatiles at the end of each work day

• Employees who handle coal tar pitch volatiles should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities

• Areas in which exposure to coal tar pitch volatiles may occur should be identified by signs or other appropriate means, and access to these areas should be limited to authorized persons

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to coal tar pitch volatiles may occur and control methods which may be effective in each case

Operation	Controls
Liberation from extraction and packaging from coal tar fraction of coking	Process enclosure, local exhaust ventilation, general dilution ventilation, personal protective equipment
Use as a binding agent in manufacture of coal briquettes used for fuel, use as a dielectric in the manufacture of battery electrodes, electric-arc furnace electrodes, and electrodes for alumina reduction	Process enclosure, local exhaust ventilation, general dilution ventilation, personal protective equipment
Use in manufacture of roofing felts and papers and roofing	Process enclosure, local exhaust ventilation, general dilution ventilation, personal protective equipment
Use for protective coatings for pipes for underground conduits and drainage, use as a coating on concrete as waterproofing and corrosion-resistant material, use in road paving and sealing	Process enclosure, local exhaust ventilation, general dilution ventilation, personal protective equipment
Use in manufacture and repair of refractory brick, use in production of foundry cores, use in manufacture of carbon ceramic items	Process enclosure, local exhaust ventilation, general dilution ventilation, personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance

• **Eye Exposure**

If condensed coal tar pitch volatiles get into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally If irritation is present after washing, get medical attention Contact lenses should not be worn when working with these chemicals

• **Skin Exposure**

If condensed coal tar pitch volatiles get on the skin, wash the contaminated skin using soap or mild detergent and water Be sure to wash the hands before eating or smoking and to wash thoroughly at the close of work

• **Breathing**

If a person breathes in large amounts of coal tar pitch volatiles, move the exposed person to fresh air at once If breathing has stopped, perform artificial respiration Keep the affected person warm and at rest Get medical attention as soon as possible

• **Rescue**

Move the affected person from the hazardous exposure If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures Do not become a casualty Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises

SPILL AND DISPOSAL PROCEDURES

• Persons not wearing protective equipment and clothing should be restricted from areas of releases until cleanup has been completed

• If coal tar pitch volatiles are released in hazardous concentrations, the following steps should be taken

1 Ventilate area of spill

2 Collect released material in the most convenient and safe manner for reclamation or for disposal in sealed containers in a secured sanitary landfill

• Waste disposal method

Coal tar pitch volatiles may be disposed of in sealed containers in a secured sanitary landfill

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RESPIRATORY PROTECTION FOR COAL TAR PITCH VOLATILES

Condition	Minimum Respiratory Protection* Required Above 0.2 mg/m³
Particulate and Vapor Concentration	
2 mg/m³ or less	A chemical cartridge respirator with an organic vapor cartridge(s) and with a fume or high-efficiency filter Any supplied-air respirator Any self-contained breathing apparatus
10 mg/m³ or less	A chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s) and with a fume or high-efficiency filter A gas mask with a chin-style or a front- or back-mounted organic vapor canister and with a full facepiece and a fume or high-efficiency filter Any supplied-air respirator with a full facepiece, helmet, or hood Any self-contained breathing apparatus with a full facepiece
200 mg/m³ or less	A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode A powered air-purifying respirator with an organic vapor cartridge and a high-efficiency particulate filter
400 mg/m³ or less	A Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode
Greater than 400 mg/m³ or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode
Escape	Any gas mask providing protection against organic vapors and particulates, including pesticide respirators which meet the requirements of this class Any escape self-contained breathing apparatus

*Only NIOSH-approved or MSHA-approved equipment should be used

Material Safety Data Sheet

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GENIUM PUBLISHING CORP

No 82

COBALT METAL/POWDER
(Revision A)
Issued March 1981
Revised April 1988

SECTION 1 MATERIAL IDENTIFICATION 25

Material Name COBALT METAL/POWDER

Description (Origin/Uses) Used in alloys and in nuclear weapons

Other Designations Co, NIOSH *RTECS* No GF8750000, CAS No 7440-48-4

Manufacturer Contact your supplier or distributor Consult the latest edition of the *Chemicalweek Buyers Guide* (Genium ref 73) for a list of suppliers

Comments The hazards of working with cobalt metal/powder are associated with cutting, grinding, welding etc , that produce dust, fumes powders and gases

Not Found

HMIS	
H 1	
F 1	R 1
R 1	I 4
PPG*	S 1
*See sect 8	K

SECTION 2. INGREDIENTS AND HAZARDS

	%	EXPOSURE LIMITS
Cobalt Metal/Powder, CAS No 7440-48-4	Ca 100	IDLH* Level 20 mg/m³ **OSHA PEL** 8 Hr TWA 0 1 mg/m³ **ACGIH TLVs, 1987-88** TLV-TWA 0 05 mg/m³ TLV STEL 0 1 mg/m³ **Toxicity Data**** Rat, Oral LD_{Lo} 1500 mg/kg

All the exposure limits above are defined for cobalt metal, dust, and fume as Co
*Immediately dangerous to life and health
**See NIOSH, *RTECS*, for additional data with references to tumorigenic effects

SECTION 3 PHYSICAL DATA

Boiling Point Ca 5792 F (3200 C)
Melting Point 2719°F (1493 C)
Specific Gravity (H_2O = 1) 8 92
Water Solubility (%) Insoluble
Molecular Weight 59 Grams/Mole

Appearance and Odor A gray, hard, magnetic, ductile, and somewhat malleable metal or black powder; odorless

SECTION 4 FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air % by Volume	LOWER	UPPER
•	•		•	•

Extinguishing Media *Do not use water Recommended extinguishing agents include dry sand, dry dolomite, dry graphite powder, or sodium chloride Solid cobalt does not burn, however, its dust can burn and it may form explosive mixtures with air

Unusual Fire or Explosion Hazards Cobalt dust particles suspended in the air can explode If a cobalt dust cloud does form, immediately eliminate all possible sources of ignition such as sparks, open flame, etc , and take appropriate precautions (e g , spray the affected area with a water mist or fog) Pyrophoric cobalt, which appears as a black powder, burns brilliantly when exposed to air Working with this material can produce heat and sparks, which can ignite flammable materials and vapors in the workplace

Special Fire-fighting Procedures Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive pressure mode

SECTION 5 REACTIVITY DATA

Cobalt metal/powder is stable in closed containers at room temperature under normal storage and handling conditions It does not undergo hazardous polymerization

Chemical Incompatibilities Pyrophoric cobalt decomposes cold acetylene and becomes incandescent. Fused ammonium nitrate can sometimes react explosively with powdered cobalt.

Conditions to Avoid Prevent contact with incompatible chemicals Powdered cobalt is more reactive than the solid metal, do not allow the powder to accumulate or form a potentially explosive dust cloud

Hazardous Products of Decomposition Only powdered cobalt can burn, various oxides of cobalt may be produced during fires

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SECTION 6. HEALTH HAZARD INFORMATION

Cobalt metal/powder is not listed as a carcinogen by the NTP, IARC, or OSHA

Summary of Risks Inhalation of cobalt dust can cause pulmonary symptoms such as wheezing, irritation of the upper respiratory tract (URT), and hypersensitivity reactions (asthma) Skin contact with powdered cobalt may cause dermatitis, especially in the creases of the elbows knees, ankles, and neck. Contact with eyes may cause conjunctivitis Ingestion may produce a hot sensation along with vomiting, diarrhea, and nausea **Medical Conditions Aggravated by Long-Term Exposure** Disorders of the skin and the URT may be worsened by exposure to cobalt, administer preplacement and periodic medical exams emphasizing these functions.

Target Organs Respiratory system, skin, bladder, kidneys, and eyes **Primary Entry** Skin contact, inhalation.

Acute Effects Contact dermatitis and breathing difficulties **Chronic Effects** Allergic asthma, restricted pulmonary functions, and interstitial fibrosis may be caused by long-term occupational exposure to cobalt or its compounds.

FIRST AID

Eyes Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes

Skin Immediately wash the affected area with soap and water

Inhalation Remove the exposed person to fresh air, restore and/or support his or her breathing as needed

Ingestion Never give anything by mouth to someone who is unconscious or convulsing If cobalt salts are ingested, give 1 to 2 glasses of water and induce vomiting

GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES Seek prompt medical assistance for further treatment, observation, and support after first aid

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak Notify safety personnel, evacuate all nonessential personnel, remove all sources of heat and ignition, and provide adequate ventilation Cleanup personnel need protection against contact with and inhalation of dust (see sect. 8) Prevent skin contact. Scoop up spilled cobalt into suitable containers for disposal Carefully sweep or vacuum up small spills or residues without creating dust.

Waste Disposal Contact your supplier or a licensed contractor for detailed recommendations Consider recycling Follow Federal, state, and local regulations

OSHA Designations

Air Contaminant (29 CFR 1910 1000 Subpart Z, for cobalt metal, dust, and fume)

EPA Designations (40 CFR 302 4)

RCRA Hazardous Waste Not Listed

CERCLA Hazardous Substance Not Listed

SECTION 8 SPECIAL PROTECTION INFORMATION

Goggles Always wear protective eyeglasses or chemical safety goggles Follow the eye- and face-protection guidelines in 29 CFR 1910 133 **Respirator** Wear a NIOSH-approved respirator per the *NIOSH Pocket Guide to Chemical Hazards* for the maximum use concentrations and/or the exposure limits cited in section 2 Follow the respirator guidelines in 29 CFR 1910 134 For emergency or nonroutine use (e g , cleaning reactor vessels or storage tanks), wear an SCBA with a full facepiece operated in the pressure-demand or positive pressure mode **Warning** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres

Other Wear impervious gloves, boots, aprons, and clean, impervious body-covering clothing to prevent any possibility of skin contact. Barrier creams may be useful to limit the effects of skin contact **Ventilation** Install and operate general and local ventilation systems powerful enough to maintain airborne levels of cobalt metal, dust, or fume below the OSHA PEL standard cited in section 2

Safety Stations Make eyewash stations, washing facilities, and safety showers available in use and handling areas

Contaminated Equipment Contact lenses pose a special hazard, soft lenses may absorb irritants and all lenses concentrate them. Particles can adhere to contact lenses and cause corneal damage Do *not* wear contact lenses in any work area.

Comments Practice good personal hygiene, always wash thoroughly after using this material Avoid transferring it from your hands to your mouth while eating, drinking, or smoking Do *not* eat, drink, or smoke in any work area. Do not inhale dust or create dusty working conditions

SECTION 9 SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation Store cobalt metal/powder in a cool, dry, well-ventilated area in closed containers away from oxidizing agents, incompatible chemicals (see sect. 5), and sources of heat or ignition.

Special Handling/Storage Practice good housekeeping techniques that minimize accumulation of dust, cleaning procedures should not create dusty conditions

Transportation Data (49 CFR 172 101-2): Not Listed

References 1 2 12, 73, 84-94, 100, 103

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Occupational Health Guideline for Copper Dusts and Mists

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information It does not attempt to present all data, rather, it presents pertinent information and data in summary form

SUBSTANCE IDENTIFICATION

- Formulas of example compounds $CuSO_4 \cdot 5H_2O$; CuCl
- Example compounds Copper sulfate dust or mist, cuprous chloride dust
- Appearance and odor Odorless solids

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for copper dusts or mists is 1 milligram of copper dusts or mists per cubic meter of air (mg/m^3) averaged over an eight-hour work shift

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Copper dusts or mists can affect the body if they are inhaled or if they come in contact with the eyes or skin They can also affect the body if they are swallowed

- **Effects of overexposure**

1 Short-term Exposure. Powdered copper or dusts or mists of copper salts may cause a feeling of illness similar to the common cold with sensations of chills and stuffiness of the head Small copper particles may enter the eye and cause irritation, discoloration, and damage

2. Long-term Exposure Repeated or prolonged exposure to copper dusts or mists may cause skin irritation or discoloration of the skin or hair

3 Reporting Signs and Symptoms. A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to copper dusts or mists

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to copper dusts and mists at potentially hazardous levels

1. Initial Medical Screening. Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from copper dusts and mists exposure

—Chronic respiratory disease Copper dusts or mists cause respiratory irritation in animals In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of copper dusts or mists might cause exacerbation of symptoms due to their irritant properties

—Liver disease Copper dusts or mists cause liver damage in animals. Persons with pre-existing liver disease may be more susceptible to the effects of these agents

—Kidney disease Copper dusts or mists cause kidney damage in animals The importance of this organ in the elimination of toxic substances justifies special consideration in those with impaired renal function

—Skin disease Skin sensitization in human subjects has occurred Persons with pre-existing skin disorders may be more susceptible to the effects of these agents

—Hematopoietic disorders Anemia has occurred in animals given copper salts orally Persons with pre-existing blood disorders may be more susceptible to the effects of these agents

—Wilson's disease Persons with pre-existing Wilson's disease may be more susceptible to the effects of these agents

2. Periodic Medical Examination. Any employee developing the above-listed conditions should be referred for further medical examination

- **Summary of toxicology**

Inhalation of dusts and mists of copper and copper salts results in irritation of the upper respiratory tract, with occasional ulceration and perforation of the nasal septum Inhalation of copper and its compounds by animals caused injury to the lungs and liver with

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These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations

U S DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U S DEPARTMENT OF LABOR
Occupational Safety and Health Administration

hemochromatosis Access of sheep to salt licks containing 5 to 9% copper sulfate caused the sudden onset of hemolytic anemia, icterus, and hemoglobinuria followed by death in a day or two, at necropsy, the liver, kidneys, and spleen showed severe degenerative changes Workers exposed to copper dust in concentrations of 0 075 to 0 120 mg/m^3 complained of mild nasal discomfort Exposure to the dust of copper acetate produced sneezing, coughing, digestive disorders, and fever Metal workers exposed to complex copper salts in dust form complained of metallic taste with irritation of nasal and oral mucosa, atrophic changes in the mucous membranes were noted in subjects exposed for long periods of time On ingestion, copper salts act as irritants and cause nausea, vomiting, abdominal pain, hemorrhagic gastritis, and diarrhea. Copper salts splashed in the eye cause conjunctivitis, corneal ulceration, and turbidity, and may produce palpebral edema. Copper particles embedded in the eye result in pronounced foreign-body reaction with characteristic discoloration of ocular tissue Allergic contact dermatitis due to copper exposure, although rare, has been reported Greenish discoloration of the skin and hair of some copper workers has been observed Although copper is an essential element for health, excessive amounts can produce harmful effects

CHEMICAL AND PHYSICAL PROPERTIES

• **Physical data**

1 Molecular weight $CuSO_4$ 249 7, $CuCl_2$ 99

2 Boiling point (760 mm Hg) Not applicable

3 Specific gravity (water = 1) Greater than 1

4 Vapor density (air = 1 at boiling point of copper dusts or mists) Not applicable

5 Melting point Higher than 100 C (212 F) For example, copper sulfate = 150 C (302 F), cuprous chloride = 430 C (806 F)

6 Vapor pressure at 20 C (68 F) Not applicable

7 Solubility in water, g/100 g water at 20 C (68 F) Ranges from very low (e g cuprous chloride = 0 006) to high (e g copper sulfate = 35)

8 Evaporation rate (butyl acetate = 1) Not applicable

• **Reactivity**

1 Conditions contributing to instability Extreme heat

2 Incompatibilities Copper dusts or mists may react with acetylene gas to form copper acetylides, which are solids that are sensitive to shock Some copper mists may react with magnesium metal to form flammable hydrogen gas

3 Hazardous decomposition products None

4 Special precautions None

• ***Flammability***

1 Ignition temperature Copper dusts = 700 C (1292 F)

• **Warning properties**

According to Grant, copper acetoarsenite, copper chloride, copper sulfate, copper carbonate and oxide, and copper metal all produce local irritant effects when in contact with the eye The *Documentation of TLV's* also notes that copper salts on the eye may cause "conjunctivitis or even ulceration and turbidity of the cornea" Concentrations producing these effects are not given

MONITORING AND MEASUREMENT PROCEDURES

• **General**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee)

• **Method**

Sampling and analyses may be performed by collection of copper dusts or mists on a cellulose ester membrane filter, followed by treatment with nitric acid, solution in hydrochloric acid, and atomic absorption spectrophotometric analysis An analytical method for copper dusts or mists is in the *NIOSH Manual of Analytical Methods*, 2nd Ed , Vol 2, 1977, available from the Government Printing Office, Washington, D C 20402 (GPO No 017-033-00260-6)

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level However, there are some exceptions where respirators may be used to control exposure Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation

PERSONAL PROTECTIVE EQUIPMENT

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch

minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with copper salts or liquids containing copper salts

- If employees' clothing may have become contaminated with powdered copper, copper salts, or liquids containing copper salts, employees should change into uncontaminated clothing before leaving the work premises
- Clothing contaminated with copper salts should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of copper salts from the clothing If the clothing is to be laundered or otherwise cleaned to remove the copper salts, the person performing the operation should be informed of copper salts's hazardous properties
- Non-impervious clothing which becomes contaminated with copper salts should be removed promptly and not reworn until the copper salts are removed from the clothing
- Employees should be provided with and required to use dust- and splash-proof safety goggles where powdered copper or dusts, mists, or liquids containing copper salts may contact the eyes

SANITATION

- Skin that becomes contaminated with copper salts should be promptly washed or showered with soap or mild detergent and water to remove any copper salts
- Eating and smoking should not be permitted in areas where powdered copper, copper salts, or liquids containing copper salts are handled, processed, or stored
- Employees who handle powdered copper, copper salts, or liquids containing copper salts should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to copper dusts or mists may occur and control methods which may be effective in each case

Operation	Controls
Liberation during mining, extracting, and refining copper ore, during fabrication and manufacture of copper rod, wire, piping, and tubing for use in electrical, plumbing, and building industries, during manufacture of domestic utensils, during manufacture of alloys	Local exhaust ventilation, general dilution ventilation, personal protective equipment
Liberation from production and application of fungicides, insecticides, and germicides for soil, feed, grain, textile, water and sewage treatments, during use of copper salts for paint pigments and coloring agents, electroplating baths, wood preservation, automotive emission controls, textile treatment, and organic synthesis	Local exhaust ventilation, general dilution ventilation, personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance

- **Eye Exposure**

If copper dusts or mists get into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally Get medical attention immediately Contact lenses should not be worn when working with these chemicals

- **Skin Exposure**

If copper salts or liquids containing copper salts get on the skin, promptly wash the contaminated skin using soap or mild detergent and water If copper salts or liquids containing copper salts penetrate through the clothing, remove the clothing promptly and wash the skin using soap or mild detergent and water If irritation persists after washing, get medical attention

- **Breathing**

If a person breathes in large amounts of copper dusts or mists, move the exposed person to fresh air at once If breathing has stopped, perform artificial respiration Keep the affected person warm and at rest Get medical attention as soon as possible

- **Swallowing**

When powdered copper, copper salts, or liquids containing copper salts have been swallowed and the person is conscious, give the person large quantities of water immediately After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger Do not make an unconscious person vomit Get medical attention immediately

- **Rescue**

Move the affected person from the hazardous exposure If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures Do not become a casualty Understand the facility's emergency rescue procedures and

know the locations of rescue equipment before the need arises

SPILL AND DISPOSAL PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of release until cleanup has been completed
- If copper dusts or mists are spilled or released, the following steps should be taken

1 Ventilate area of release

2 Collect spilled material in the most convenient and safe manner for reclamation, or for disposal in a secured sanitary landfill Liquid containing copper should be absorbed in vermiculite, dry sand, earth, or a similar material

- Waste disposal method

Copper dusts or mists and copper compounds may be disposed of in sealed containers in a secured sanitary landfill

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1,1-DICHLOROETHYLENE[1/]

Summary

1,1-Dichloroethylene caused kidney tumors (male mice only) and leukemia in one study of mice exposed by inhalation to 1,1-dichloroethylene. The results of other studies were equivocal or negative. 1,1-Dichloroethylene is mutagenic, and has caused adverse reproductive effects when administered to rats and rabbits by inhalation. Chronic exposure causes liver damage, and acute exposure to high doses produces nervous system damage.

CAS Number. 75-35-4

Chemical Formula: CH_2CCl_2

IUPAC Name. 1,1-Dichloroethene

Important Synonyms and Trade Names, Vinylidene chloride, VDC, 1,1-dichloroethene, 1,1-DCE

Chemical and Physical Properties

Molecular Weight 96 94

Boiling Point· 37°C

Melting Point -122 1°C

Specific Gravity. 1.218 at 20°C

Solubility in Water 400 g/liter at 20°C

1/ U S Environmental Protection Agency, Office of Waste Program Enforcement. September 1985 Chemical, physical, and biological properties of compounds present at hazardous waste sites A Final Report Prepared by Clement Associates, Inc , Arlington, Virginia

Solubility in Organics: Sparingly soluble in alcohol, ether, acetone, benzene, and chloroform

Log Octanol/Water Partition Coefficient (K_{ow}). 1 84 (Mabey et al 1981) Estimated

Soil/Water Partition Coefficient (K_{oc}):

239	Lyman et al. (1982) Eqn 4-8 (log K_{ow} = 1.84)
78	Lyman and Loreti (1987) (log K_{ow} = 1.84)
65	USEPA (1986a)

Bioconcentration Factor:

20 2	Davies and Dobbs (1984) Eqn C (log K_{ow} = 2.18)
26 7	Lyman et al. (1982) Eqn 5-2 (log K_{ow} = 2 18)
30 9	Davies and Dobbs (1984) Eqn B (log K_{ow} = 2 18)

Vapor Pressure 500 mm Hg at 20°C

600 mm Hg at 25°C (USEPA 1986a)

Vapor Density. 3.25

Henry's Law Constant 3.4×10^{-2} atm-m^3/mole (USEPA 1986a)

Transport and Fate

Volatilization is likely to be the primary transport process for 1,1-dichloroethylene (VDC), and its subsequent photooxidation in the atmosphere by reaction with hydroxyl radicals is the predominant fate process. The half-life of 1,1-dichloroethylene in water is estimated to be between one and six days (USEPA 1984)

A range of estimated soil-water partition coefficients (K_{oc}) is reported above and indicates that sorption of 1,1-dichloroethylene to soils/sediments and dissolved organic material will occur Pavlou (1980) estimates that sorption of volatile organic compounds will range

from low to moderate. The combined water solubility and low organic partitioning of 1,1-dichloroethylene suggests that this compound will exhibit some degree of environmental mobility.

A range of estimated bioconcentration factor (BCFs) for 1,1-dichloroethylene is also reported above. ASTM (1985) indicates that chemicals with bioconcentration factors less than approximately 100 have low potential for causing harm to wildlife and human health via biomagnification of residues up food chains. The magnitude of the concentration factors suggests that appreciable bioconcentration or biomagnification of 1,1-dichloroethylene residues is not likely to occur.

Health Effects

1,1-Dichloroethylene caused kidney tumors in male mice and leukemia in both males and females when exposed by inhalation. Equivocal results were obtained in other inhalation studies. Negative results were obtained in cancer studies with rats and mice following oral exposure or in hamsters following inhalation exposure 1,1-Dichloroethylene has been classified according to EPA's Proposed Guidelines for Carcinogen Risk Assessment in EPA's Group C (possible human carcinogen) based on limited evidence in animals and inadequate evidence in humans (USEPA 1985)

1,1-Dichloroethylene was mutagenic in several bacterial assays 1,1-Dichloroethylene did not appear to be teratogenic but did cause embryotoxicity and fetotoxicity when administered to pregnant rats and rabbits by inhalation Chronic exposure to oral doses of 1,1-dichloroethylene as low as 5 mg/kg/day caused liver changes in rats Acute exposure to high doses causes central nervous system depression Neurotoxicity has not been associated with low-level chronic exposure The oral LC_{50} value for rats and mice are 1,500 and 200 mg/kg, respectively

Toxicity to Wildlife and Domestic Animals

1,1-Dichloroethylene is not very toxic to freshwater or saltwater species, with acute LC_{50} values generally ranging from 80 to 200 mg/liter (USEPA 1980) A chronic study in which no adverse effects were observed indicated that the acute-chronic ratio was less than 40. A 13-day study reporting an LC_{50} of 29 mg/liter indicated that the acute-chronic ratio for 1,1-dichloroethylene is greater than 4.

No reports of the toxicity of 1,1-dichloroethylene to terrestrial wildlife or domestic animals were found in the literature reviewed.

Regulations and Standards

Ambient Water Quality Criteria (USEPA 1986b)

Aquatic Life (Freshwater)

The available data are not adequate for establishing criteria However, EPA does report the lowest values known to cause toxicity in aquatic organisms.

Acute toxicity 11,600 µg/liter
Chronic toxicity No available data

Aquatic Life (Saltwater)

Acute toxicity 224,000 µg/liter
Chronic toxicity No available data

Human Health

Due to the carcinogenicity of 1,1-dichloroethylene the ambient water criterion is set at zero However, estimates of the carcinogenic risks associated with lifetime exposure from ingestion of contaminated water and contaminated aquatic organisms are:

Risk	Concentration
10^{-5}	0.33 µg/liter
10^{-6}	0.033 µg/liter
10^{-7}	0.0033 µg/liter

National Primary Drinking Water Standard (USEPA). 0.007 mg/liter (40 CFR Part 141)

CAG Potency Slope for Inhalation Exposure (USEPA 1989) = 1 2 $(mg/kg/day)^{-1}$

CAG Potency Slope for Oral Exposure (USEPA 1989) = 0 6 $(mg/kg/day)^{-1}$

D_T Value

The D_T value is defined as that contaminant intake rate (mg/kg/day) that should not induce an adverse effect to human health or should not pose a risk of cancer occurrence greater than a predetermined risk level

For oral and inhalation exposures to 1,1-dichloroethylene, the D_T value is based on the USEPA Cancer Assessment Group's cancer potency slopes The cancer potency slopes are intended to be a plausible upper bound of the potency of a carcinogen in inducing cancer at low doses Calculation of a D_T using a cancer potency slope requires selection of an acceptable cancer risk level A range of risk levels from 10^{-4}

to 10^{-7} will be considered for all carcinogens, therefore a range of D_T values is presented. Derivation of the inhalation D_T value for 1,1-dichloroethylene is as follows·

$$D_T = \frac{\text{Risk Level}}{\text{Potency Slope (mg/kg/day)}^{-1}}$$

$$= \frac{1 \times 10^{-4}}{1\ 16\ \ (\text{mg/kg/day})^{-1}}$$

$$= 8.6 \times 10^{-5}\ \text{mg/kg/day}$$

For oral exposure to 1,1-dichloroethylene, the D_T value is also based on the USEPA Cancer Assessment Group's cancer potency estimate Derivation of the oral D_T value is as follows.

$$D_T = \frac{\text{Risk Level}}{\text{Potency Slope (mg/kg/day)}^{-1}}$$

$$= \frac{1 \times 10^{-4}}{0\ 6\ \ (\text{mg/kg/day})^{-1}}$$

$$= 1\ 7 \times 10^{-4}\ \text{mg/kg/day}$$

The range of inhalation and oral D_T values for 1,1-dichloroethylene is presented below.

Risk Level	Oral D_T (mg/kg/day)	Inhalation D_T (mg/kg/day)
10^{-4}	$1\ 7 \times 10^{-4}$	$8\ 3 \times 10^{-5}$
10^{-5}	$1\ 7 \times 10^{-5}$	8.3×10^{-6}
10^{-6}	$1\ 7 \times 10^{-6}$	$8\ 3 \times 10^{-7}$
10^{-7}	$1\ 7 \times 10^{-7}$	$8\ 3 \times 10^{-8}$

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MATERIAL SAFETY DATA SHEET

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MSDS # 100

LITHIUM DRIDE

Issued December 1985
Revised

From Genium s MSDS Collection to be used as a reference

SECTION 1 MATERIAL IDENTIFICATION

MATERIAL NAME LITHIUM HYDRIDE

OTHER DESIGNATIONS HLi, CAS # 7580 67 8

MANUFACTURER/SUPPLIER Available fro man suppliers, including
Lithium corporation of America, 449 North Cox Road, Gastonia, NC 28054
(704)867-37

SECTION 2 INGREDIENTS AND HAZARDS

SECTION 2 INGREDIENTS AND HAZARDS	%	HAZARD DATA
Lithium Hydride	95-99	8-hr TWA 0 025 mg/m^3*

*Current ACGIH TLV (1985-86) and OSHA PEL

SECTION 3 PHYSICAL DATA

Boiling pt ,1 atm deg F(C) --- Decomposes
Vapor pressure at 20°C, mmHg --- 0
Vapor density (Air = 1) --- N/A
Solubility in water --- Reacts to form hydrogen gas and lithium hydroxide
Specific gravity (H_2O = 1) --- 0 75

Melting pt , deg F(C) --- 1267(686)
% Volatile by volume --- N/A
Evaporation rate (BuAc = 1) --- N/A
Molecular weight --- 7 95

APPEARANCE & ODOR Off-white, translucent, odorless solid which darkens rapidly on exposure to light (Commercial product is light to bluish gray)

SECTION 4 FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp	Flammability Limits in Air	Lower	Upper
Not applicable	392°F(200°C)	Not applicable		

EXTINGUISHING MEDIA Dry graphite, dolomite or lithium chloride Do not use water, carbon dioxide, dry chemical, or halogenated extinguishing agents Lithium hydride is a flammable solid When heated or in contact with oxidizing agents, moisture, or acids an exothermic reaction results with the evolution of corrosive dust and hydrogen gas, which can explode or catch fire spontaneously at room temperature This material can form airborne dust clouds which may explode on contact with flame, heat, or oxidizing materials Fires involving lithium hydride may reignite after fire is initially extinguished Do not leave extinguished fire unattended Turn over residues carefully and be prepared to reextinguish if necessary Firefighters should wear self-contained breathing apparatus with facepiece and full protective clothing

SECTION 5 REACTIVITY DATA

This material is stable in closed containers at room temperature under normal handling and storage conditions It does not undergo hazardous polymerization

Lithium hydride is incompatible with water, oxidizers, halogenated hydrocarbons, and acids Contact with these materials may cause fire or explosion Lithium hydride may ignite spontaneously in air

Thermal decomposition or burning may produce irritating alkali fumes and hydrogen gas

SECTION 6 HEALTH HAZARD INFORMATION

TLV 0 025mg/m^3 (See Section II)

Dusts of lithium hydride are extremely irritating and corrosive and may cause coughing, sneezing, and irritation or damage to the upper respiratory tract The dust and solid may cause severe burns on contact with the skin and redness or permanent injury on contact with the eyes If ingested, lithium hydride will burn the gastrointestinal tract It may produce symptoms of CNS damage, including muscle twitches, mental confusion, blurring of vision, coma, and death The TLV of 0 025 mg/m^3 has been established to prevent nasal irritation

FIRST AID

EYE CONTACT Promptly flush eyes, including under eyelids, with running water for at least 15 minutes Get medical attention SKIN CONTACT Flush exposed area with water while removing contaminated clothing Get medical attention if skin is irritated or burned INHALATION Remove to fresh air Restore and/or support breathing as required Get medical help INGESTION Give large volumes of water or milk Contact a physician or poison control center Do not induce vomiting unless directed to do so Never give anything by mouth to a person who is unconscious or is having convulsions

Lithium Hydride has not been identified as a carcinogen by NTP, IARC or OSHA

SECTION 7 SPILL, LEAK AND DISPOSAL PROCEDURES

Notify safety personnel of spills Remove all heat and ignition sources Provide maximum explosion-proof ventilation Evacuate all non-essential personnel from the area except for those involved in cleanup Cleanup personnel should wear gloves, safety glasses, face shield, flameproof disposable suit, and an appropriate NIOSH-approved respirator Carefully collect solid and place in dry metal container for disposal Use caution to avoid generating dust When picking up spill, have extinguishing agent ready to put out fire if fire should occur Use nonsparking tools

DISPOSAL Place in suitable container for disposal by licensed contractor, or add small quantities cautiously to dry butanol, neutralize with aqueous acid, and flush to sewer with water Follow all Federal, State, and Local regulations

SECTION 8 SPECIAL PROTECTION INFORMATION

Provide general and local exhaust ventilation (explosion proof) to meet TLV requirements For emergency or nonroutine exposures where the TLV may be exceeded, use an appropriate NIOSH-approved respirator Fume hoods should have a face velocity of 100 lfm * All electrical service should have an explosion-proof design When handling lithium hydride, wear safety glasses, face shield, dust mask, and fire-proof clothing Remove contaminated clothing immediately and do not reuse until it has been properly cleaned

Eyewash station and safety shower should be readily available in use and handling areas

Contact lenses pose a special hazard, soft lenses may absorb and all lenses concentrate irritants

* lfm = linear feet per minute

SECTION 9 SPECIAL PRECAUTIONS AND COMMENTS

Store in closed containers in a cool, dry, well-ventilated, isolated, fireproof area Protect containers from physical damage

Keep material away from water, moist air, acids, oxidizing materials, heat, sparks, and flame Use in an inert atmosphere, such as nitrogen, or in an area where the relative humidity is below 50%

Protect against dust inhalation Avoid contact with eyes, skin, and clothing Wash thoroughly after handling. Do not eat or smoke in use or handling areas.

DOT Classification Flammable Solid, Dangerous when wet, UN 1414

DATA SOURCE(S) CODE (See Glossary) 1,2,4,5,6,7,8,9,25,26,34,37,47,75,78,79, 81 CR

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NO. 94

MAGNESIUM OXIDE

Date October 1981

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME MAGNESIUM OXIDE
OTHER DESIGNATIONS. Calcined Brucite, Magnesia, Periclase, MgO, G.E. Material D4C37, CAS #001 309 484
MANUFACTURER: Available from several suppliers, including:
Malkinckrodt, Inc.
P.O. Box M
Paris, Kentucky 40361 Tel: (600) 987-7000

SECTION II. INGREDIENTS AND HAZARDS

SECTION II. INGREDIENTS AND HAZARDS	%	HAZARD DATA
Magnesium Oxide	>97	8-hr TWA 15 mg/m^3* (fume)
*Current OSHA Standard. ACGIH (1981) TLV for fume is 10mg/m^3 (as Mg)		Human, Inhalation TCLo 400/mg/m^3 Hamster, Intratracheal TDLo 500mg/hg 30 W-I TFX: NEO

SECTION III. PHYSICAL DATA

Boiling point, 1 atm, deg C ------- 3600
Solubility in water @ 20C, mg/L --- 6.2
Specific Gravity (H_2O=1) ------ ca 3.7
Melting point, deg C ---------- >2500
Molecular Weight ---------- 40.31

Appearance and Odor White powder, odorless

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER

Noncombustible material. Use extinguishing media that is appropriate for surrounding fire.

Firefighters should wear self-contained breathing apparatus as this material can become airborne.

SECTION V. REACTIVITY DATA

This is a stable material in closed containers at room temperature under normal storage and handling conditions. It does not polymerize.
This alkaline material can absorb CO_2 and H_2O from air. It is soluble in aqueous acids. It reacts violently with chlorine trifluoride and phosphorus pentachloride.

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SECTION VI. HEALTH HAZARD INFORMATION

TLV 15mg/m^3 (fume)

Inhalation of freshly generated magnesium oxide fume can cause an acute toxic reaction called metal fume fever* along with leukocytosis, cough and chest pain. Exposure to MgO dust can produce irritation of the eyes and nasal passages.

FIRST AID

Eye Contact Flush thoroughly with running water for 15 min. including under eyelids.
Skin Contact Remove contaminated clothing. Wash affected area with soap and water.
Inhalation. Remove to fresh air. Restore and/or support breathing as required.
Ingestion Contact physician. Give water to drink to dilute.
Seek medical assistance for further treatment, observation and support.

*Response to MgO fume is milder than to ZnO fume.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Provide adequate ventilation. Clean up personnel may need respirator protection against dust or fumes. Pick up spills and place in appropriate containers for disposal or recovery (avoid dusting conditions). Flush residue with water.
DISPOSAL Deposit in an approved landfill. MgO is considered to be of low toxicity in nature with low solubility in water.
Follow Federal, State and Local regulations
AQUATIC TOXICITY TLm 96 >1000 ppm

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide local exhaust ventilation to meet TLV requirements in the workplace where dust or fumes may be generated. An air-supplied or self-contained breathing apparatus can be used below 750 mg/m^3, with a full facepiece needed above 150 mg/m^3.
Avoid eye contact by use of chemical safety goggles where dusty conditions may occur. Wear protective clothing appropriate for the work situation
Eyewash station and washing facilities should be accessible to use area.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store in tightly closed containers in a cool, dry, well-ventilated area away from acids. Protect containers from physical damage.
Avoid inhalation or eye contact with dust. Practice good personal hygiene when handling this material Use good housekeeping practices to prevent accumulation of dust. Wear clean work clothes

DATA SOURCE(S) CODE 1,2,4-12,14,20,26,31,37,47,48

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APPROVALS: MIS CRD

Industrial Hygiene and Safety 10-9-81

MEDICAL REVIEW: 29 December 1981

MATERIAL SAFETY DATA SHEET

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MSDS # 148
MANGANESE METAL/POWDER

Issued September, 1985
Revised

From Genium s MSDS Collection to be used as a reference

SECTION 1 MATERIAL IDENTIFICATION

17

MATERIAL NAME MANGANESE METAL/POWDER
OTHER DESIGNATIONS Mn, CAS #7439-96-5
SUPPLIER Available from several suppliers, including

Belmont Metals, Inc
327 Belmont Avenue
Brooklyn, NY 11207
(718) 342-4900

Chemetals, Inc
7310 Ritchie Highway
Glen Burnie, MD 21061
(301) 768-6600

SECTION 2 INGREDIENTS AND HAZARDS

	%	HAZARD DATA
MANGANESE, Mn	>99%	Ceiling limit 5 mg/m^3, as Mn*
* Current (1985-86) ACGIH TLV and OSHA PEL (both are ceiling limits)		Human, Inhalation TCLo 2 3 mg/m^3

SECTION 3 PHYSICAL DATA

Melting point	1244 ± 3°C	Solubility in water	decomposes
Boiling point	2097°C	Vapor pressure @ 1227°C, mmHg	1
Specific gravity	7 2	Molecular weight	54 94

APPEARANCE & ODOR Gray powder or metal No odor

SECTION 4 FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp	Flammability Limits in Air	Lower	Upper
N/A				

Manganese metal/powder can present a dust explosion hazard under favoring conditions of particle size and airborne dust dispersion The minimum explosive concentration of Mn is 0 125 oz/ft^3, with a minimum ignition temperature of 450°C Oxygen concentrations less than 15% prevent ignition*

Flammable hydrogen gas is generated under certain conditions (see Section 5)
EXTINGUISHING AGENTS Blanket burning powder with dry powder extinguishing agent designed for metal fires (e g , G-1, Met-L-X) Firefighters should wear self-contained breathing apparatus and full protective gear
* REF Data source #54, page 1089

SECTION 5 REACTIVITY DATA

This material is stable in closed containers at room temperature When heated to high temperature, manganese burns in air forming manganese oxides (Some oxidation may occur at normal temperatures in air) Manganese reacts slowly with water at 100°C forming hydrogen gas (flammable) Contact with acids (including dilute acids) readily dissolves Mn, with the evolution of hydrogen Hot concentrated potassium and sodium hydroxides also dissolves Mn, forming hydrogen and manganese hydroxide

Other incompatible materials include fluorine, chlorine, hydrogen peroxide, nitric acid, nitrogen dioxide, sulfur dioxide and phosphorus

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SECTION 6 HEALTH HAZARD INFORMATION

TLV 5 mg/m^3 (ceiling)

Although manganese is an essential element for man, acute or chronic manganese poisoning can occur from excessive intake via inhalation or ingestion The most notable effects of chronic manganese poisoning are neurological disorders occurring after 6-24 months of exposure Symptoms include apathy, loss of appetite, drowsiness, speech difficulties, muscular twitching, spastic gait and other CNS effects Symptoms resemble Parkinson's disease Progressive and permanent injury can occur from chronic Mn poisoning if it is not treated Inhalation of manganese fumes may cause "metal fume fever" characterized by flu-like symptoms fever, chills, nausea, weakness, body aches "Manganese pneumonititis" has been reported in workers exposed to manganese ores and compounds The TLV is also a ceiling limit as reports show poisoning symptoms near this value FIRST AID

EYE CONTACT Flush well with running water to remove dust particles Get medical attention if irritation persists

SKIN CONTACT Wash with mild soap and water

INHALATION Remove to fresh air Support breathing as required Get prompt medical help

INGESTION If person is conscious, give them 2-3 glasses of water to drink, then induce vomiting Repeat Get medical assistance promptly

GET MEDICAL ATTENTION = Paramedic, In-plant, community.

SECTION 7 SPILL, LEAK AND DISPOSAL PROCEDURES

Remove sources of heat and ignition Ventilate spill area Clean-up personnel should wear appropriate respiratory protective equipment Carefully scoop up spilled material (avoid dust generation) and place in a suitable container for salvage

DISPOSAL Return scrap material to supplier or processor for recovery Unsalvagable waste may be buried in an approved landfill Follow Local, State and Federal regulations

SECTION 8 SPECIAL PROTECTION INFORMATION

Provide general and local exhaust ventilation to meet the TLV requirement (Consideration should be given to the pyrophoricity of finely divided Mn powder when designing exhaust ventilation systems and other process equipment that may contain heavily dust-laden air) NIOSH-approved respirators should be worn where airborne concentrations exceed the ceiling limit Fume or high efficiency particulate filter respirators are acceptable for concentrations up to 50 mg/m^3 (250 mg/m^3 with full facepiece) Other protective equipment (gloves, clothing) may be desirable depending on the work situation (eg , where prolonged/repeated contact is likely) Prevent eye contact by use of chemical safety goggles where dusty conditions exist Eyewash stations and wash facilities should be accessible in areas of use

Contact lenses pose a special hazard, soft lenses may absorb and all lenses concentrate irritants

SECTION 9 SPECIAL PRECAUTIONS AND COMMENTS

Store in closed containers in a cool, dry, well-ventilated area away from ignition sources, acids, alkali, and other incompatible materials Protect containers from physical damage

Maintain good housekeeping practices to prevent accumulation of dust Use clean-up procedures that minimize dust generation

Use with adequate ventilation Avoid breathing dust and fumes Practice good personal hygiene Wash hands thoroughly after handling and before eating and smoking

DOT CLASSIFICATION Not listed in 49 CFR, Part 172 101 or 172 102

DATA SOURCE(S) CODE (See Glossary) 2, 4, 8, 9, 12, 14, 20, 25, 27, 44, 47, 55, 58, V.

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APPROVALS/ JO Accrocco 11/85

INDUST HYGIENE/SAFETY JW 11-85

MEDICAL REVIEW Dec 85

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GENIUM PUBLISHING CORP

No 26

MERCURY
(Revision C)
Issued September 1981
Revised August 1988

SECTION 1. MATERIAL IDENTIFICATION 26

Material Name MERCURY

Description (Origin/Uses) Used in barometers, thermometers, hydrometers, and pyrometers, in mercury arc lamps producing ultraviolet rays, in switches and fluorescent lamps, as a catalyst in oxidations of organic compounds, in alloys, in explosives, and for extracting gold and silver from ore

Other Designations Colloidal Mercury, Metallic Mercury, Quicksilver, Hg, Hydrargyrum, CAS No 7439-97-6

Manufacturer Contact your supplier or distributor Consult the latest edition of the *Chemicalweek Buyers Guide* (Genium ref 73) for a list of suppliers

Comments Inorganic and organic mercury compounds are highly toxic, as is pure mercury

Genium

HMIS
H 3 R 1
F 0 I 4
R 0 S 1
PPG* K 0
*See sect 8

SECTION 2. INGREDIENTS AND HAZARDS / % / EXPOSURE LIMITS

SECTION 2. INGREDIENTS AND HAZARDS	%	EXPOSURE LIMITS
Mercury, CAS No 7439-97-6	Ca 100	**OSHA PEL** Ceiling 1 mg per 10 m³ **ACGIH TLV (Skin*), 1987-88** TLV-TWA 0 05 mg/m³ as Hg (Mercury Vapor) **Toxicity Data**** Rabbit, Inhalation, LC_{Lo} 29 mg/m³ (30 Hrs)
*Mercury can be absorbed through intact skin, which contributes to overall exposure **See NIOSH, *RTECS* (OV4550000), for additional data with references to reproductive, mutagenic, and tumorigenic effects		

SECTION 3. PHYSICAL DATA

Boiling Point 673 F (357 C)
Specific Gravity (H_2O = 1) 13.546 at 68°F (20 C)
Vapor Pressure 0 0018 Torr at 77 F (25 C)
Water Solubility (%) Insoluble
Molecular Weight 201 Grams/Mole
Melting Point -37 93°F (-38 85°C)

Appearance and Odor A silver, heavy liquid, odorless **Danger** Mercury vapor has no warning properties

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air % by Volume	LOWER	UPPER
*	*		*	*

Extinguishing Media *Mercury does not burn Use extinguishing agents that will put out the surrounding fire

Unusual Fire or Explosion Hazards When exposed to the high temperatures that occur during a fire, mercury can vaporize to form extremely toxic fumes

Special Fire-fighting Procedures Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode

SECTION 5. REACTIVITY DATA

Mercury is stable in closed containers at room temperature under normal storage and handling conditions It cannot undergo hazardous polymerization

Chemical Incompatibilities Hazardous reactions involving mercury and acetylene, ammonia, boron phosphodiiodide, chlorine, chlorine dioxide, methyl azide, sodium carbide, nitric acid, oleum, and sulfuric acid are reported (Genium ref 84)

Conditions to Avoid *Do not expose mercury to incompatible chemicals*

Hazardous Products of Decomposition Extremely toxic mercury metal fumes are likely to be produced during fires

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SECTION 6 HEALTH HAZARD INFORMATION

Mercury is not listed as a carcinogen by the NTP, IARC, or OSHA

Summary of Risks Mercury is very toxic due to its liquid and fat solubility, lack of charge, and membrane permeability It is a slowly cumulative poison that concentrates in the brain, kidneys, and liver It is very hazardous when spilled or heated Mercury and its vapor are rapidly absorbed by the membranes lining the respiratory tract, the gastrointestinal (GI) tract, and the skin Mercury is a teratogen (causes physical defects in embryos) **Medical Conditions Aggravated by Long-Term Exposure** Preexisting problems of the target organs can be worsened Provide preplacement and periodic medical exams emphasizing the target organs **Target Organs** Skin, eyes, respiratory system, central nervous system (CNS), kidneys **Primary Entry** Skin absorption/contact, inhalation **Acute Effects** Erosion of the respiratory/GI tracts, nausea, vomiting, bloody diarrhea, shock, headache, metallic taste Inhalation of high concentrations for short periods can cause pneumonitis, chest pain, dyspnea, coughing, stomatitis, gingivitis, and salivation **Chronic Effects** Tremors, emotional problems, loss of concentration, depression, drowsiness, fatigue, insomnia, loss of memory, kidney problems, eye lesions, vision disturbances, sore mouth and throat, problems with the sense of taste or smell, nosebleeds, nasal inflammation, loss of weight or appetite, poor hand-eye coordination, awkwardness, and unsteadiness, as well as dermatitis **FIRST AID** **Eyes** Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes **Skin** Immediately wash the affected area with soap and water because of the increased exposure from skin absorption **Inhalation** Remove exposed person to fresh air, restore and/or support his or her breathing as needed Have medical personnel administer oxygen to treat the chemical pneumonitis that may develop **Ingestion** Never give anything by mouth to someone who is unconscious or convulsing Note to physician If indicated by degree of ingestion, saline cathartics and charcoal should be used Chelation therapy with d-penicillamine may also be indicated

GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES Seek prompt medical assistance for further treatment, observation, and support after first aid Treatment of chronic mercury poisoning requires expert medical care At the first signs, immediately remove the exposed person from further exposure and have him or her examined and treated by a physician trained in occupational mercury poisoning

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak Notify safety personnel, restrict access to the spill area to necessary personnel, and provide adequate ventilation Clean up spills promptly Specialized equipment and/or techniques may be required to safely deal with large mercury spills, if large quantities of mercury are used in the workplace, detailed, prior spill-management planning is recommended Collect spilled mercury by using a suction pump and an aspirator bottle with a long capillary tube For finely divided mercury in inaccessible cracks, corners, etc , treatment with calcium polysulfide and excess sulfur is recommended to convert the mercury globules into mercury sulfide Vacuum cleaners may be used if they are equipped with specially designed mercury-absorbent exhaust filters Collect the mercury into tightly sealed containers for later disposal or reclamation Cleanup personnel must use the recommended personal protective equipment (see sect. 8)

Waste Disposal Consider reclamation, recycling, or destruction rather than disposal in a landfill Do not pour mercury down a drain Mercury is very harmful to the environment. Contact your supplier or a licensed contractor for detailed recommendations Follow Federal, state, and local regulations

OSHA Designations
Air Contaminant (29 CFR 19010 1000 Subpart Z)

EPA Designations (40 CFR 302 4)
RCRA Hazardous Waste No U151
CERCLA Hazardous Substance, Reportable Quantity 1 lb (0 454 kg)*

*Per the Clean Water Act, § 407 (a), Clean Air Act, § 112, and Resource Conservation and Recovery Act, § 3001

SECTION 8 SPECIAL PROTECTION INFORMATION

Goggles Always wear protective eyeglasses or chemical safety goggles Where splashing of mercury may occur, wear a full face shield or splash guard Follow OSHA eye- and face-protection regulations (29 CFR 1910 133)

Respirator Use a NIOSH-approved respirator per the *NIOSH Pocket Guide to Chemical Hazards* for the maximum-use concentrations and/or the exposure limits cited in section 2 Follow OSHA respirator regulations (29 CFR 1910 134) **Other** Wear impervious gloves, boots aprons, gauntlets, etc , to prevent any contact with mercury and the skin

Ventilation Install and operate general and local ventilation systems powerful enough to continuously maintain airborne levels of mercury below the OSHA PEL standard cited in section 2

Safety Stations Make emergency eyewash stations, washing facilities, and safety/quick-drench showers available in work areas

Contaminated Equipment Contact lenses pose a special hazard, soft lenses may absorb irritants and all lenses concentrate them Do *not* wear contact lenses in any work area Remove contaminated clothing and launder it before wearing it again, clean mercury from shoes and equipment. Separate work and street clothes, store work clothes in special lockers and always shower before changing to street clothes

Comments Practice good personal hygiene, always wash thoroughly after using this material Keep it off of your clothing and equipment Avoid transferring it from your hands to your mouth while eating, drinking, or smoking Do *not* eat, drink, or smoke in any work area

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation Store mercury in a cool, dry, well-ventilated area in tightly closed unbreakable polyethylene containers Protect these containers from physical damage

Special Handling/Storage Construct storage areas to have smooth, hard, nonporous floors with no cracks or spaces so that spilled mercury globules do not form in inaccessible areas

Comments Mercury evaporates slowly, but if it is spilled it can form many tiny globules that evaporate much faster than a single pool of it will In an unventilated area, significant concentration of mercury vapor can develop from this enhanced evaporation effect This poisonous vapor is particularly hazardous if breathed over a long period of time, so spills or releases of mercury require very meticulous cleaning procedures

Transportation Data (49 CFR 172 101-2)

DOT Shipping Name Mercury, Metal	**DOT Label** None	**IMO Class** 8
DOT Hazard Class ORM-B	**DOT ID No** NA2809	**IMO Label** Corrosive

References 1, 2 8 26 38 84-94 100

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GENIUM PUBLISHING CORP

No 373

METHYL CHLORIDE
(Revision A)
Issued May 1981
Revised November 1987

SECTION 1 MATERIAL IDENTIFICATION

24

Material Name METHYL CHLORIDE

Description (Origin/Uses) Used as a refrigerant

Other Designations Chloromethane, CH_3Cl, NIOSH *RTECS* No PA6300000, CAS No 0074-87-3

Manufacturer Contact your supplier or distributor Consult the latest edition of the *Chemicalweek Buyers Guide* (Genium ref 73) for a list of suppliers

HMIS
H 2
F 4
R 1
PPG*
*See sect. 8

R 1
I 3
S 1
K 4

SECTION 2 INGREDIENTS AND HAZARDS

	%	EXPOSURE LIMITS
Methyl Chloride, CAS No 0074-87-3 H_3CCl *This material can be absorbed through intact skin, which contributes to overall exposure **Maximum allowable concentration ***NIOSH views methyl chloride as an occupational carcinogen and suggests that all exposures to it be reduced to the lowest feasible level ****See NIOSH, *RTECS* for additional data with references to reproductive and mutagenic effects	ca 100	**ACGIH TLVs (Skin*), 1987-88** TLV-TWA 50 ppm, 105 mg/m³ TLV-STEL 100 ppm, 205 mg/m³ **OSHA PELs (Skin*)** 8-Hr TWA 100 ppm Ceiling 200 ppm (30 Min) MAC** 300 ppm for 5 Min in any 3 Hr period **NIOSH REL Ca***** **Toxicity Data****** Rat, Inhalation, LC_{50} 15,200 mg/m³ (30 Min) Mouse, Inhalation, LC_{50} 3146 ppm (7 Hrs)

SECTION 3 PHYSICAL DATA

Boiling Point -10 7 F (-23 7 C)
Vapor Density (Air = 1) 1 8
Water Solubility 100 (complete)

Melting Point -143°F (-97°C)
Molecular Weight 50 49 Grams/Mole
% Volatile by Volume 100%

Appearance and Odor A colorless, odorless gas that compresses under pressure to a cryogenic liquid with poor warning properties (see sect 6)

SECTION 4 FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air	LOWER	UPPER
*	*	% by Volume	8 1	17 2

Extinguishing Media *Methyl chloride is an extremely explosive and flammable gas If it is burning, try to stop the flow of gas, use a water spray to protect men effecting the shutoff and to cool fire-exposed containers

Unusual Fire or Explosion Hazards Methyl chloride is denser than air and will collect in enclosed or low-lying areas like sumps, so eliminate ignition sources there

Special Fire-fighting Procedures Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode

SECTION 5 REACTIVITY DATA

Methyl chloride is stable in closed containers at room temperature under normal storage and handling conditions It does not undergo hazardous polymerization

Chemical Incompatibilities This material is incompatible with strong oxidizing agents, amines, amides, and metals like Zn, Al, Mg, Na and K

Conditions to Avoid Do not allow ignition sources like open flame, unprotected heaters lighted tobacco products, electric sparks, and excessive heat in work areas because of the extreme flammability of this material

Hazardous Products of Decomposition Extremely toxic gases like phosgene and HCl are produced during fire conditions

SECTION 6 HEALTH HAZARD INFORMATION

Methyl chloride is listed as an occupational carcinogen by NIOSH

Summary of Risks Inhalation of high concentrations of methyl chloride causes serious central nervous system (CNS) damage, lingering illness, and sometimes death Because methyl chloride has so little odor and [often a slowly progressive or] a mild narcotic action, a person may be exposed to considerable concentrations without being aware of the danger The onset of symptoms of poisoning such as dizziness headache, optical difficulties, nausea, and vomiting may be delayed for many hours (Genium ref 84, pp 49-62) "Severe exposures require hospitalization, monitoring, and treatment for acidosis Recovery may be prolonged and permanent neurologic impairment has been reported (Genium ref 100, p 354)

Medical Conditions Aggravated by Long-Term Exposure CNS disorders **Target Organs** CNS, liver, kidneys, eyes, and skin **Primary Entry** Inhalation, skin absorption/contact **Acute Effects** Neurologic effects like mental confusion, dizziness, staggering gait, slurred speech, and drowsiness **Chronic Effects** Anorexia, nervousness insomnia, incoordination, diminished vision, and emotional instability

FIRST AID

Eye Contact Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes **Skin Contact** Immediately wash the affected area with soap and water because of the increased hazard from absorption Carefully monitor the exposed skin area for frostbite damage (cryogenic injuries) and treat it accordingly **Inhalation** Remove victim to fresh air, restore and/or support his breathing as needed **Ingestion** This type of exposure to methyl chloride is extremely unlikely because it appears as a pressurized cryogenic (extremely low-temperature) liquid

GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES Seek prompt medical assistance for further treatment, observation, and support after first aid

SECTION 7 SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak Notify safety personnel, provide ventilation, and eliminate all ignition sources immediately Cleanup personnel need protection against contact and inhalation of vapor (see sect 8) Try to shut off the flow of methyl chloride gas

Waste Disposal Contact your supplier or a licensed contractor for detailed recommendations Follow Federal, state, and local regulations

OSHA Designations
Air Contaminant (29 CFR 1910 1000 Subpart Z)
EPA Designations (40 CFR 302 4)
RCRA Hazardous Waste, No U045
CERCLA Hazardous Substance, Reportable Quantity 1 lb (0 454 kg)

SECTION 8 SPECIAL PROTECTION INFORMATION

Goggles Always wear protective eyeglasses or chemical safety goggles Follow the eye and face protection guidelines of 29 CFR 1910 133 **Respirator** Use a NIOSH approved respirator per the *NIOSH Pocket Guide to Chemical Hazards* (Genium ref 88) for the maximum use concentrations and/or the exposure limits cited in section 2 Follow the respirator guidelines in 29 CFR 1910 134 For emergency or nonroutine use (e g , cleaning reactor vessels or storage tanks) use an SCBA with a full facepiece operated in the pressure demand or positive pressure mode **Other Equipment** Wear neoprene or polyvinyl alcohol impregnated gloves, boots, aprons and clean, impervious, body covering clothing to prevent any possibility of skin contact **Ventilation** Install and operate general and local maximum explosion-proof ventilation systems of sufficient power to control airborne levels of methyl chloride below the OSHA PELs cited in section 2 **Safety Stations** Make eyewash stations, washing facilities, and safety showers available in areas of use and handling **Contaminated Equipment** Contact lenses pose a special hazard, soft lenses may absorb irritants, and all lenses concentrate them Do *not* wear contact lenses in any work area Remove contaminated clothing and launder it before wearing it again, clean this material from shoes and equipment.

Comments Practice good personal hygiene, always wash thoroughly after using this material Avoid transferring it from hands to mouth while eating, drinking, or smoking Do *not* smoke, eat, or drink in any work area Avoid inhalation of vapor!

SECTION 9 SPECIAL PRECAUTIONS AND COMMENTS

Storage Segregation Store methyl chloride in a cool, dry, well-ventilated area away from oxidizing agents, ignition sources, and chemical incompatibilities (see sect 5) Outside or detached storage is advised for this highly flammable gas **Special Handling/ Storage** Methyl chloride is shipped or stored as a pressurized liquid in cylinders or tank cars Protect these containers against physical damage and regularly inspect them for leaks, cracks, or faulty valves All containers used in shipping/transferral operations must be electrically grounded to prevent static sparks **Engineering Controls** Preplan handling and emergency response procedures prior to use All engineering systems (ventilation, production, etc) must be of maximum explosion-proof design Methyl chloride must be used in closed engineering systems because of its flammability/explosivity hazards (see sect 4) This prevents dispersion of this highly flammable gas into work areas **Warning** Methyl chloride gas has extremely poor warning properties An automatic air-monitoring system is needed if this gas is used in large amounts because even highly toxic concentrations of this material will be colorless and odorless

Comments All operations with methyl chloride must be done carefully to prevent accidental ignition of this highly flammable liquid Do not smoke in any use or storage area! Follow recommended standard operating procedures for using liquefied cryogenic gases

Transportation Data (49 CFR 172 101-2)

DOT Shipping Name Methyl Chloride
DOT Hazard Class Flammable Gas
IMO Class 2 3
DOT ID No UN1063
IMO Label Poison Gas and Flammable Gas
DOT Label Flammable Gas

References 1 2, 12, 73, 84 94, 100, 103 PJI

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Approvals
Indust Hygiene/Safety
Medical Review M. L. Habicht

Material Safety Data Sheet

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GENIUM PUBLISHING CORP

No 303
METHYL ETHYL KETONE
(Revision C)

Issued September 1979
Revised March 1986

SECTION 1. MATERIAL IDENTIFICATION

20

MATERIAL NAME METHYL ETHYL KETONE

OTHER DESIGNATIONS MEK, Butanone, 2-Butanone, Ethyl Methyl Ketone, $CH_3COCH_2CH_3$, ASTM D740, CAS #0078-93-3

MANUFACTURER/SUPPLIER. Available from many suppliers, including:
Ashland Chemical Company, Industrial Chemicals & Solvents Div., PO Box 2219, Columbus, OH 43216, Telephone (614) 889-3844

HMIS
H 1
F 3
R 1
PPE*
*See sect. 8

SECTION 2. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Methyl Ethyl Ketone, (C_4H_8O)	ca 100	8-hr TWA 200 ppm* or 590 mg/m^3
		Human, Inhalation TCLo 100 ppm/5 min
• Current OSHA PEL and ACGIH (1985-86) TLV NIOSH (1978) proposed a 10-hr TWA of 200 ppm.		Rat, Oral, LD_{50} 2.7 g/kg
		Rabbit, Skin, LD_{50} 13 g/kg

SECTION 3. PHYSICAL DATA

Boiling Point, 1 atm 176 F (80 C)
Vapor Pressure @ 20°C .. 72
Vapor Density (Air = 1) .. 2.5
Viscosity @ 25°C, cp .. 0.40
Solubility in Water @ 20°C, wt. % 27.1

Specific Gravity (20/4°C) ... 0.805
Volatiles, vol. % ... ca 100
Evaporation Rate (BuAc = 1) .. 5.7
Freezing Point ... -122.8°F (-86°C)
Molecular Weight ... 72.12

Appearance and odor Colorless liquid with a moderately sharp, fragrant, mintlike odor. Unfatigued, odor recognition threshold (100% of test panel) is 6-10 ppm.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp	Flammability Limits In Air % by Vol.	LOWER	UPPER
20°F (-6.7°C) CC	960°F (516°C)		1.8	10.0

EXTINGUISHING MEDIA Dry chemical, carbon dioxide, alcohol foam, water spray. Use water spray to disperse vapors and to flush spills away from exposures. A stream of water can scatter flames. Water may be ineffective in extinguishing fire but should be used to help control fire and keep fire-exposed containers cool. Methyl ethyl ketone is a dangerous fire hazard and a moderate explosion hazard when exposed to heat or flame. Vapors can flow along surfaces to a distant ignition source and flash back.

Fire fighters should wear self-contained breathing apparatus in enclosed areas.

SECTION 5. REACTIVITY DATA

Methyl ethyl ketone is a stable material in closed containers at room temperature under normal storage and handling conditions. It does not polymerize.

This material is an OSHA Class IB Flammable Liquid. It is incompatible with oxidizing agents that can cause spontaneous ignition and violent reaction. Ignition is caused by reaction with potassium t-butoxide.

Thermal-oxidative degradation products can include carbon monoxide, carbon dioxide, and various hydrocarbons.

MEK can attack many plastics, resins, and rubber.

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SECTION 6. HEALTH HAZARD INFORMATION | TLV

Methyl ethyl ketone is not listed as a carcinogen by the NTP, IARC, or OSHA. Inhalation of methyl ethyl ketone vapors can irritate the eyes, nose, and respiratory tract. Exposure to high concentrations will produce headache, dizziness, and, in extreme cases, unconsciousness It can have a narcotic effect, however, its irritancy will often preclude exposure to narcotic concentrations Prolonged or repeated skin contact may cause drying, cracking, irritation, and dermatitis. Eye contact may cause irritation and burning sensations. Ingestion can irritate the digestive tract; ingestion of several ounces can cause narcosis and acidosis.**

FIRST AID SKIN CONTACT Wash area of contact with soap and water Remove contaminated clothing immediately EYE CONTACT Immediately wash with plenty of water, including under the eyelids. If irritation persists, get medical attention. INHALATION Remove victim to fresh air If required, restore breathing Keep warm and at rest. Get immediate medical attention! INGESTION If victim is conscious and medical help is not readily available, give him 3 glasses of water or milk to drink to induce vomiting Get medical help as soon as possible* with special attention to acidosis.**

* GET MEDICAL ASSISTANCE = In plant, paramedic, community Get medical help for further treatment, observation, and support after first aid, if indicated.

** P G Kopelman, "Severe Metabollic Acidosis After Ingestion of Butanone," *Brit Med J* 286 (1986).21

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety personnel and implement containment procedures. Remove all sources of heat or ignition Provide optimum (explosion-proof) ventilation.

Cleanup personnel should use protection against inhalation of vapors and contact with liquid. Use foam to control vapors. Contain spills using absorbent material (dry sand or vermiculite) Use nonsparking tools. Mix well and place in appropriate container for disposal Flush trace residues with much water Do not flush to sewers or open waterways

DISPOSAL Waste may be burned in an approved incinerator or disposed of by a licensed disposal firm. Follow Federal, state, and local regulations

EPA Hazardous Waste No U159 (40 CFR 261), the primary hazardous properties of MEK are ignitability and toxicity (40 CFR 261.33)

SECTION 8. SPECIAL PROTECTION INFORMATION

Provide general and local exhaust fume ventilation to met TLV requirements Exhaust hoods should have a minimum velocity of 100 lfm (linear feet per minute) Exhaust fans and other electrical services must be of explosion-proof construction.

For emergency and nonroutine work above the TLV an approved, full-facepiece, organic-vapor, canister gas mask is recommended, but for unknown concentrations or those above or about 3000 ppm, self-contained or air-supplied respirators (positive pressure) are needed

Use chemical safety goggles where liquid contact with the eyes is possible Do not use contact lenses when working with solvents, soft lenses may absorb irritants and all lenses concentrate them. Use impervious gloves Where splashing may occur, use a face shield, apron, and other protective clothing as needed to prevent skin contact. An eyewash station must be available near the workplace A safety shower is desirable when large amounts of this material are used. Methyl n-butyl ketone has caused neurotoxic effects, and studies have shown that MEK may trigger these effects (K Saida, et al, *J Neuropathology and Exp Neurology* 35 [May 1976] 207)

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Store in a clean, cool, well-ventilated area away from heat, ignition, and oxidizing agents Containers should be electrically interconnected and grounded for liquid transfers to prevent static sparks. Storage and use areas should be No Smoking areas Use nonsparking tools Small amounts should be handled in approved safety cans with proper labeling Emptied containers may retain hazardous product residues (vapor or liquid) Electrical services must meet code requirements

Avoid skin and eye contact. Avoid breathing vapors Do not ingest. Avoid contact with copper or copper-bearing materials Wash thoroughly after handling

DOT Classification Flammable Liquid ID No. UN1193 Label Flammable Liquid

Data Source(s) Code 1-9, 12, 14, 19-21, 23, 26, 27, 34, 38, 47, 82, 84 CK

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Approvals Joseph O Ricciardo, 11/86

Indust Hygiene/Safety DJW 10-86

Medical Review [signature] Oct 86

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GENIUM PUBLISHING CORP

No 304
METHYL ISOBUTYL KETONE
(Revision C)

Issued. September 1979
Revised March 1986

SECTION 1 MATERIAL IDENTIFICATION

20

MATERIAL NAME METHYL ISOBUTYL KETONE

OTHER DESIGNATIONS MIBK, Hexone, 4-Methyl-2-pentanone, Methyl i-Butyl Ketone, Isobutyl Methyl Ketone, $CH_3COCH_2CH(CH_3)_2$, ASTM D1153, CAS #0108-10-1

MANUFACTURER/SUPPLIER Available from many suppliers, including
JT Baker, 222 Red School Lane, Phillipsburgh, NJ 08865, Telephone (201) 859-2151

HMIS
H 1
F 3
R 0
PPE*
*See sect. 8

SECTION 2 INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Methyl Isobutyl Ketone ($C_6H_{12}O$)	ca 100	8-hr TWA 100 ppm* or 410 mg/m^3
• Current OSHA PEL ACGIH (1985 86) TLV is 50 ppm or 205 mg/m^3		Human, Inhalation, TCLo 200 ppm (Irritation)
		Rat, Oral, LD_{50} 2.08 g/kg
		Rat, Inhalation, LCLo 4000 ppm/15 mn.

SECTION 3. PHYSICAL DATA

Boiling Point, 1 atm 241 F (116°C)
Vapor Pressure @ 20 C, mm Hg 16
Vapor Density (Air = 1) 3.5
Solubility in Water @ 20°C, wt. % 1 91

Specific Gravity, 20/20°C ... 0 80
Volatiles, % ca 100
Evaporation Rate (BuAc = 1) .. 1.62
Melting Point ... -119°F (-84°C)
Molecular Weight 100 18

Appearance and odor Colorless, mobile liquid with a sharp, mintlike odor Unfatigued odor recognition threshold (100% test panel) is 0 3 to 0.5 ppm Distinct odor at 15 ppm.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp	Flammability Limits In Air	LOWER	UPPER
73°F (22 8°C) TCC	860°F (460°C)	% by Vol.	1 4	7.5

EXTINGUISHING MEDIA Dry chemical, carbon dioxide, or foam. Use water with caution. Use water spray to cool fire-exposed containers and surrounding combustibles. Use of a solid stream of water can scatter and spread flames to other areas. (This material is lighter than water and only slightly soluble in water)
Vapors are heavier than air and can flow along surfaces to distant ignition sources and flash back. Methyl isobutyl ketone is a flammable liquid that can form explosive mixtures with air when heated

Fire fighters should use self-contained breathing apparatus and fully protective clothing

SECTION 5 REACTIVITY DATA

Methyl isobutyl ketone is a stable material in closed containers at room temperature under normal storage and handling conditions It does not polymerize
This material is an OSHA class IC flammable liquid. It is incompatible with strong oxidizing agents that can cause spontaneous ignition and violent reaction It ignites on reaction with potassium t-butoxide.
It is a solvent capable of attacking some plastics, resins, and rubbers.
Products of thermal-oxidative degradation of this material can include carbon monoxide and carbon dioxide
Measurement of its flash point is needed to classify this borderline material as either a class IB or a class IC flammable liquid

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SECTION 6 HEALTH HAZARD INFORMATION | TLV

Methyl isobutyl ketone is not listed as a carcinogen by the NTP, IARC, or OSHA
This material can irritate the eyes, respiratory tract, and skin. Exposure to high concentrations of this material may cause nausea, headaches, dizziness, and unconsciousness. Skin contact may cause defatting and irritation. Eye contact is irritating Ingestion causes irritation and a burning sensation to the upper digestive tract. The material is a depressant of the central nervous system.

FIRST AID

EYE CONTACT Flush thoroughly with running water (including under eyelids) for 15 minutes
SKIN CONTACT Remove contaminated clothing Wash affected area with soap and water
INHALATION Remove to fresh air
INGESTION Get medical help!*

* GET MEDICAL ASSISTANCE = In plant, paramedic, community Seek medical assistance for further treatment, observation, and support, as indicated

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety personnel of major spills Provide optimum explosion-proof ventilation. Remove sources of ignition Provide cleanup personnel with protection against contact with liquid and inhalation of vapors.

Absorb small spills on paper and allow waste to evaporate in an exhaust hood Contain large spills and absorb waste on vermiculite Pick this up with a nonsparking scoop and place it in a closed metal container for disposal.

Spills can be flushed with water to remove material from a hazardous area, flush it to an open area or to the ground for evaporation. Prevent the discharge of waste into sewers, drains, and waterways

DISPOSAL Burn waste material in an approved incinerator Follow Federal, state, and local regulations

SECTION 8. SPECIAL PROTECTION INFORMATION

Provide general and exhaust ventilation to meet TLV requirements. Exhaust hoods should have a minimum face velocity of 100 lfm (linear feet per minute) Exhaust fans and other electrical services must be of explosion-proof construction.
For emergency and nonroutine work above the TLV, an approved, full-facepiece, organic-vapor, canister gas mask is recommended, but for unknown concentrations or those above about 3000 ppm, self-contained or air-supplied respirators (positive pressure) are needed Use safety goggles where liquid contact with the eyes is possible Do not wear contact lenses when working with solvents They pose a special hazard, soft lenses may absorb irritants and all lenses concentrate them. Wear impervious gloves Where splashing may occur, use a face shield, apron, and other protective clothing as needed to prevent skin contact.
• An eyewash station should be available near the workplace A safety shower is desirable when large amounts are used Medical surveillance of workers should include preplacement and (at least) annual examinations with attention to possible peripheral neuropathies (*Lancet*, no 8138 [August 18, 1979], p 363)

SECTION 9 SPECIAL PRECAUTIONS AND COMMENTS

Store in tightly closed drums or metal safety cans in a cool, well-ventilated storage area away from ignition sources and oxidizing agents Storage facility must be of the OSHA-approved type for class IC (or IB) liquids (see sect. 5) Prevent damage to containers
Ground and bond metal containers when dispensing Use only nonsparking tools near the solvent. No smoking in areas of storage or use
Avoid prolonged or repeated contact with skin Prevent eye contact.

DOT Classification Flammable Liquid DOT ID No. UN1245 Label Flammable Liquid

Data Source(s) Code 2 4 6 9 12, 14 19-21, 23, 26, 27 38, 47 82 84 CK

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Approvals JO Buroco, 11/86
Indust. Hygiene/Safety DJW 10-86
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Material Safety Data Sheet

from Genium's Reference Collection
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GENIUM PUBLISHING CORP

No 310
METHYLENE CHLORIDE
(Revision F)

Issued September 1985
Revised November 1988

SECTION 1. MATERIAL IDENTIFICATION

Material Name METHYLENE CHLORIDE

Description (Origin/Uses) Used widely in paint removers, as a solvent for plastics, as a degreasing agent, in propellant mixtures for aerosol sprays, and as a blowing agent in foams

Other Designations Dichloromethane, Freon 30®, Methane Dichloride, Methylene Bichloride, Methylene Dichloride, CH_2Cl_2, CAS No 0075-09-2

Manufacturer Contact your supplier or distributor Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref 73) for a list of suppliers

HMIS
H 2 R 1
F 1 I 3
R 0 S 3
PPG* K 1
*See sect. 8

NFPA
1
2 0
-

SECTION 2. INGREDIENTS AND HAZARDS/EXPOSURE LIMITS

Methylene Chloride, ca 100%

OSHA PEL
8-Hour TWA 500 ppm
Ceiling 1000 ppm Acceptable Maximum Peak above the Ceiling 2000 ppm for 5 Minutes in Any 2-Hour Period

ACGIH TLV, 1988-89
TLV-TWA 50 ppm, 175 mg/m³
(Adopted 1988-89)

Toxicity Data*
Rat, Oral, LD_{50} 2136 mg/kg
Human, Inhalation, TC_{Lo} 500 ppm (8 Hours)

*See NIOSH, *RTECS* (PA8050000), for additional data with references to irritative, reproductive, mutagenic, and tumorigenic effects

SECTION 3 PHYSICAL DATA

Boiling Point 103.55 F (39 75 C) at 76 Torrs
Melting Point -142°F (-96 7°C)
Vapor Density (Air = 1) 2 9
Vapor Pressure 440 Torrs at 77°F (25°C)
Molecular Weight 84 94 Grams/Mole
Solubility in Water (%) 1% by Weight
Specific Gravity (H_2O = 1). 1 3255 at 68°F (20°C)
% Volatile by Volume Ca 100

Appearance and Odor A clear, colorless, volatile liquid, distinctive, penetrating, ethereal odor The odor will not serve as a useful warning property because concentrations of 100 ppm are not easily perceptible Most persons can detect this odor at above 300 ppm.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point*	Autoignition Temperature 1033°F (556°C)	LEL 12% v/v	UEL 19% v/v

Extinguishing Media *Methylene chloride is not flammable under ordinary conditions However, flammable vapor-air mixtures can form at approximately 212°F (100°C) Use water spray to cool fire-exposed containers and to flush spills away from exposures Use extinguishing agents that will put out the surrounding fire **Unusual Fire or Explosion Hazards.** Methylene chloride vapor is heavier than air and may collect and concentrate in low-lying, confined spaces The high vapor pressure of methylene chloride means that when it is spilled, its vapor concentration in air can increase rapidly If this vapor is heated, an explosion hazard is associated with the vapor-air mixture Containers of this material may rupture violently if they are involved in fires **Special Fire-fighting Procedures:** Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode

SECTION 5. REACTIVITY DATA

Stability/Polymerization Methylene chloride is stable in closed containers during routine operations. Hazardous polymerization cannot occur **Chemical Incompatibilities** Methylene chloride can react dangerously with nitrogen tetroxide, liquid oxygen, potassium, sodium, sodium-potassium alloys, lithium, potassium hydroxide with N-methyl-N-nitroso urea, potassium *t*-butoxide, and finely powdered aluminum and magnesium **Conditions to Avoid.** Avoid all exposure to sources of ignition, heat, and incompatible chemicals Prolonged exposure to water may cause hydrolysis to highly corrosive hydrochloric acid when the temperature is above 140°F (60°C) In oxygen-enriched atmospheres or when heated (>212°F [100°C]), methylene chloride vapor can be readily ignited **Hazardous Products of Decomposition** Exposure to high temperature (from open flame, hot surfaces, uninsulated steam lines, welding arcs, etc) can produce toxic and corrosive thermal-oxidative products of decomposition such as hydrogen chloride, carbon monoxide, and even small quantities of phosgene gas, which is extremely poisonous

SECTION 6. HEALTH HAZARD INFORMATION

Carcinogenicity Methylene chloride is listed as a suspected human carcinogen by the ACGIH (which classifies it as a group A2 carcinogen) **Summary of Risks** Accidental contact of liquid methylene chloride with skin or eyes causes painful irritation and possible burns if not promptly removed Exposure by way of contaminated gloves, clothing, or paint remover formulations can produce these same irritant effects Long-term exposure to mild or moderate doses of methylene chloride may cause a delayed (24 to 48 hours) onset of dizziness, headache, mental confusion, slurred speech, double vision, and sleeplessness Medical recovery can be slow Overexposure to methylene chloride can cause elevated levels of carboxy hemoglobin in the blood (this same effect results from overexposure to carbon monoxide) **Medical Conditions Aggravated by Long-Term Exposure** None reported **Target Organs.** Skin, eyes, respiratory system, CNS, liver, kidneys, and blood **Primary Entry** Inhalation, skin contact/absorption **Acute Effects:** Headache, giddiness, stupor, irritability, fatigue, tingling in the limbs, and narcosis that is not usually fatal if the exposure is terminated before anesthetic death occurs **Chronic Effects** The ACGIH classification of this material as a suspected human carcinogen implies that cancer is a possible effect of chronic exposure to methylene chloride **FIRST AID** **Eyes.** Immediately flush eyes, including under the eyelids, gently but thoroughly with

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SECTION 6. HEALTH HAZARD INFORMATION, cont.

flooding amounts of running water for at least 15 minutes Skin Rinse the affected area with flooding amounts of water and then wash it with soap and water **Inhalation** Remove the exposed person to fresh air, restore and/or support his or her breathing as needed Have qualified medical personnel administer oxygen as required **Note to Attending Physician** Do not administer adrenalin. **Ingestion** Unlikely Should this type of exposure occur, do not induce vomiting because of the danger of aspiration. If spontaneous vomiting should occur, position the exposed person's head below his or her trunk to resist aspiration **Get medical help (in plant, paramedic, community) for all exposures.** Seek prompt medical assistance for further treatment, observation, and support after first aid **Note to Physician**· Absorbed methylene chloride is stored in body fat and metabolizes to carbon monoxide This produced carbon monoxide increases and sustains carboxyhemoglobin levels in the blood, which concommitantly reduces the oxygen-carrying capacity of the blood. NIOSH advises preplacement and annual medical exams that emphasize liver, kidney, eye, skin, CNS, and respiratory system functions and a complete blood count. Simultaneous exposure to tobacco smoke, alcohol, and carbon monoxide, along with heavy manual labor, increases the body burden of a worker as well as the toxic hazards of the methylene chloride In significant exposures, serum methylene chloride levels are of no clinical importance. Neurologic and hepatic status as well as carboxy hemoglobin should be monitored.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak. Notify safety personnel, evacuate unnecessary personnel, eliminate all sources of ignition immediately, and provide adequate explosion-proof ventilation Cleanup personnel need protection against this liquid's contact with the skin or eyes as well as inhalation of its vapor Contain large spills and collect waste or absorb it with an inert material such as sand, earth, or vermiculite Use nonsparking tools to place waste liquid or absorbent into closable containers for disposal Keep waste out of sewers, watersheds, and waterways **Waste Disposal**· Contact your supplier or a licensed contractor for detailed recommendations Follow Federal, state, and local regulations

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910 1000 Subpart Z)
EPA Designations (40 CFR 302.4)
RCRA Hazardous Waste, NO U080
CERCLA Hazardous Substance, Reportable Quantity· 1000 lbs (454 kg), per the Clean Water Act (CWA), § 307 (a), and the Resource Conservation and Recovery Act (RCRA), § 3001

SECTION 8 SPECIAL PROTECTION INFORMATION

Goggles. Always wear protective eyeglasses or chemical safety goggles Where splashing is possible, wear a full face shield Follow OSHA eye- and face-protection regulations (29 CFR 1910 133) **Respirator**· Use a NIOSH-approved respirator per Genium reference 88 for the maximum-use concentrations and/or exposure limits cited in section 2 Follow OSHA respirator regulations (29 CFR 1910 134) For emergency or nonroutine operations (spills or cleaning reactor vessels and storage tanks), wear an SCBA **Warning**· Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres **Other**· Wear impervious neoprene, PVA, or Viton gloves, boots, aprons, and gauntlets, etc , to prevent any skin contact with liquid methylene chloride. **Ventilation:** Install and operate general and local maximum, explosion-proof ventilation systems powerful enough to maintain airborne levels of acetone below the exposure limits cited in section 2 Local exhaust ventilation is preferred because it prevents dispersion of the contaminant into the general work area by eliminating it at its source Consult the latest edition of Genium reference 103 for detailed recommendations Floor or sump ventilation may be necessary **Safety Stations** Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work areas **Contaminated Equipment** Contact lenses pose a special hazard, soft lenses may absorb irritants, and all lenses concentrate them. Do *not* wear contact lenses in any work area Remove contaminated clothing and launder it before wearing it again, clean this material from shoes and equipment **Other**· Because the health effects of carbon monoxide and methylene chloride are additive (see sect. 6), workplaces should be equipped with automatic sensing equipment that identifies workroom atmospheric levels of both of these materials **Comments** Practice good personal hygiene, always wash thoroughly after using this material and before eating, drinking, smoking, using the toilet, or applying cosmetics Keep it off your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking Do *not* eat, drink, or smoke in any work area Do not inhale methylene chloride vapor

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation Store methylene chloride in closed, moisture-proof containers in a cool, dry, well-ventilated area away from sources of ignition, strong oxidizers, caustics, and incompatible chemicals (see sect. 5) Protect containers from physical damage **Special Handling/Storage** Prevent moist air from entering storage containers Provide ventilation at the floor level in storage areas because methylene chloride vapor is denser than air Installation of a dryer and a safety seal on each tank is recommended Aluminum is not recommended for use as a storage material, appropriate storage materials include galvanized iron, black iron, or steel **Engineering Controls** Make sure all engineering systems (production, transportation) are of maximum explosion-proof design Electrically ground and bond all containers and pipelines used in shipping, transferring, reacting, production, and sampling operations to prevent generating static sparks

Transportation Data (49 CFR 172 101-2)
DOT Shipping Name Dichloromethane *or* Methylene Chloride
DOT Hazard Class ORM-A
ID No UN1593
DOT Packaging Requirements 49 CFR 173 605
DOT Packaging Exceptions 49 CFR 173.505

IMO Shipping Name Dichloromethane
IMO Hazard Class 6 1
IMO Label Saint Andrew's Cross (X)*
IMDG Packaging Group III

*Harmful-Stow away from Foodstuffs

References 1, 26, 38, 84-94, 100, 116, 117, 120, 122

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GENIUM PUBLISHING CORP

No 311

METHYL CHLOROFORM
(Revision E)
Issued November 1975
Revised November 1988

SECTION 1. MATERIAL IDENTIFICATION

Material Name METHYL CHLOROFORM

Description (Origin/Uses) Used in cold-type metal cleaning, also in cleaning plastic molds

Other Designations 1,1,1-Trichloroethane, CH_3CCl_3, CAS No 0071-55-6

Manufacturer Contact your supplier or distributor Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref 73) for a list of suppliers

HMIS
H 2 R 1
F 0 I –
R 1 S 2
PPG* K 1
*See sect. 8

NFPA

SECTION 2. INGREDIENTS AND HAZARDS/EXPOSURE LIMITS

Methyl Chloroform, CAS No 0071-55-6

OSHA PELs
8-Hr TWA 350 ppm, 1900 mg/m³
STEL 450 ppm, 2450 mg/m³

ACGIH TLVs, 1988-89
TLV-TWA 350 ppm, 1900 mg/m³
TLV-STEL 450 ppm, 2450 mg/m³

Toxicity Data**
Man, Inhalation, LC_{Lo} 27 g/m³ (10 Mins)
Man, Inhalation, TC_{Lo} 350 ppm
Human, Oral, TD_{Lo} 670 mg/kg
Rat, Oral, LD_{50} 10300 mg/kg

*Contact your supplier for specifications, including details about inhibitors that can be added to the methyl chloroform product.
**See NIOSH, *RTECS* (KJ2975000), for additional data with references to irritative, reproductive, and mutagenic effects.

SECTION 3. PHYSICAL DATA

Boiling Point. 165°F (74 1°C)
Melting Point -26.5°F (-32.5°C)
Vapor Density (Air = 1) 4.55
Vapor Pressure 100 Torrs at 68°F (20°C)
Molecular Weight. 133 Grams/Mole
Solubility in Water (%) Insoluble
Specific Gravity (H_2O = 1): 1.3376 at 68°F (20°C)
% Volatile by Volume· Ca 100

arance and Odor· A colorless liquid, mild, sweetish, pleasant, etherlike odor that may be just perceptible (if unfatigued) at about 100 n the air

Comments Small variations in the above-noted physical properties are expected because of the various inhibitors that may be included in the methyl chloroform product.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point None Found	Autoignition Temperature 998°F (537°C)	LEL 8 0% v/v	UEL 10 5% v/v

Extinguishing Media Methyl chloroform does not burn at ordinary temperatures High-energy sources such as an electric arc or an elevated temperature are required for ignition of this material. When the source of ignition is removed, methyl chloroform tends to stop burning Use water spray to cool fire-exposed containers Use water fog, carbon dioxide, dry chemical, or foam to fight fires involving this material or nearby fires **Unusual Fire or Explosion Hazards.** Methyl chloroform vapor is heavier than air and may travel a considerable distance to a low-lying high-energy source of ignition and flash back to its origin. Use care in selecting equipment (see sect. 5, Comments) **Special Fire-fighting Procedures.** Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode

SECTION 5. REACTIVITY DATA

Stability/Polymerization Methyl chloroform is stable in closed containers during routine operations. Hazardous polymerization cannot occur **Chemical Incompatibilities** Methyl chloroform can react dangerously with acetone, nitrogen tetroxide, oxygen (gas or liquid), sodium, sodium hydroxide, and sodium-potassium alloys **Conditions to Avoid.** Avoid exposure to any high-energy source of ignition or to incompatible chemicals **Hazardous Products of Decomposition:** Toxic and corrosive gases such as hydrogen chloride, dichloracetylene, chlorine, and phosgene can be produced by decomposition of methyl chloroform at high temperatures, contact with hot metals, or exposure to ultraviolet radiation Phosgene is usually produced in very small quantities, however, the significant irritating properties of hydrogen chloride (the dominant product of decomposition) prevent significant exposure to the phosgene **Comments:** This material can be hydrolyzed by water to form hydrochloric acid and acetic acid It will react with strong caustics to form flammable or explosive materials It attacks natural rubber Methyl chloroform requires an inhibitor content to prevent corrosion of metals When the inhibitor is depleted, this material can decompose rapidly by reaction with finely divided white metals such as aluminum, magnesium, or zinc Do not use these metals in pressurized spraying equipment where methyl chloroform is involved

CTION 6. HEALTH HAZARD INFORMATION

Carcinogenicity Methyl chloroform is not listed as a carcinogen by the NTP, IARC, or OSHA
Summary of Risks Methyl chloroform exhibits low oral toxicity It can defat the exposed skin of workers and cause redness and scaling Although methyl chloroform is low in systemic toxicity, it is an anesthetic that is capable of causing death if it is inhaled at concentrations of 14000 to 15000 ppm. Fatalities that have occurred in poorly ventilated areas such as pits or tanks are attributed to anesthesia and/or sensitization of the myocardium to epinephrine Quick and complete recovery is reported upon prompt removal of unconscious exposed persons from the area of exposure The TLV-TWA cited in section 2 is set to prevent initial anesthetic effects and/or objections to the

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SECTION 6. HEALTH HAZARD INFORMATION, cont.

odor Medical Conditions Aggravated by Long Term Exposure None reported Target Organs Skin, eyes, heart, cardiovascular system, and CNS Primary Entry Inhalation, skin absorption Acute Effects Headache, lassitude, dermatitis, skin and eye irritation, cardiac arrhythmias, and depression of the CNS Chronic Effects None reported. FIRST AID Eyes. Immediately flush eyes, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 minutes. Skin. Rinse the affected area with flooding amounts of water, then wash it with soap and water Inhalation. Remove the exposed person to fresh air; restore and/or support his or her breathing as needed Have qualified medical personnel administer oxygen as required. Ingestion. Unlikely Should this type of exposure occur, medical help is not readily available, and the amount swallowed was appreciable, give the exposed person milk of magnesia to drink and induce vomiting Repeat this procedure Aspiration hazards exist, so the decision whether or not to induce vomiting must be made carefully If vomiting is to be induced, carry it out as quickly as possible before the ingested methyl chloroform is internally absorbed This procedure would increase the chance of aspiration. Get medical help (in plant, paramedic, community) for all exposures. Seek prompt medical assistance for further treatment, observation, and support after first aid Note to Physician The estimated lethal dose by ingestion for a man weighing 150 pounds is 0.5 to 1 pint. Do not use adrenalin or sympathomimetic amines in treatment because of the increased cardiac sensitivity involved Ingestion may cause spontaneous vomiting.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak. Notify safety personnel, evacuate unnecessary personnel, eliminate all sources of ignition immediately, and provide adequate explosion-proof ventilation Cleanup personnel need protection against skin or eye contact with this liquid as well as inhalation of its vapor (see sect. 8) Contain large spills and collect or absorb waste with an inert material such as sand, earth, or vermiculite Use nonsparking tools to place liquid or absorbent waste into closable containers for disposal. Keep waste out of sewers, watersheds, and waterways Waste Disposal Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910 1000 Subpart Z)
EPA Designations (40 CFR 302.4)
RCRA Hazardous Waste, No U226
CERCLA Hazardous Substance, Reportable Quantity· 1000 lbs (454 kg), per the Resource Conservation and Recovery Act, § 3001

SECTION 8 SPECIAL PROTECTION INFORMATION

Goggles Always wear protective eyeglasses or chemical safety goggles Where splashing is possible, wear a full face shield Follow OSHA eye- and face-protection regulations (29 CFR 1910 133) Respirator· Use a NIOSH-approved respirator per Genium reference 88 for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow OSHA respirator regulations (29 CFR 1910 134) For emergency or nonroutine operations (spills or cleaning reactor vessels and storage tanks), wear an SCBA Warning Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres. Other: Wear impervious gloves, boots, aprons, and gauntlets, etc., to prevent prolonged or repeated skin contact with this material. Suggested materials include neoprene, polyvinyl alcohol, or polyethylene Natural rubber is not recommended Ventilation Install and operate general and local maximum, explosion-proof ventilation systems powerful enough to maintain airborne levels of this material below the OSHA PEL standard cited in section 2. Local exhaust ventilation is preferred because it prevents dispersion of the contaminant into the general work area by eliminating it at its source Consult the latest edition of Genium reference 103 for detailed recommendations Safety Stations Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work areas Contaminated Equipment Contact lenses pose a special hazard, soft lenses may absorb irritants and all lenses concentrate them. Do *not* wear contact lenses in any work area Remove contaminated clothing and launder it before wearing it again, clean this material from your shoes and equipment. Other· Exercise care in the selection of safety and handling equipment because methyl chloroform attacks natural rubber Comments. Practice good personal hygiene, always wash thoroughly after using this material Keep it off your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking Do *not* eat, drink, or smoke in any work area. Do not inhale methyl chloroform vapor Consider functions of the CVS, CNS, liver, and skin while administering preplacement and periodic medical exams

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation Store methyl chloroform in closed containers in a cool, dry, well-ventilated area away from sources of ignition and incompatible chemicals (see sect. 5) Protect containers from physical damage Steel is a recommended material for storage containers Special Handling/Storage· Prevent moisture contamination of storage facilities Monitor levels of inhibitor Use caution in cleaning operations involving white metal fines (see sect. 5) Engineering Controls Make sure all engineering systems (production, transportation) are of maximum, explosion-proof design Electrically ground and bond all containers and pipelines, etc., used in shipping, transferring, reacting production, and sampling operations to prevent generating static sparks Other Personnel who regularly work with methyl chloroform should avoid drinking alcoholic beverages shortly before, during, or after exposure

Transportation Data (49 CFR 172.101-2)

DOT Shipping Name 1,1,1-Trichloroethane
DOT Hazard Class. ORM-A
ID No UN2831
DOT Packaging Requirements 49 CFR 173 605
DOT Packaging Exceptions 49 CFR 173 605

IMO Shipping Name 1,1,1-Trichloromethane
IMO Hazard Class. 6 1
IMO Label Saint Andrew s Cross (X)*
IMDG Packaging Group III

*Harmful Stow away from Foodstuffs (Materials of Class 6 1 Packaging Group III)

References 1, 38, 84-94, 116, 117, 120, 122

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GENIUM PUBLISHING CORP

No 84
MOLYBDENUM METAL/
POWDER
(Revision A)
Issued March 1981
Revised April 1988

SECTION 1. MATERIAL IDENTIFICATION

25

Material Name MOLYBDENUM METAL/POWDER

Description (Origin/Uses) Used to make specialty steels and nonferrous alloys, used in spark plugs and also as a lubricant additive

Other Designations Mo, NIOSH *RTECS* No QA4680000, CAS No 7439-98-7

Manufacturer Contact your supplier or distributor Consult the latest edition of the *Chemicalweek Buyers Guide* (Genium ref 73) for a list of suppliers

Comments The hazards of working with Molybdenum are associated with cutting, grinding, welding, etc., that produce dust, fumes, powders, and gases

HMIS		Not Found
H	1	
F	1	R 1
R	0	I 2
PPG*		S 1
*See sect. 8		K

SECTION 2. INGREDIENTS AND HAZARDS

	%	EXPOSURE LIMITS
Molybdenum Metal/Powder, CAS No 7439-98-7	Ca 100	**OSHA PEL** 8 Hr TWA * 5 mg/m³ 8 Hr TWA ** 15 mg/m³ **ACGIH TLVs, 1987-88** TLV-TWA * 5 mg/m³ TLV-TWA ** 10 mg/m³ **Toxicity Data***** Rat, Intraperitoneal, LD_{L_0} 114 mg/kg

*Exposure limit defined for soluble molybdenum compounds as Mo
**Exposure limit defined for insoluble molybdenum compounds as Mo
***See NIOSH, *RTECS*, for additional data with references to reproductive and mutagenic effects
Note All exposure levels are defined for dust or fume

SECTION 3. PHYSICAL DATA

Boiling Point 10040°F (5560°C)
Melting Point 4730°F (2610°C)
Specific Gravity (H_2O = 1) 10.28 at 68°F (20 C)
Water Solubility (%)· Insoluble
Molecular Weight: 96 Grams/Mole

Appearance and Odor A silver white metal or dark gray/black powder; odor not found

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air % by Volume	LOWER	UPPER
•	•		•	•

Extinguishing Media· *Use dry chemical, "alcohol" foam, carbon dioxide, or water spray to put out molybdenum fires. Contact your supplier for further recommendations

Unusual Fire or Explosion Hazards Molybdenum dust particles suspended in the air can explode. If a molybdenum dust cloud forms, immediately eliminate all possible sources of ignition such as sparks, open flame, etc., and spray the affected area with a water mist or fog When powdered molybdenum is exposed to heat or sources of ignition, it is a weak fire and explosion hazard, the solid metallic form of molybdenum is less reactive Working with this material can produce heat and sparks, which can ignite flammable materials and vapors in the workpalce.

Special Fire-fighting Procedures. Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode

SECTION 5. REACTIVITY DATA

Molybdenum metal/powder is stable in closed containers at room temperature under normal storage and handling conditions. It does not undergo hazardous polymerization

Chemical Incompatibilities Hazardous reactions are reported for molybdenum and bromine trifluoride, chlorine trifluoride, fluorine, and lead dioxide

Conditions to Avoid Do not expose powdered molybdenum to sources of ignition, prevent dust clouds from forming

Hazardous Products of Decomposition. During fires molybdenum can form oxides such as molybdenum trioxide (MoO_3), which is irritating to the eyes, nose, and throat.

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SECTION 6. HEALTH HAZARD INFORMATION

Molybdenum metal/powder is not listed as a carcinogen by the NTP, IARC, or OSHA

Summary of Risks Limited data suggest that molybdenum compounds have a relatively low order of toxicity The metal itself (Mo), the ore molybdenite, and the dioxide (MoO_2) are less toxic than the more active and soluble molybdenum compounds such as ammonium molybdate and the trioxide (MoO_3) Molybdenum itself is a necessary trace element in humans that is closely associated with copper; excessive intake of molybdenum may cause a copper deficiency

Medical Conditions Aggravated by Long-Term Exposure. None reported. **Target Organs.** None reported

Primary Entry Skin contact, inhalation **Acute Effects:** Mild, transient irritation of eyes, nose, and throat, elevated serum uric acid levels have been reported **Chronic Effects.** None reported.

FIRST AID

Eyes Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes

Skin Wash the affected area with soap and water

Inhalation Remove the exposed person to fresh air; restore and/or support his or her breathing as needed.

Ingestion Never give anything by mouth to someone who is unconscious or convulsing Give the exposed person 1 to 2 glasses of water, then induce vomiting.

GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES. Seek prompt medical assistance for further treatment, observation, and support after first aid.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak Notify safety personnel, evacuate all nonessential personnel, and provide adequate ventilation. Cleanup personnel need protection against contact with and inhalation of dust (see sect. 8) Scoop up spilled molybdenum into suitable containers for disposal Carefully sweep or vacuum up small spills or residues without creating dust.

Waste Disposal Contact your supplier or a licensed contractor for detailed recommendations Consider recycling Follow Federal, state, and local regulations

OSHA Designations

Air Contaminant (29 CFR 1910 1000 Subpart Z, for soluble and insoluble compounds as Mo)

EPA Designations (40 CFR 302 4)

RCRA Hazardous Waste Not Listed

CERCLA Hazardous Substance Not Listed

SECTION 8 SPECIAL PROTECTION INFORMATION

Goggles Always wear protective eyeglasses or chemical safety goggles Follow the eye- and face-protection guidelines in 29 CFR 1910 133 **Respirator** Consult the *NIOSH Pocket Guide to Chemical Hazards* for general recommendations on respirators. Follow the respirator guidelines in 29 CFR 1910 134 For emergency or nonroutine use (e.g , cleaning reactor vessels or storage tanks), wear an SCBA with a full facepiece operated in the pressure-demand or positive-pressure mode **Warning** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres

Other Wear impervious gloves, boots, and aprons, etc., as required by the work environment to prevent prolonged or repeated skin contact. Barrier creams may be useful to limit the effects of skin contact. **Ventilation** Install and operate general and local ventilation systems powerful enough to maintain airborne levels of molybdenum below the OSHA PEL standard cited in section 2

Safety Stations Make eyewash stations, washing facilities, and safety showers available in use and handling areas

Contaminated Equipment Contact lenses pose a special hazard, soft lenses may absorb irritants and all lenses concentrate them. Particles can adhere to contact lenses and cause corneal damage Do *not* wear contact lenses in any work area.

Comments Practice good personal hygiene, always wash thoroughly after using this material. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking Do *not* eat, drink, or smoke in any work are i. Do not inhale molybdenum dust.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation Store molybdenum metal/powder in a cool, dry, well-ventilated area in closed containers away from sources of ignition and incompatible chemicals (see sect. 5)

Special Handling/Storage Practice good housekeeping techniques to minimize accumulation of dust, cleaning procedures should not create dusty conditions

Transportation Data (49 CFR 172 101-2) Not Listed

References 1, 2 12, 73, 84-94, 100, 103

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Medical Review MJ Hardies, MD

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Occupational Health Guideline for Nickel Metal and Soluble Nickel Compounds

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information It does not attempt to present all data, rather, it presents pertinent information and data in summary form

APPLICABILITY

The general guidelines contained in this document apply to all soluble nickel compounds Physical and chemical properties of several specific compounds are provided for illustrative purposes

SUBSTANCE IDENTIFICATION

Nickel, metallic

- Formula Ni
- Synonyms Nickel catalyst, Raney nickel
- Appearance and odor Silvery gray, metallic (or darker), odorless powder

Nickel nitrate hexahydrate

- Formula $Ni(NO_3)_2 \cdot {}_6H_2O$
- Synonyms None
- Appearance and odor Green, odorless solid

Nickel sulfate hexahydrate

- Formula $NiSO_4 \cdot {}_6H_2O$
- Synonyms None
- Appearance and odor Green odorless solid

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for nickel metal and soluble nickel compounds is 1 milligram of nickel metal and soluble nickel compounds per cubic meter of air (mg/m^3) averaged over an eight-hour work shift NIOSH has recommended that the permissible exposure limit for nickel be reduced to 0 015 mg/m^3 averaged over a work shift of up to 10 hours per day, 40 hours per week, and that nickel be regulated as an occupational carcinogen The NIOSH Criteria Document for Inorganic Nickel and the Special Occupational Hazard Review for Nickel Carbonyl should be consulted for more detailed information

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Metallic nickel or soluble nickel compounds can affect the body if they are inhaled or if they come in contact with the eyes or skin They can also affect the body if they are swallowed

- **Effects of overexposure**

Nickel fumes are respiratory irritants and may cause pneumonitis Skin contact may cause an allergic skin rash Nickel and its compounds have been reported to cause cancer of the lungs and sinuses Nickel itself is not very toxic if swallowed, but its soluble salts are quite toxic and, if swallowed, may cause giddiness and nausea Exposure to nickel carbonyl (by inhalation or skin absorption) may cause both initial and delayed symptoms Initial symptoms include headache, dizziness, shortness of breath, and vomiting These symptoms generally disappear when the worker is exposed to fresh air The delayed symptoms may develop 12 to 36 hours after exposure The shortness of breath returns, a blue color of the skin may appear, and a fever may develop The exposed person may become delirious In some cases the symptoms may run together Death may occur

- **Reporting signs and symptoms**

A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to nickel metal and soluble nickel compounds

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These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations

U S DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U S DEPARTMENT OF LABOR
Occupational Safety and Health Administration

Contact with sulfur may cause evolution of heat Contact of nickel nitrate with wood and other combustibles may cause fire

3 Hazardous decomposition products Toxic gases and vapors (such as nickel carbonyl and oxides of nitrogen) may be released in a fire involving nickel or in the decompostion of nickel compounds

4 Special precautions None

• **Flammability**

1 Flash point Not applicable

2 Minimum ignition temperature Not available

3 Minimum explosive concentration Not available, but nickel sponge catalyst may ignite spontaneously in air

4 Extinguishant Dry powder, dry sand, dry dolomite, dry graphite

• **Warning properties**

Grant states that "workers employed in nickel plating involving nickel sulfate, sulfuric acid, and chlorine are said to have developed conjunctivitis and epiphora when ventilation was poor " Since, according to Grant, "both sulfuric acid mist and chlorine gas are known to cause burning and stinging of the eyes," and since the AIHA *Hygienic Guide* states that eye contact "does not present any problem peculiar to nickel," nickel metal and soluble compounds are not treated as eye irritants

MONITORING AND MEASUREMENT PROCEDURES

• **General**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee)

• **Method**

Sampling and analyses may be performed by collection on a cellulose membrane filter followed by treatment with nitric and perchloric acids, solution in nitric acid, and analysis with an atomic absorption spectrophotometer An analytical method for nickel metal and soluble nickel compounds is in the *NIOSH Manual of Analytical Methods* 2nd Ed , Vol 5, 1979, available from the Government Printing Office, Washington, D C 20402 (GPO No 017-033-00349-1) number PB 258 433)

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level However, there are some exceptions where respirators may be used to control exposure Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation

PERSONAL PROTECTIVE EQUIPMENT

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with powdered metallic nickel or solids or liquids containing soluble nickel compounds

• If employees' clothing may have become contaminated with powdered metallic nickel or solid soluble nickel compounds, employees should change into uncontaminated clothing before leaving the work premises

• Clothing contaminated with metallic nickel or soluble nickel compounds should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of metallic nickel or soluble nickel compounds from the clothing If the clothing is to be laundered or otherwise cleaned to remove the metallic nickel or soluble nickel compounds, the person performing the operation should be informed of these substances's hazardous properties

• Non-impervious clothing which becomes contaminated with metallic nickel or soluble nickel compounds should be removed promptly and not reworn until the metallic nickel or soluble nickel compounds are removed from the clothing

SANITATION

• Skin that becomes contaminated with metallic nickel or soluble nickel compounds should be promptly washed or showered with soap or mild detergent and water to remove any metallic nickel or soluble nickel compounds

• Eating and smoking should not be permitted in areas where solids or liquids containing soluble nickel compounds are handled, processed, or stored

• Employees who handle powdered metallic nickel or solids or liquids containing soluble nickel compounds should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities

• Areas in which exposure to nickel metal and soluble nickel compounds may occur should be identified by

2 Collect spilled material in the most convenient and safe manner for reclamation or for disposal in a secured sanitary landfill Liquid containing nickel should be absorbed in vermiculite, dry sand, earth, or a similar material

• Waste disposal method

Nickel metal and soluble nickel compounds may be disposed of in sealed containers in a secured sanitary landfill

REFERENCES

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• Patty, F A (ed) *Toxicology*, Vol II of *Industrial Hygiene and Toxicology* (2nd ed rev), Interscience, New York, 1963

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* SPECIAL NOTE

Nickel metal and soluble nickel compounds appear on the OSHA "Candidate List" of chemicals being considered for further scientific review regarding their carcinogenicity (*Federal Register*, Vol 45, No 157, pp 5372-5379, 12 August 1980)

The International Agency for Research on Cancer (IARC) has evaluated the data on these chemicals and has concluded that they cause cancer See *IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man*, Volume 11, 1976

RESPIRATORY PROTECTION FOR NICKEL METAL AND SOLUBLE COMPOUNDS

Condition	Minimum Respiratory Protection* Required Above 1 mg/m³
Dust, Mist, or Fume Concentration	
10 mg/m³ or less	Any fume respirator or high efficiency particulate respirator Any supplied-air respirator Any self-contained breathing apparatus
50 mg/m³ or less	A high efficiency particulate filter respirator with a full facepiece Any supplied-air respirator with a full facepiece, helmet, or hood Any self-contained breathing apparatus with a full facepiece
1000 mg/m³ or less	A powered air-purifying respirator with a high efficiency particulate filter A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode
2000 mg/m³ or less	A Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode
Greater than 2000 mg/m³ or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode

*Only NIOSH-approved or MSHA-approved equipment should be used

MATERIAL SAFETY DATA SHEET

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MSDS # 560
o-CRESOL

Issued November 1985
Revised

From Genium s MSDS Collection, to be used as a reference

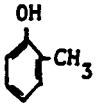
SECTION 1 MATERIAL IDENTIFICATION

18

MATERIAL NAME o-CRESOL
OTHER DESIGNATIONS 2-Methylphenol, o-Cresylic Acid, o-Hydroxytoluene, o-Methylphenol, o-Oxytoluene, C_7H_8O, CAS # 0095 48 7
MANUFACTURER/SUPPLIER Available from several sources, including
Koppers Company, Organic Materials Group
Koppers Building
Pittsburgh, PA 15219 (412) 227-2000

SECTION 2 INGREDIENTS AND HAZARDS

	%	HAZARD DATA
O-CRESOL	99 2	8-Hr TWA 5 ppm, 22 mg/m³*
Phenol	0 3	Rat, oral LD50 121 mg/kg
2,6-Xylenol	0 5	Rat, skin LD50 1100 mg/kg
		Rabbit, skin 524 mg/24 hrs Severely irritating
		Rabbit, eye 105 mg/kg Severely irritating



* Current ACGIH TLV and OSHA PEL
o-Cresol is not listed as a carcinogen by NTP, IARC or OSHA

SECTION 3 PHYSICAL DATA

Boiling point, 1 atm	376°F (191°C)	Specific gravity (H_2O=1), 25°C	1 048
Vapor pressure @ 25°C, mmHg	0 25	Volatiles, % by vol ..	ca 100
Vapor density (Air=1)	3 72	Evaporation rate (BuAc=1)	N/A
Solubility in water, wt %	2 5	Melting point	87 6°F (30 9°C)
		Molecular weight	108 13

APPEARANCE & ODOR Colorless, yellowish, or pink liquid or crystal with a characteristic sweet, tar-like odor The odor can be easily recognized at concentrations as low as 5 ppm in air

SECTION 4 FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp	Flammability Limits in Air	Lower	Upper
178°F (81°C) C C	1110°F (599°C)	% by vol at 300°F	1 35	

EXTINGUISHING MEDIA Carbon dioxide, dry chemical, foam Do not use a solid stream of water since the stream will scatter and spread the fire Use water spray to cool fire-exposed containers

This combustible liquid is a moderate fire hazard and a slight explosion hazard when exposed to heat, sparks or open flame

Firefighters should wear self-contained breathing apparatus and full protective clothing when fighting fires involving o-Cresol

SECTION 5 REACTIVITY DATA

This material is stable in closed containers at room temperature under normal storage and handling conditions It does not undergo hazardous polymerization

o-Cresol is incompatible with strong oxidizing agents When o-Cresol is mixed with chlorosulfonic acid, nitric acid, or oleum in a closed container, an increase in temperature and pressure results

Thermal decomposition or burning produces toxic vapors and gases, including carbon monoxide

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SECTION 6 HEALTH HAZARD INFORMATION

TLV 5 ppm or 22 mg/m^3

Cresol is a highly toxic compound Overexposure to o-Cresol via ingestion, skin absorption, or inhalation may cause muscular weakness, headache, dizziness, nausea, vomiting, gastrointestinal disturbances, respiratory distress, confusion, loss of consciousness, and death It may also cause damage to the kidney, liver, pancreas and spleen Vapors of o-Cresol are irritating to the eyes, nose, throat and respiratory tract The liquid is extremely corrosive to the skin and eyes If eye contact occurs, it may cause loss of vision if not promptly and completely removed Contact with skin may cause severe irritation or burns, dermatitis, or death if large areas of skin are exposed to o-Cresol and it is not promptly removed Chronic exposure to low doses of o-Cresol may cause gastrointestinal disturbances, headache, dizziness, mental disturbance, skin rash and damage to the liver and kidneys The main industrial hazard associated with use of o-Cresol is prolonged and/or extensive skin contact Under normal conditions, overexposure to vapors of o-Cresol is unlikely because of its low vapor pressure and disagreeable odor Some individuals may be hypersensitive to this material Toxic effects of o-Cresol are similar to Phenol, but less severe

FIRST AID EYE CONTACT Promptly flush eyes, including under eyelids, for at least 15 minutes with running water Get medical attention SKIN CONTACT Flush skin with running water while removing contaminated clothing for at least 5 minutes Get medical attention* INHALATION Remove victim to fresh air Restore and/or support breathing as needed Get medical help* INGESTION Give victim one glass of milk or water Contact a physician or Poison Control Center Do not induce vomiting unless instructed to do so Do not give anything by mouth to a person who is unconscious or is having convulsions Get medical attention*

* MEDICAL ATTENTION = Inplant, Paramedic, Community

SECTION 7 SPILL, LEAK AND DISPOSAL PROCEDURES

Notify safety personnel of large spills or leaks Remove all sources of heat and ignition Provide maximum explosion-proof ventilation Evacuate the area of all nonessential personnel Clean-up personnel need full protective clothing and equipment to prevent inhalation and contact with solid or liquid Absorb small spills on paper, vermiculite or other absorbent material and place in a closed metal container for disposal Dike large spills and allow material to cool and solidify Shovel solid into steel container for disposal Do not allow o-Cresol to enter sewer, watersheds, or waterways

DISPOSAL Place in a suitable container for disposal by licensed contractor or burn in an approved incinerator

o-Cresol is designated as a hazardous waste by the EPA The EPA (RCRA) HW No is U052 (40 CFR 261)
EPA (CWA) RQ is 1000 lbs/454 kgs (40 CFR 117)

SECTION 8 SPECIAL PROTECTION INFORMATION

Provide general and local exhaust ventilation (explosion proof) to meet TLV requirements When o-Cresol is heated, vapor inhalation can be a serious hazard without proper precaution For emergency or nonroutine exposures where the TLV may be exceeded, use an appropriate NIOSH-approved respirator Fume hoods should maintain a minimum face velocity of 100 lfm All electrical service in use or storage areas should have an explosion-proof design DANGER! Avoid any contact with this material Full protective equipment, including splash goggles, face shield, impervious gloves, apron, boots, impervious shirts and trousers, hard hat with brim, acid suit, and respirator should be available and worn as necessary Remove contaminated clothing promptly and do not reuse until it has been properly laundered

Eye wash stations and safety showers should be readily available in use and handling areas
Contact lenses pose a special hazard, soft lenses may absorb and all lenses concentrate irritants

SECTION 9 SPECIAL PRECAUTIONS AND COMMENTS

Store in closed containers in a cool, dry, well-ventilated area away from oxidizing agents, heat, sparks and open flame Protect container from physical damage Outside or detached storage is preferred
Use only with adequate ventilation Avoid contact with skin, eyes, and clothing Do not breathe vapors
Wash thoroughly after handling o-Cresol may turn color upon exposure to air or light Untrained workers should not handle this material

DOT CLASSIFICATION Corrosive material, UN2076

DATA SOURCE(S) CODE (See Glossary) 1,2,6,7 9,12,23 26,31,34,37 47,54,63,69,75,78,79, 59, R

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MEDICAL REVIEW [signature] Feb 86

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MATERIAL SAFETY DATA SHEET

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MSDS # 355

PHENOL (Revision B)

Issued September, 1980
Revised September, 1985

From Genium s MSDS Collection to be used as a reference

SECTION 1 MATERIAL IDENTIFICATION

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MATERIAL NAME PHENOL

OTHER DESIGNATIONS Carbolic Acid, Hydrobenzene, Oxybenzene, Phenic acid, Phenyl Hydrate, Phenyl hydroxide, Phenylic acid, Phenyl alcohol, CAS #000 108 952, C_6H_5OH

MANUFACTURER/SUPPLIER Available from many suppliers, including,
Dow Chemical USA
2020 Dow Center
Midland MI 48640 (517) 636-1000

3 2 0

SECTION 2 INGREDIENTS AND HAZARDS

	%	HAZARD DATA
PHENOL	ca 100	8 hr TWA 5 ppm, 19 mg/m^3 (Skin) STEL 10 ppm, 38 mg/m^3* Human, Oral LDLo 140 mg/kg Rat, oral LDLo 414 mg/kg Rat, skin LD50 669 mg/kg

* Current OSHA PEL and ACGIH TLV/STEL (1984-85) (Skin) notation indicates a potential contribution to overall exposure via absorption through the skin

NIOSH recommends a 10 hr TWA of 20 mg/m^3 with a ceiling of 60 mg/m^3 for any 15 minute period

SECTION 3 PHYSICAL DATA

Boiling Point @ 1 atm	359 4°F (181 9°C)	Specific Gravity (H_2O=1)	
Vapor pressure @ 25°C	0 35	Solid 1 017 @ 25/4°C	
Vapor density (Air=1)	3 24	Liquid 1 0576 @ 41/4°C	
Solubility in water (% by wt)	8 4 @ 20°C	Melting point	109 4°F (43°C)
(Sol in all proportion @ temp	>66°C)	Volatiles, % by vol @ 20°C	ca 100
		Evaporation rate (BuAc=1)	<0 03
		Viscosity, CPS, @ 80°C	1 51
		Molecular weight	94 12

APPEARANCE & ODOR White crystalline solid with a characteristic sharp medicinal sweet, tangy odor which is detectable above 0 05 ppm Phenol turns pink or red if it contains impurities or if it is exposed to heat or light.

SECTION 4 FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp	Flammability Limits in Air	Lower	Upper
175°F (79°C) C C	1319°F (715°C)	% by volume	1 5	8 6

EXTINGUISHING MEDIA Carbon dioxide, dry chemical, or alcohol type foam Do not use a solid stream of water since the stream will scatter and spread the fire Use water spray to cool fire-exposed tanks/containers Phenol presents a moderate fire hazard when exposed to heat, flame, or oxidizers When heated, it remits toxic fumes and vapors which will form explosive mixtures with air Solid phenol burns with difficulty, giving off a heavy smoke

Firefighters should wear self-contained breathing apparatus and full protective clothing when fighting fires involving phenol NOTE Water containing phenol can cause severe chemical burns

SECTION 5 REACTIVITY DATA

This material is stable at room temperature under normal handling and storage conditions It does not undergo hazardous polymerization Phenol is incompatible with strong oxidizing agents and halogens Reaction with calcium hypochlorite is exothermic and produces toxic fumes which may ignite Hot phenol is corrosive to many metals, including aluminum, lead, magnesium, and zinc Reaction with these materials causes phenol to become discolored Do not heat phenol above 122°F (90°C)

Thermal decomposition or burning produces oxides of carbon and water

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• **Summary of toxicology**

1 *Effects on animals* In rats or mice, chronic oral administration or subcutaneous or intraperitoneal injection of lead subacetate, lead acetate, or lead phosphate produced cancer of the kidneys Intravenous or intraperitoneal injection of lead nitrate, lead acetate, or lead chloride to pregnant mice, rats, or hamsters caused increased fetal mortality and malformations of the posterior extremities and urogenital and intestinal tracts in the offspring

2 *Effects on humans* Inhalation or ingestion of inorganic lead has caused peripheral neuropathy with paralysis of the muscles of the wrists and ankles, encephalopathy, anemia (due to decreased red blood cell life and impaired heme synthesis), proximal kidney tubule damage, decreased kidney function, and chronic kidney disease Lead can accumulate in the soft tissues and bones, with the highest accumulation in the liver and kidneys, and elimination is slow Lead can penetrate the placental barrier, resulting in neurologic disorders in infants

• **Signs and symptoms of exposure**

1 *Short-term (acute)* Exposure to inorganic lead can cause decreased appetite, insomnia, headache, muscle and joint pain, colic, and constipation

2 *Long-term (chronic)* Exposure to inorganic lead can cause weakness, weight loss, nausea, vomiting, constipation, blue or blue-black dot-like pigmentation on the gums ("lead line"), severe headache and abdominal cramps, delirium, convulsions, and coma

RECOMMENDED MEDICAL PRACTICES

• **Medical surveillance program**

Workers with potential exposures to chemical hazards should be monitored in a systematic program of medical surveillance intended to prevent or control occupational injury and disease The program should include education of employers and workers about work-related hazards, placement of workers in jobs that do not jeopardize their safety and health, earliest possible detection of adverse health effects, and referral of workers for diagnostic confirmation and treatment The occurrence of disease (a 'sentinel health event," SHE) or other work-related adverse health effects should prompt immediate evaluation of primary preventive measures (e g , industrial hygiene monitoring, engineering controls, and personal protective equipment) A medical surveillance program is intended to supplement, not replace, such measures

A medical surveillance program should include systematic collection and epidemiologic analysis of relevant environmental and biologic monitoring, medical screening, morbidity, and mortality data This analysis may provide information about the relatedness of adverse health effects and occupational exposure that cannot be discerned from results in individual workers Sensitivity specificity, and predictive values of biologic monitoring and medical screening tests should be evaluated on an industry-wide basis prior to application in any given worker group Intrinsic to a surveillance program is the dissemination of summary data to those who need to know, including employers, occupational health professionals, potentially exposed workers, and regulatory and public health agencies

• **Preplacement medical evaluation**

Prior to placing a worker in a job with a potential for exposure to inorganic lead, the physician should evaluate and document the worker's baseline health status with thorough medical, environmental, and occupational histories, a physical examination, and physiologic and laboratory tests appropriate for the anticipated occupational risks These should concentrate on the function and integrity of the kidneys and the hematopoietic (blood cell forming), nervous, gastrointestinal, and reproductive systems

A preplacement medical evaluation is recommended in order to detect and assess preexisting or concurrent conditions which may be aggravated or result in increased risk when a worker is exposed to inorganic lead at or below the NIOSH REL

The examining physician should consider the probable frequency, intensity, and duration of exposure, as well as the nature and degree of the condition, in placing such a worker Such conditions, which should not be regarded as absolute contraindications to job placement, include preexisting neuromuscular disease In addition to the medical interview and physical examination, the physician should consider obtaining additional baseline electrophysiologic and electromyographic studies and an assessment of fertility, using standardized methods and evaluation criteria The physician should also obtain baseline values for the complete blood count including the reticulocyte count and for those tests which characterize prior internal exposure (e g , blood lead level) and the effects of prior exposures (e g , erythrocyte zinc protoporphyrin and delta-aminolevulinic acid dehydrogenase)

• **Periodic medical screening and/or biologic monitoring**

Occupational health interviews and physical examinations should be performed at regular intervals Additional examinations may be necessary should a worker develop symptoms that may be attributed to exposure to inorganic lead The interviews, examinations, and appropriate medical screening and/or biologic monitoring tests should be directed at identifying an excessive decrease or adverse trend in the physiologic function of the kidneys and the hematopoietic (blood cell forming), nervous, gastrointestinal, and reproductive systems as compared to the baseline status of the individual worker or to expected values for a suitable reference population The following tests should be used and interpreted according to standardized epidemiologic procedures and evaluation criteria a complete blood count with reticulocyte count and those tests which characterize prior internal exposure (e g , blood lead level) and the effects of exposures (e g , erythrocyte zinc protoporphyrin and delta-aminolevulinic acid dehydrogenase)

• **Medical practices recommended at the time of job transfer or termination**

The medical, environmental, and occupational history interviews, the physical examination, and selected physiologic and laboratory tests which were conducted at the time of placement should be repeated at the time of job transfer or termination Any changes in the worker's health status should be compared to those expected for a suitable reference population Because occupational exposure to inorganic lead may cause adverse reproductive effects and diseases of prolonged induction-

latency the need for medical surveillance may extend well beyond termination of employment

- **Sentinel health events**

1 Acute SHE s include Acute renal failure
2 Delayed-onset or reproductive SHE s include Inflammatory and toxic neuropathy and chronic renal failure

MONITORING AND MEASUREMENT PROCEDURES

- **TWA exposure evaluation**

Measurements to determine worker exposure to inorganic lead should be taken so that the TWA exposure is based on a single entire workshift sample or an appropriate number of consecutive samples collected during the entire workshift Under certain conditions, it may be appropriate to collect several short-term interval samples (up to 30 minutes each) to determine the average exposure level Air samples should be taken in the worker's breathing zone (air that most nearly represents that inhaled by the worker)

- **Method**

Sampling and analysis may be performed by collecting inorganic lead with cellulose membrane filters followed by acid digestion and analysis by atomic absorption A detailed sampling and analytical method for inorganic lead may be found in the *NIOSH Manual of Analytical Methods* (method number 7082)

PERSONAL PROTECTIVE EQUIPMENT

Chemical protective clothing (CPC) should be selected after utilizing available performance data consulting with the manufacturer, and then evaluating the clothing under actual use conditions

Workers should be provided with and required to use CPC, gloves, face shields (8-inch minimum) and other appropriate protective clothing necessary to prevent skin contact with inorganic lead

Workers should be provided with and required to use dust-proof safety goggles where inorganic lead may come in contact with the eyes

SANITATION

Clothing which is contaminated with inorganic lead should be removed immediately and placed in closed containers for storage until it can be discarded or until provision is made for the removal of inorganic lead from the clothing If the clothing is to be laundered or cleaned, the person performing the operation should be informed of inorganic lead's hazardous properties

Change and shower rooms should be provided with separate locker facilities for street and work clothes

Skin that becomes contaminated with inorganic lead should be promptly washed with soap and water

The storage preparation, dispensing, or consumption of food or beverages the storage or application of cosmetics, the storage or smoking of tobacco or other smoking materials or the storage or use of products for chewing should be prohibited in work areas

Workers who handle inorganic lead should wash their faces, hands, and forearms thoroughly with soap and water before eating, smoking, or using toilet facilities

COMMON OPERATIONS AND CONTROLS

Common operations in which exposure to inorganic lead may occur and control methods which may be effective in each case are listed in Table 2

Table 2.—Operations and methods of control for inorganic lead

Operations	Controls
During primary (ore) and secondary (scrap) smelting of lead, during the manufacture of storage batteries, during typecasting and remelting of type metal in printing	Process enclosure, local exhaust ventilation, dust control, personal protective equipment
During soldering in the fabrication of metal articles	Process enclosure, local exhaust ventilation, personal protective equipment
During melting and pouring of lead and alloys containing lead, during welding, burning, and cutting of metal structures containing lead or painted with lead containing surface coatings	Local exhaust ventilation, personal protective equipment
During the use of lead in the manufacture of surface coatings, including paints and varnishes, during the manufacture of ceramics and glass	Local exhaust ventilation, personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, remove the victim from further exposure, send for medical assistance, and initiate emergency procedures

- **Eye exposure**

Where there is any possibility of a worker's eyes being exposed to inorganic lead, an eye-wash fountain should be provided within the immediate work area for emergency use

If inorganic lead gets into the eyes, flush them immediately with large amounts of water for 15 minutes, lifting the lower and upper lids occasionally Get medical attention as soon as possible Contact lenses should not be worn when working with this compound

• Skin exposure

Where there is any possibility of a worker's body being exposed to inorganic lead, facilities for quick drenching of the body should be provided within the immediate work area for emergency use

If inorganic lead gets on the skin, wash it immediately with soap and water If inorganic lead penetrates the clothing, remove the clothing immediately and wash the skin with soap and water Get medical attention promptly

• **Rescue**

If a worker has been incapacitated move the affected worker from the hazardous exposure Put into effect the established emergency rescue procedures Do not become a casualty Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises

SPILLS AND LEAKS

Workers not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed

If inorganic lead is spilled or leaked, the following steps should be taken

1 Remove all ignition sources
2 Ventilate area of spill or leak
3 For small quantities of liquids containing inorganic lead, absorb on paper towels and place in an appropriate container
4 Large quantities of liquids containing inorganic lead may be absorbed in vermiculite, dry sand, earth, or a similar material and placed in an appropriate container
If in solid form, inorganic lead may be collected and placed in an appropriate container
6. Inorganic lead may be collected by vacuuming with an appropriate system

WASTE REMOVAL AND DISPOSAL

U S Environmental Protection Agency, Department of Transportation, and/or state and local regulations shall be followed to assure that removal, transport, and disposal are in accordance with existing regulations

RESPIRATORY PROTECTION

It must be stressed that the use of respirators is the least preferred method of controlling worker exposure and should not normally be used as the only means of preventing or minimizing exposure during routine operations However, there are some exceptions for which respirators may be used to control exposure when engineering and work practice controls are not technically feasible, when engineering controls are in the process of being installed, or during emergencies and certain maintenance operations including those requiring confined-space entry (Table 3)

In addition to respirator selection, a complete respiratory protection program should be instituted which as a minimum complies with the requirements found in the OSHA Safety and Health Standards 29 CFR 1910 134 A respiratory protection program should include as a minimum an evaluation of the worker's ability to perform the work while wearing a respirator, the regular training of personnel, fit testing, periodic environmental monitoring, maintenance, inspection, and cleaning The implementation of an adequate respiratory protection program, including selection of the correct respirators, requires that a knowledgeable person be in charge of the program and that the program be evaluated regularly

Only respirators that have been approved by the Mine Safety and Health Administration (MSHA, formerly Mining Enforcement and Safety Administration) and by NIOSH should be used **Remember! Air-purifying respirators will not protect from oxygen-deficient atmospheres.**

For each level of respirator protection, only those respirators that have the minimum required protection factor and meet other use restrictions are listed All respirators that have higher protection factors may also be used

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Table 3.—Respiratory protection for inorganic lead

Condition	Minimum respiratory protection*†
Concentration	
Less than or equal to 0 5 mg/m³	Any supplied air respirator
	Any air-purifying respirator with a high-efficiency particulate filter
	Any self-contained breathing apparatus
Less than or equal to 1 25 mg/m³	Any powered air-purifying respirator with a high-efficiency particulate filter
	Any supplied-air respirator operated in a continuous flow mode
Less than or equal to 2 5 mg/m³	Any air-purifying full facepiece respirator with a high-efficiency particulate filter
	Any powered air-purifying respirator with a tight-fitting facepiece and a high-efficiency particulate filter
	Any self-contained breathing apparatus with a full facepiece
	Any supplied-air respirator with a full facepiece
	Any supplied-air respirator with a tight-fitting facepiece and operated in a continuous flow mode
Less than or equal to 50 mg/m³	Any supplied-air respirator with a half-mask and operated in a pressure-demand or other positive pressure mode
Less than or equal to 100 mg/m³	Any supplied-air respirator with a full facepiece and operated in a pressure-demand or other positive pressure mode
Planned or emergency entry into environments containing unknown concentrations or levels above 100 mg/m³	Any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode
	Any supplied-air respirator with a full facepiece and operated in a pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive pressure mode
Firefighting	Any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode
Escape only	Any air-purifying full facepiece respirator with a high-efficiency particulate filter
	Any appropriate escape-type self-contained breathing apparatus

* Only NIOSH/MSHA-approved equipment should be used

† The respiratory protection listed for any given condition is the minimum required to meet the NIOSH REL of 100 $\mu g/m^3$ (TWA)

Occupational Health Guideline for Iron Oxide Fume

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information It does not attempt to present all data, rather, it presents pertinent information and data in summary form

SUBSTANCE IDENTIFICATION

- Formula Fe_2O_3
- Synonyms Ferric oxide fume
- Appearance Red-brown fume with a metallic taste

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for iron oxide fume is 10 milligrams of iron oxide fume per cubic meter of air (mg/m^3) averaged over an eight-hour work shift. The American Conference of Governmental Industrial Hygienists has recommended for iron oxide fume a Threshold Limit Value of 5 mg/m^3

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Iron oxide fume can affect the body if it is inhaled

- **Effects of overexposure**

Repeated exposure to iron oxide fume over a period of years may cause x-ray changes of the lungs, but does not cause the exposed person to become ill.

- **Reporting signs and symptoms**

A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to iron oxide fume

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to iron oxide fume at potentially hazardous levels

1 Initial Medical Examination.

—A complete history and physical examination The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring Examination of the respiratory system should be stressed

—14" x 17" chest roentgenogram Iron oxide fume causes an apparently benign pneumoconiosis However, since exposure may be associated with other more toxic dust exposures, surveillance of the lungs is indicated

—FVC and FEV (1 sec) Iron oxide fume causes an apparently benign pneumoconiosis However, since exposure may be associated with other more toxic dust exposures, periodic surveillance is indicated

2. Periodic Medical Examination. The aforementioned medical examinations should be repeated on an annual basis, except that an x-ray is considered necessary only when indicated by the results of pulmonary function testing

- **Summary of toxicology**

Inhalation of iron oxide fume or dust causes an apparently benign pneumoconiosis termed siderosis Iron oxide alone does not cause fibrosis in the lungs of animals, and the same probably applies to humans Exposures of 6 to 10 years are usually considered necessary before changes recognizable by x-ray can occur; the retained dust gives x-ray shadows that may be indistinguishable from fibrotic pneumoconiosis Eight of 25 welders exposed chiefly to iron oxide for an average of 18 7 (range 3 to 32) years had reticulonodular shadows on chest x-rays consistent with siderosis but no reduction in pulmonary function, exposure levels ranged from 0 65 to 47 mg/m^3 In another study, 16 welders with an average exposure of 17 1 (range 7 to 30) years also had x-rays suggesting siderosis and spirograms which were normal, however, the static and functional compliance of the lungs was reduced, some of the welders were smokers. The welders with the lowest compliance complained of dyspnea.

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations

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SPILL PROCEDURES

- Persons not wearing protective equipment and clothing should be restricted from areas of releases until cleanup has been completed
- If potentially hazardous amounts of iron oxide fume are inadvertantly released, ventilate the area of the release to disperse the fume

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RESPIRATORY PROTECTION FOR IRON OXIDE FUME

Condition	Minimum Respiratory Protection* Required Above 10 mg/m³
Particulate Concentration	
100 mg/m³ or less	Any fume respirator or high efficiency particulate filter respirator Any supplied-air respirator Any self-contained breathing apparatus
500 mg/m³ or less	A high efficiency particulate filter respirator with a full facepiece Any supplied-air respirator with a full facepiece, helmet, or hood Any self-contained breathing apparatus with a full facepiece
5,000 mg/m³ or less	A powered air-purifying respirator with a high efficiency particulate filter A Type C supplied-air respirator operated in pressure-demand or other positive pressure or continuous-flow mode
Greater than 5,000 mg/m³ or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode

*Only NIOSH-approved or MSHA-approved equipment should be used

Occupational Health Guideline for 1,2-Dichloroethylene

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information. It does not attempt to present all data, rather, it presents pertinent information and data in summary form

SUBSTANCE IDENTIFICATION

- Formula ClCH=CHCl
- Synonyms Acetylene dichloride; dioform, trans-acetylene dichloride, sym-dichloroethylene
- Appearance and odor Colorless liquid with an ether-like, slightly acrid odor, like chloroform

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for 1,2-dichloroethylene is 200 parts of 1,2-dichloroethylene per million parts of air (ppm) averaged over an eight-hour work shift. This may also be expressed as 790 milligrams of 1,2-dichloroethylene per cubic meter of air (mg/m³)

HEALTH HAZARD INFORMATION

- **Routes of exposure**

1,2-Dichloroethylene can affect the body if it is inhaled or if it comes in contact with the eyes or skin It can also affect the body if it is swallowed

- **Effects of overexposure**

Exposure to 1,2-dichloroethylene may cause dizziness, drowsiness, and unconsciousness

- **Reporting signs and symptoms**

A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to 1,2-dichloroethylene

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to 1,2-dichloroethylene at potentially hazardous levels

1 Initial Medical Screening Employees should be screened for history of certain medical conditions (listed below) which might place the employee at increased risk from 1,2-dichloroethylene exposure.

—Liver disease Although 1,2-dichloroethylene is not known as a liver toxin in humans, the importance of this organ in the biotransformation and detoxification of foreign substances should be considered before exposing persons with impaired liver function.

—Chronic respiratory disease In persons with impaired pulmonary function, especially those with obstructive airway diseases, the breathing of 1,2-dichloroethylene might cause exacerbation of symptoms due to its irritant properties.

2. Periodic Medical Examination Any employee developing the above-listed conditions should be referred for further medical examination

- **Summary of toxicology**

1,2-Dichloroethylene vapor is a narcotic and a mucous-membrane irritant. Variations in toxicity of the cis- as compared with the trans-form have been reported. A concentration of 39,000 ppm was lethal to guinea pigs, and narcosis was produced at 18,000 ppm Dogs exposed to high concentrations of vapor developed superficial corneal turbidity which was reversible No effects were observed in several species with repeated exposure for up to 6 months at 1000 ppm It has been used as a general anesthetic in man, one industrial fatality was due to very high vapor inhalation in a small enclosure

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**

1 Molecular weight 96 9
2 Boiling point (760 mm Hg) 45 to 60 C (113 to 140 F)
3 Specific gravity (water = 1) 1 27
4 Vapor density (air = 1 at boiling point of 1,2-dichloroethylene) 3 34
5 Melting point −49 to −81 5 C (−56 to −115 F)
6 Vapor pressure at 20 C (68 F) 180 to 265 mm Hg

These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program However they may not be sufficient to achieve compliance with all requirements of OSHA regulations

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7 Solubility in water g/100 g water at 20 C (68 F) 0 35 to 0 63

8 Evaporation rate (butyl acetate = 1) Data not available

• **Reactivity**

1 Conditions contributing to instability Heat

2 Incompatibilities Contact with strong oxidizers may cause fires and explosions

3 Hazardous decomposition products Toxic gases and vapors (such as hydrogen chloride, phosgene, and carbon monoxide) may be released in a fire involving 1,2-dichloroethylene

4 Special precautions 1,2-Dichloroethylene will attack some forms of plastics, rubber, and coatings

• **Flammability**

1 Flash point 2 2 to 3 9 C (36 to 39 F) (closed cup)

2 Autoignition temperature 460 C (860 F) for trans-1,2-dichloroethylene

3 Flammable limits in air, % by volume Lower 9 7, Upper 12 8

4 Extinguishant Dry chemical, foam, carbon dioxide

• **Warning properties**

May reports an odor threshold of 0 085 ppm for dichloroethylene For the purposes of this guideline, 1,2-dichloroethylene is treated as a material with adequate warning properties

1,2-Dichloroethylene is an eye irritant, according to [illegible]rant, but the concentrations at which irritation occurs [illegible]e not mentioned

MONITORING AND MEASUREMENT PROCEDURES

• **General**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level Air samples should be taken in the employee s breathing zone (air that would most nearly represent that inhaled by the employee)

• **Method**

Sampling and analyses may be performed by collection of 1 2-dichloroethylene vapors using an adsorption tube with subsequent desorption with carbon disulfide and gas chromatographic analysis Also detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure 1 2-dichloroethylene may be used An analytical method for 1 2-dichloroethylene is in the *NIOSH Manual of Analytical Methods* 2nd Ed Vol 2 1977 available from the Govern[illegible]nt Printing Office Washington D C 20402 (GPO [illegible] 017-033-00260 6)

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level However, there are some exceptions where respirators may be used to control exposure. Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations. If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation

PERSONAL PROTECTIVE EQUIPMENT

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid 1,2-dichloroethylene.

• Clothing wet with liquid 1,2-dichloroethylene should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of 1,2-dichloroethylene from the clothing If the clothing is to be laundered or otherwise cleaned to remove the 1,2-dichloroethylene, the person performing the operation should be informed of 1,2-dichloroethylene's hazardous properties

• Any clothing which becomes wet with liquid 1,2-dichloroethylene should be removed immediately and not reworn until the 1,2-dichloroethylene is removed from the clothing

• Employees should be provided with and required to use splash-proof safety goggles where liquid 1,2-dichloroethylene may contact the eyes

SANITATION

• Skin that becomes wet with liquid 1,2-dichloroethylene should be promptly washed or showered with soap or mild detergent and water to remove any 1,2-dichloroethylene

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to 1,2-dichloroethylene may occur and control methods which may be effective in each case

Operation	Controls
Use as a low temperature solvent for heat-sensitive substances in extraction of caffeine, perfume oils, and fats from flesh of animals	Local exhaust ventilation, general dilution ventilation, personal protective equipment
Use in rubber and dye industries in extraction and application	Process enclosure, local exhaust ventilation, personal protective equipment
Use as a direct solvent in gums, waxes, oils, camphor, and phenol, use in solvent mixtures for esters and ether derivatives, lacquers, resins, thermoplastics, and artificial fibers	Local exhaust ventilation, general dilution ventilation, personal protective equipment
Use in organic synthesis for polymers and telomers	Process enclosure, local exhaust ventilation, personal protective equipment
Use in miscellaneous applications as liquid dry cleaning agent, cleaning solution for printed circuit boards, food packaging adhesives, and germicidal fumigants	General dilution ventilation, local exhaust ventilation, personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance

• **Eye Exposure**

If 1,2-dichloroethylene gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally If irritation is present after washing, get medical attention Contact lenses should not be worn when working with this chemical

• **Skin Exposure**

If 1,2-dichloroethylene gets on the skin, promptly wash the contaminated skin using soap or mild detergent and water If 1,2-dichloroethylene soaks through the clothing, remove the clothing promptly and wash the skin using soap or mild detergent and water If irritation persists after washing, get medical attention

• **Breathing**

If a person breathes in large amounts of 1,2-dichloroethylene, move the exposed person to fresh air at once If breathing has stopped, perform artificial respiration Keep the affected person warm and at rest. Get medical attention as soon as possible

• **Swallowing**

When 1,2-dichloroethylene has been swallowed, get medical attention immediately If medical attention is not immediately available, get the afflicted person to vomit by having him touch the back of his throat with his finger or by giving him syrup of ipecac as directed on the package. This non-prescription drug is available at most drug stores and drug counters and should be kept with emergency medical supplies in the workplace Do not make an unconscious person vomit.

• **Rescue**

Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures. Do not become a casualty Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

• Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed

• If 1,2-dichloroethylene is spilled or leaked, the following steps should be taken

1 Remove all ignition sources.

2 Ventilate area of spill or leak

3 For small quantities, absorb on paper towels Evaporate in a safe place (such as a fume hood) Allow sufficient time for evaporating vapors to completely clear the hood ductwork Burn the paper in a suitable location away from combustible materials Large quantities can be reclaimed or collected and atomized in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device 1,2-Dichloroethylene should not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion Sewers designed to preclude the formation of explosive concentrations of 1,2-dichloroethylene vapors are permitted

• **Waste disposal method**

1,2-Dichloroethylene may be disposed of by atomizing in a suitable combustion chamber equipped with an appropriate effluent gas cleaning device

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RESPIRATORY PROTECTION FOR 1,2-DICHLOROETHYLENE

Condition	Minimum Respiratory Protection* Required Above 200 ppm
Vapor Concentration	
1000 ppm or less	A chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s)
4000 ppm or less	A gas mask with a chin-style or a front- or back-mounted organic vapor canister Any supplied-air respirator with a full facepiece, helmet, or hood Any self-contained breathing apparatus with a full facepiece
Greater than 4000 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode
Escape	Any gas mask providing protection against organic vapors Any escape self-contained breathing apparatus

*Only NIOSH-approved or MSHA-approved equipment should be used

Material Safety Data Sheet

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GENIUM PUBLISHING CORP

No 385

ETHYL BENZENE
(Revision A)
Issued August 1978
Revised November 1988

SECTION 1. MATERIAL IDENTIFICATION

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Material Name ETHYL BENZENE

Description (Origin/Uses)· Used as a solvent and as an intermediate in the production of styrene monomer

Other Designations. Phenylethane, Ethylbenzol, $C_2H_5C_6H_5$, CAS No 0100-41-4

Manufacturer· Contact your supplier or distributor Consult the latest edition of the *Chemicalweek Buyers Guide* (Genium ref 73) for a list of suppliers

NFPA: 3 / 2 / 0 / -

HMIS	
H 2	R 1
F 3	I 3
R 0	S 2
PPG*	K 4
*See sect. 8	

SECTION 2. INGREDIENTS AND HAZARDS

	%	EXPOSURE LIMITS
Ethyl Benzene, CAS No 0100-41-4	Ca 100	**OSHA PELs** 8-Hr TWA. 100 ppm, 435 mg/m³ 15- Min STEL. 125 ppm, 545 mg/m³ **ACGIH TLVs, 1988-89** TLV-TWA 100 ppm, 435 mg/m³ TLV-STEL. 125 ppm, 545 mg/m³ **Toxicity Data*** Human, Inhalation, TC_{Lo} 100 ppm (8 Hrs) Rat, Oral, LD_{50} 3500 mg/kg
*See NIOSH, *RTECS* (DA0700000), for additional data with references to reproductive, irritative, and mutagenic effects		

SECTION 3. PHYSICAL DATA

Boiling Point: 277°F (136°C)
Melting Point· -139°F (-95°C)
Vapor Pressure: 7 1 Torrs at 68°F (20°C)
Vapor Density (Air = 1) 3 7
% Volatile by Volume Ca 100

Molecular Weight: 106 Grams/Mole
Solubility in Water (%): Slight
Specific Gravity (H_2O = 1): 0 86258 at 77°F (25°C)

Appearance and Odor A clear, colorless, flammable liquid, characteristic aromatic hydrocarbon odor

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method. 64°F (18°C) CC	Autoignition Temperature 810°F (432.22°C)	LEL. 1% v/v	UEL. 6 7% v/v

Extinguishing Media Use foam, dry chemical, or carbon dioxide to put out ethyl benzene fires A water spray may be ineffective in extinguishing the fire, because it can scatter and spread the burning liquid Use water spray to cool fire-exposed containers of ethyl benzene, to disperse ethyl benzene vapor, and to protect personnel attempting to stop an ethyl benzene leak. **Unusual Fire or Explosion Hazards:** This liquid can readily form explosive vapor-air mixtures, especially when heated Ethyl benzene vapor is heavier than air and may travel a considerable distance to a low-lying source of ignition and flash back to its origin **Special Fire-fighting Procedures.** Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode

SECTION 5. REACTIVITY DATA

Stability/Polymerization Ethyl benzene is stable in closed containers during routine operations. Hazardous polymerization cannot occur **Chemical Incompatibilities** Hazardous chemical reactions can occur between ethyl benzene and strong oxidizing agents, acids, ammonia, and bases **Conditions to Avoid** Avoid any exposure to sources of ignition such as heat, sparks, open flame, and lighted tobacco products, etc., and to incompatible chemicals Use caution when entering confined spaces, particularly low-lying areas where explosive concentrations of ethyl benzene vapor may be present. Provide good ventilation to such areas to prevent the concentration of this vapor **Hazardous Products of Decomposition** Thermal-oxidative degradation can include toxic gases such as carbon monoxide and/or aromatic hydrocarbon gases

SECTION 6. HEALTH HAZARD INFORMATION

Carcinogenicity Ethyl benzene is not listed as a carcinogen by the NTP, IARC, or OSHA
Summary of Risks Ethyl benzene vapor is severely irritating to the eyes and to the mucous membranes of the respiratory system. Sustained inhalation of excessive levels can cause depression of the central nervous system (CNS) characterized by dizziness, headache, narcosis, and coma Skin contact with liquid ethyl benzene causes irritation, dermatitis and defatting can also develop The acute oral toxicity of ethyl benzene is low, however, ingestion of it presents a serious aspiration hazard Aspirating even a small amount into the lungs can result in extensive edema (lungs filled with fluid) and hemorrhaging of the lung tissue No systemic effects are expected at the levels that produce pronounced, unignorable, disagreeable skin and eye irritation The TLVs cited in section 2 are set to prevent this intolerable irritation **Medical Conditions Aggravated by Long-Term Exposure** None reported **Target Organs** Skin, eyes, respiratory system, and CNS **Primary Entry** Inhalation, skin contact **Acute Effects.** Irritation of the skin, eyes, and respiratory system. Also, cardiac-rhythm disturbance due to sensitization, acute bronchitis, bronchospasm, pulmonary and laryngeal edema, euphoria, headache, giddiness, dizziness, and incoordination, as well as possible depression, confusion, and coma **Chronic Effects** None reported **First Aid** Eyes. Immediately

SECTION 6 HEALTH HAZARD INFORMATION, cont.

flush eyes, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 minutes Skin Rinse the affected area with plenty of water, then wash it with soap and water **Inhalation** Remove the exposed person to fresh air, restore and/or support his or her breathing as needed Have qualified medical personnel administer oxygen as required. **Ingestion.** Unlikely Should this type of exposure occur, the aspiration hazard must be considered. Do not induce vomiting unless directed to do so by a physician To prevent aspiration by spontaneous vomiting, keep the victim's head low (between his or her knees) Get medical help (in plant, paramedic, community) for all exposures. Seek prompt medical assistance for further treatment, observation, and support after first aid. Note to Physician Professional judgment is required as to whether or not to induce vomiting because of the possibility of aspiration. A gastric lavage may be administered, followed by saline catharsis, if this procedure is appropriate to the specific incident. Monitor cardiac and pulmonary functions

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak Notify safety personnel, evacuate unnecessary personnel, eliminate all sources of ignition immediately, and provide adequate explosion-proof ventilation. Cleanup personnel need protection against skin or eye contact with this liquid as well as inhalation of its vapor (see sect. 8) Contain large spills and collect waste or absorb it with an inert material such as sand, earth, or vermiculite Use nonsparking tools to place waste liquid or absorbent into closable containers for disposal Keep waste out of sewers, watersheds, and waterways **Waste Disposal**· Contact your supplier or a licensed contractor for detailed recommendations Follow Federal, state, and local regulations.

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910 1000 Subpart Z).
EPA Designations (40 CFR 302.4)
CERCLA Hazardous Substance, Reportable Quantity· 1000 lbs (454 kg), per the Clean Water Act (CWA), §§ 311 (b) (4) and 307 (a)

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles. Always wear protective eyeglasses or chemical safety goggles. Where splashing is possible, wear a full face shield Follow OSHA eye- and face-protection regulations (29 CFR 1910 133) **Respirator:** Wear a NIOSH-approved respirator per Genium reference 88 for the maximum-use concentrations and/or the exposure limits cited in section 2. Follow OSHA respirator regulations (29 CFR 1910 134) For emergency or nonroutine operations (spills or cleaning reactor vessels and storage tanks), wear an SCBA. **Warning**· Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres **Other:** Wear impervious gloves, boots, aprons, and gauntlets, etc., to prevent prolonged or repeated skin contact with this material **Ventilation** Install and operate general and local maximum, explosion-proof ventilation systems powerful enough to maintain airborne levels of this material below the OSHA PEL standard cited in section 2 Local exhaust ventilation is preferred because it prevents dispersion of the contaminant into the general work area by eliminating it at its source Consult the latest edition of Genium reference 103 for detailed recommendations. **Safety Stations.** Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work areas **Contaminated Equipment:** Contact lenses pose a special hazard, soft lenses may absorb irritants, and all lenses concentrate them. Do *not* wear contact lenses in any work area. Remove contaminated clothing and launder it before wearing it again, clean this material from shoes and equipment. **Comments:** Practice good personal hygiene, always wash thoroughly after using this material and before eating, drinking, smoking, using the toilet, or applying cosmetics Keep it off your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking Do *not* eat, drink, or smoke in any work area. Do not inhale ethyl benzene vapor

SECTION 9 SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation Store ethyl benzene in closed containers in a cool, dry, well-ventilated area away from sources of ignition and strong oxidizers Protect containers from physical damage **Special Handling/Storage** Outside, isolated, detached, or remote storage is recommended for large quantities of ethyl benzene. Isolate bulk storage areas from acute fire hazards **Engineering Controls:** Make sure all engineering systems (production, transportation) are of maximum explosion-proof design To prevent static sparks, electrically ground and bond all containers, pipelines, etc , used in shipping, transferring, reacting, production, and sampling operations **Other**· Use safety cans for transferring small amounts of ethyl benzene.

Transportation Data (49 CFR 172.101-2)

DOT Shipping Name Ethyl Benzene
DOT Hazard Class. Flammable Liquid
ID No UN1175
DOT Label Flammable Liquid
DOT Packaging Exceptions 49 CFR 173 118
DOT Packaging Requirements: 49 CFR 173 119

IMO Shipping Name Ethylbenzene
IMO Hazard Class 3.2
IMO Label Flammable Liquid
IMDG Packaging Group II

References· 1, 26 38, 84-94, 100, 116, 117, 120, 122

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OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR INORGANIC LEAD

INTRODUCTION

"Inorganic lead" is defined as lead oxides, metallic lead, and lead salts (including organic salts such as lead soaps but excluding lead arsenate) This guideline summarizes pertinent information about inorganic lead for workers, employers, and occupational safety and health professionals who may need such information to conduct effective occupational safety and health programs Recommendations may be superseded by new developments in these fields, therefore, readers are advised to regard these recommendations as general guidelines

SUBSTANCE IDENTIFICATION

- **Formula** Pb
- **Synonyms** C I pigment metal 4, C I 77575, KS-4, lead flake, lead S2
- **Identifiers** CAS 7439-92-1, RTECS OF7525000, DOT 1794
- **Appearance and odor** Bluish-white, silvery, or gray odorless solid

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**

1 Molecular weight 207 19
2 Boiling point (at 760 mmHg) 1,740°C (3,164°F)
3 Specific gravity (water = 1) 11 34
4 Melting point 327 5°C (621 5°F)
5 Insoluble in water

- **Reactivity**

1 Incompatibilities Lead reacts vigorously with oxidizing materials Contact with hydrogen peroxide or active metals such as sodium or potassium may cause fires or explosions
2 Hazardous decomposition products Toxic fumes (e g , lead oxide) may be released in a fire involving inorganic lead

- **Flammability**

1 Extinguishant Dry sand, dry dolomite, or dry graphite
2 Caution Lead is combustible in powder form when exposed to heat or flame

- **Warning properties**

Evaluation of warning properties for respirator selection Based on lack of information on odor threshold and eye irritation levels, inorganic lead should be treated as a chemical with poor warning properties

EXPOSURE LIMITS

The current Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for inorganic lead is 50 micrograms of lead per cubic meter of air ($\mu g/m^3$) as a time-weighted average (TWA) concentration over an 8-hour workshift If a worker is exposed to lead for more than 8 hours in any workday, the PEL, as a TWA for that day, shall be reduced according to the following formula maximum permissible limit (in $\mu g/m^3$) = 400 divided by hours worked in the day The National Institute for Occupational Safety and Health (NIOSH) recommended exposure limit (REL) is 100 $\mu g/m^3$ as a TWA for up to a 10-hour workshift, 40-hr workweek The American Conference of Governmental Industrial Hygienists (ACGIH) threshold limit value (TLV®) is 0 15 mg/m^3 (150 $\mu g/m^3$) as a TWA for a normal 8-hour workday and a 40-hour workweek (Table 1)

Table 1.—Occupational exposure limits for inorganic lead

	Exposure units $\mu g/m^3$
OSHA PEL TWA	50
NIOSH REL TWA	100*
ACGIH TLV® TWA	150

* Air level to be maintained such that worker blood lead remains $\leq$60 μg/100g

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Inorganic lead may cause adverse health effects following exposure via inhalation or ingestion

U S DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health
Division of Standards Development and Technology Transfer

Re sed 9/85

MSDS # _ 22 Issued 9/80 PHENOL (Rev. B)

SECTION 6 HEALTH HAZARD INFORMATION

TLV 5 ppm or 19 mg/m^3 (Skin)

Phenol is a general protoplasmic poison which is corrosive to body tissue Poisoning can occur via skin absorption, vapor inhalation, or ingestion Vapors of phenol are irritating to the eyes, nose, and throat The liquid is rapidly absorbed through the skin Contact with the skin causes a white wrinkled discoloration followed by a severe burn or systemic poisoning if not properly removed. Intense burning and pain from skin contact may be delayed Absorption of phenol through skin may cause sudden collapse, or death Symptoms develop rapidly When ingested, phenol causes burning of the gastrointestinal tract, and blotches on the lips and in the mouth headache, nausea, dizziness, dyspnea, shock, convulsions, and death may follow exposures by any route Chronic exposure to low concentrations of phenol may cause digestive disturbances, nervous disorders, skin eruptions, and death due to liver and kidney damage The TLV is set to prevent systemic poisoning

FIRST AID EYE CONTACT Immediately flush eyes, including under eyelids, with copious amounts of running water for at least 30 minutes Get medical attention! (Inplant, community, paramedic) SKIN CONTACT Immediately flush skin for at least 30 minutes while removing contaminated clothing and shoes Get medical attention! INHALATION Remove victim to fresh air. Restore and/or support breathing as necessary Keep person warm and quiet Transport to a medical facility. INGESTION Give victim large quantities of milk or water as quickly as possible Induce vomiting by touching back of throat with finger Do not give fluids or induce vomiting if victim is unconscious or is having convulsions. Contact a physician or Poison Control Center and transport to a medical facility

SECTION 7 SPILL, LEAK AND DISPOSAL PROCEDURES

Notify safety personnel of spills or leaks Remove all sources of heat and ignition Provide maximum explosion-proof ventilation Evacuate all personnel from area, except for those involved in clean-up Close the leak immediately, if possible Absorb small spills on paper, vermiculite or other absorbent and place in a closed metal container for disposal Dike large spills and allow material to cool and solidify Shovel solid into steel containers for disposal Flush spill area thoroughly with water and collect flushings and wash water for disposal Do not allow phenol to enter sewer, watersheds, or waterways! Notify proper authorities including the National Response Center (800-424-8802) Clean-up personnel must wear a self-contained breathing apparatus and full personal protective clothing and equipment DISPOSAL Burn contaminated waste in an approved incinerator Phenol may be recovered by charcoal absorption, solvent extraction or steam stripping A concentration of 1% by weight is required for economical recovery Phenol is water soluble and is amenable to biological or chemical oxidation Solutions can be chemically oxidized by chlorine chlorine dioxide, or other oxidants Phenol content of water supply not to exceed 0 001 mg/L (DO NOT flush phenol down drains) RCRA Hazardous Waste # U188 Reportable Spill Quantity 1000 lbs

SECTION 8 SPECIAL PROTECTION INFORMATION

Provide general and local exhaust ventilation (explosion-proof) to meet TLV requirements When phenol is heated vapor inhalation can be a serious hazard without proper precaution For emergency or nonroutine exposures where the TLV may be exceeded, use an appropriate NIOSH-approved full face respirator Fume hoods should maintain a minimum face velocity of 100 lfm All electrical service in use or storage areas should have an explosion-proof design

DANGER! Avoid any contact with this material Full protective equipment, including splash goggles, faceshield impervious gloves, apron, boots, impervious shirt and trousers, hard hat with brim, acid suit and respirator should be available and worn as appropriate Remove contaminated clothing immediately and do not reuse until it has been properly laundered

Eyewash stations and safety showers should be readily available in use and handling areas

Contact lenses pose a special hazard, soft lenses may absorb and all lenses concentrate irritants

SECTION 9 SPECIAL PRECAUTIONS AND COMMENTS

Store in closed containers in a cool, dry, well-ventilated area away from heated surfaces, open flame and ignition sources Outside or detached storage is preferred Protect containers from physical damage Phenol is a very dangerous compound Do not breathe vapor or allow liquid to come in contact with the skin Wear appropriate protective equipment and remove contaminated clothing immediately Use extreme caution when transporting phenol to prevent leaks Vent containers before heating and do not heat above 140°F (60°C) Do not eat or smoke in areas where this material is being used or handled Do not allow employees who have diseases of the central nervous system, liver, kidney, or lungs to work in area of phenol exposure Provide preplacement and periodic medical exams to employees working with phenol Do not allow untrained workers to handle this material (see also ASTM D2286 Sampling and Handling Phenol)

ICC & DOT - Class B Poison LABEL POISON

DATA SOURCE(S) CODE (See Glossary) 2-12, 15, 19, 23-24, 31, 34, 37, 38, 59, 79 R

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APPROVALS [signature] 11/85

INDUST HYGIENE/SAFETY [signature] 11-85

MEDICAL REVIEW [signature] Dec 85

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PLUTONIUM
MSDS/HAZCOM INFORMATION

Physical/Chemical Characteristics	
Vapor pressure	nf
Solubility in water	nf
Specific gravity	nf
Evaporation rate	nf
Atomic weight	242
Freezing point	nf
Boiling point	3232°F
Appearance	Silvery metal
Odor	nf
Physical Hazards	
Fire	nf
Explosion	nf
Reactivity	nf
Health Hazards	
Signs/symptoms of exposure	nf
Medical conditions aggravated	nf
Primary routes of entry	Inhalation, injestion
OSHA PEL	No OSHA PEL for this substance
ACGIH TLV	No ACGIH TLV for this substance
Carcinogen?	yes
Safe Handling Precaution	nf
Control Measures/Special Protection	nf
Spill Measures	nf
Special Precautions	nf
Other Information	nf

NOTE "nf" indicates that no information was found beyond that already presented

RADIUM
MSDS/HAZCOM INFORMATION

Physical/Chemical Characteristics	
Vapor pressure	nf
Solubility in water	nf
Specific gravity	nf
Evaporation rate	nf
Atomic weight	226
Freezing point	nf
Boiling point	1737°F
Appearance	Brilliant white metal, tarnishes in air
Odor	nf
Physical Hazards	
Fire	nf
Explosion	nf
Reactivity	nf
Health Hazards	
Signs/symptoms of exposure	nf
Medical conditions aggravated	nf
Primary routes of entry	Inhalation, injestion
OSHA PEL	No OSHA PEL for this substance
ACGIH TLV	No ACGIH TLV for this substance
Carcinogen?	yes
Safe Handling Precaution	nf
Control Measures/Special Protection	nf
Spill Measures	nf
Special Precautions	nf
Other Information	nf

NOTE "nf" indicates that no information was found beyond that already presented

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GENIUM PUBLISHING CORP

No 136

SELENIUM

Issued April 1988

SECTION 1 MATERIAL IDENTIFICATION

25

Material Name SELENIUM

Description (Origin/Uses) Used to manufacture other selenium compounds, also used in photography and xerography and as a catalyst and pigment

Other Designations Elemental Selenium, Selenium Base, Selenium Dust, Selenium Metal, Selenium Metal Powder, Se, NIOSH *RTECS* No VS7700000, CAS No 7782-49 2

Manufacturer Contact your supplier or distributor Consult the latest edition of the *Chemicalweek Buyers Guide* (Genium ref 73) for a list of suppliers

Comments. See Genium Industrial MSDS 152 (Selenium Dioxide).

Not Found

HMIS			
H	3		
F	0	R	1
R	1	I	4
PPG*		S	2
*See sect. 8		K	0

SECTION 2. INGREDIENTS AND HAZARDS

	%	EXPOSURE LIMITS
Selenium, CAS No 7782-49 2	ca 100	IDLH* Level 100 mg/m³ **OSHA PEL**** 8-Hr TWA 0 2 mg/m³ **ACGIH TLV,** 1987-88** TLV-TWA 0 2 mg/m³ **Toxicity Data***** Rat, Oral, LD_{50} 6700 mg/kg Rat, Inhalation, LD_{Lo} 33 mg/kg (8 Hrs)

*Immediately dangerous to life and health
**This exposure limit is defined for selenium compounds as Se
***See NIOSH, *RTECS* for additional data with references to reproductive, mutagenic and tumorigenic effects

SECTION 3. PHYSICAL DATA

Boiling Point ca 1263 F (684°C)
Water Solubility Insoluble
Melting Point ca 644 F (340 C)

Specific Gravity (H_2O = 1) Both amorphous and crystalline forms have specific gravities between 4 and 5
Molecular Weight 79 Grams/Mole

Appearance and Odor A dark red to bluish black amorphous solid or dark red, grey, or black crystals appearing in two distinct forms or allotropes, because of differences in crystalline structures, odorless

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air % by Volume	LOWER	UPPER
•	•		•	•

Extinguishing Media *Selenium does not burn Use agents such as dry chemical, "alcohol" foam, or carbon dioxide that will extinguish the surrounding fire

Unusual Fire or Explosion Hazards None

Special Fire-fighting Procedures Wear a self contained breathing apparatus (SCBA) with a full facepiece operated in the pressure demand or positive-pressure mode

SECTION 5. REACTIVITY DATA

Selenium is stable in closed containers at room temperature under normal storage and handling conditions It does not undergo hazardous polymerization

Chemical Incompatibilities This material reacts dangerously with carbides, fluorine, oxygen, potassium, and many more materials (see Genium ref 84)

Conditions to Avoid Avoid direct contact with incompatible chemicals to prevent dangerous and violent reactions Avoid the unintended contact of water with selenium in storage areas or reactor vessels

Hazardous Products of Decomposition When heated to decomposition, selenium readily emits toxic oxides of selenium (SeO_2) Selenium itself is a highly toxic and dangerous material

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SECTION 6 HEALTH HAZARD INFORMATION

Selenium is not listed as a carcinogen by the NTP, IARC, or OSHA

Summary of Risks Direct exposure to selenium or inhalation of its dust causes severe irritation of the skin, eyes, and the upper respiratory tract (URT) **Caution** Some symptoms of exposure to selenium (e g chemical pneumonia) may be delayed for several hours **Medical Conditions Aggravated by Long-Term Exposure** None reported **Target Organs** URT, skin eyes **Primary Entry** Inhalation skin contact **Acute Effects** Skin and eye burns contact dermatitis, intense irritation of the URT, and headache Cases with flulike symptoms resembling metal-fume fever within 24 hours of exposure have been reported **Chronic Effects** Odor of garlic on breath, fatigue irritability, URT irritation, pallor, gastrointestinal distress, metallic taste, and an allergic eye reaction with red, sometimes puffy, eyelids

FIRST AID **Eyes** Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water **Skin** Immediately wash the affected area with plenty of running water Any worker who develops a rash or contact dermatitis must get medical attention and prevent any further contact with selenium metal or its compounds (e g , selenium dioxide, see Genium Industrial MSDS 152) **Inhalation** Remove exposed person to fresh air; restore and/or support his or her breathing as needed Prompt administration of oxygen gas (O_2) by trained medical personnel may aid recovery **Ingestion** Give exposed person several glasses of water to dilute material Do not induce vomiting Never give anything by mouth to someone who is unconscious or convulsing

Treat each exposure to selenium as an emergency! GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES Seek prompt medical assistance for further treatment, observation, and support after first aid If chelation therapy to remove the metallic selenium is indicated, calcium disodium edetate ($CaNa_2$-EDTA) is the chelating agent of choice, do *not* use dimercaprol Burns may require treatment with 10% sodium thiosulfate cream

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak Notify safety personnel, evacuate all nonessential personnel provide adequate ventilation, and do not add any water to the spill or leak area Cleanup personnel need protection against contact with and inhalation of dust (see sect. 8) Scoop up spilled selenium into suitable containers for disposal Carefully sweep or vacuum up small spills or residues without creating dust

Waste Disposal Contact your supplier or a licensed contractor for detailed recommendations for disposal Follow Federal, state and local regulations

OSHA Designations

Air Contaminant (29 CFR 1910 1000 Subpart Z)

EPA Designations (40 CFR 302 4)

RCRA Hazardous Waste Listed without a Number

CERCLA Hazardous Substance, Reportable Quantity 1 lb (0 454 kg)

SECTION 8 SPECIAL PROTECTION INFORMATION

Goggles Always wear protective eyeglasses or chemical safety goggles Follow the eye- and face-protection guidelines in 29 CFR 1910 133 **Respirator** Use a NIOSH-approved respirator per the *NIOSH Pocket Guide to Chemical Hazards* for the maximum-use concentrations and/or the exposure limits cited in section 2 Follow the respirator guidelines in 29 CFR 1910 134 For emergency or nonroutine use (e g , cleaning reactor vessels or storage tanks) wear an SCBA with a full facepiece operated in the pressure demand or positive pressure mode **Warning** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres

Other Wear impervious gloves, boots aprons, and clean, impervious, body-covering clothing to prevent any possibility of skin contact

Ventilation Install and operate general and local maximum explosion-proof ventilation systems powerful enough to maintain airborne levels of selenium below the OSHA PEL standard cited in section 2 **Safety Stations** Make eyewash stations, washing facilities, and safety showers available in areas of use and handling Make the 10% sodium thiosulfate solution or cream and the $CaNa_2$-EDTA chelating agent formula (sect. 6) readily available to a trained safety specialist. **Contaminated Equipment** Contact lenses pose a special hazard, soft lenses may absorb irritants and all lenses concentrate them Particles can adhere to contact lenses and cause corneal damage Do *not* wear contact lenses in any work area

Comments Practice good personal hygiene always wash thoroughly after using this material Avoid transferring it from your hands to your mouth while eating drinking or smoking Do *not* eat, drink, or smoke in any work area

SECTION 9 SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation Store selenium in a cool, dry, well-ventilated area in tightly closed containers away from oxidizing agents, organic materials water metals, and incompatible chemicals (see sect. 5) **Special Handling/Storage** Prevent moisture or water contamination in any storage facility Consider installing an automatic monitoring system to detect selenium contamination, storage under an inert gas (e g a nitrogen blanket) may be warranted depending on the work environment **Engineering Controls** Use selenium in closed engineering systems because of its significant health and physical hazards (see sects 4, 5, and 6) All engineering systems (production transportation etc) should be of maximum explosion proof design (i e , they must be nonsparking, electrically grounded and bonded etc) **Comments** Perform all work with selenium with a sustained, conscientious effort to prevent accidental contact with water Do not create a dusty working environment. Develop a sustained, conscientious program of working guidelines prior to any accidental exposure

Transportation Data (49 CFR 172 101-2)

DOT Shipping Name Selenium Metal Powder	**DOT Label** Poison	**IMO Label** St. Andrew's Cross (X)*
DOT Class Poison B	**DOT ID No** UN2658	**IMO Class** 6 1

*Harmful Stow away from Foodstuffs (IMO Label, Materials of Class 6 1 Packaging Group III)

References 1 2 12 73 84 94 100 103

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Prepared by PJ Igoe, BS

Industrial Hygiene Review DJ Wilson, CIH

Medical Review MJ Hardies, MD

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Material Safety Data Sheet

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GENIUM PUBLISHING CORP

No 181

SILVER

Issued April 1986

SECTION 1 MATERIAL IDENTIFICATION

20

MATERIAL NAME SILVER
DESCRIPTION Elemental metal
OTHER DESIGNATIONS Ag, Argentum, CAS #7440-22-4

MANUFACTURER/SUPPLIER Available from many suppliers

COMMENTS Photography products account for 30% of industrial consumption. Additional uses include electrical conductors, coins, silverware, and jewelry

HMIS
H 1
F 0
R 0
PPE*
*See sect. 8

Not Found

SECTION 2. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Silver, Ag	99+	TWA 0 1 mg/m^3*
		TWA 0 01 mg/m^3**
		---
* Current (1985-86) ACGIH TLV for silver dust and fume		Rat, Implant, TD 2570 mg/kg
** Current (1985-86) ACGIH TLV for soluble silver compounds and OSHA exposure limit.		

SECTION 3. PHYSICAL DATA

Boiling Point 3833 6°F (2112°C)
Vapor Pressure Not Found
Water Solubility Insoluble
Vapor Density (Air = 1) Not Found
Evaporation Rate Not Found

Specific Gravity (H_2O = 1) 10 5
Melting Point 1763 4°F (961 9°C)
Percent Volatile by Volume Not Found
Molecular Weight .. 107 87

Appearance and odor Ductile and malleable lustrous white metal

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp	Flammability Limits In Air	LOWER	UPPER
Not Found	Not Found	Not Found	Not Applicable	Not Applicable

NFPA Classification Noncombustible.

EXTINGUISHING MEDIA Use proper extinguisher for surrounding fire

UNUSUAL FIRE/EXPLOSION HAZARDS None

SPECIAL FIRE-FIGHTING PROCEDURES None

SECTION 5. REACTIVITY DATA

Silver is stable Hazardous polymerization cannot occur

CHEMICAL INCOMPATIBILITIES Acetylene and silver form an insoluble, explosive acetylide If silver is treated with nitric acid in the presence of ethyl alcohol, silver fulminate may be formed, which can be detonated
Ethylenimine forms explosive compounds with silver Finely divided silver and hydrogen peroxide solutions may explode
This material is incompatible with oxalic and tartaric acid Ammonia plus silver may form explosive compounds
Bromoazide explodes on contact with silver foil

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SECTION 6. HEALTH HAZARD INFORMATION | TLV

Silver is not considered a carcinogen by the NTP, IARC, or OSHA

SUMMARY OF RISKS Silver has no known physiological function in man and will accumulate in most tissues Chronic accumulation (threshold in excess of 1 gram) in the body can result in argyria, a permanent condition associated with widespread bluish pigmentation of the skin and conjunctiva. TARGET ORGANS Generally, where contact occurs. PRIMARY ENTRY Inhalation, long-term handling (causes particles to become embedded in skin), or absorption through sweat glands ACUTE EFFECTS are associated with soluble silver compounds that may be caustic, causing local irritations or destruction of tissue, depending upon strength of solution. CHRONIC EFFECTS Argyria may be a local or general effect, depending upon previous exposure FIRST AID EYE CONTACT Flush with water for 15 minutes. Get medical attention.* SKIN CONTACT Wash skin with soap and water Argyria from long-term exposure is permanent and cannot be washed away INHALATION Remove victim to fresh air INGESTION Dilute with water Get medical attention *

* GET MEDICAL ASSISTANCE = In plant, paramedic, community Get medical help for further treatment, observation, and support after first aid, if indicated.

COMMENTS The original 0 01 mg/m^3 TLV was established to prevent a lifetime body accumulation exceeding 1 gram, where argyria would become evident. Evaluation of 25 years of data has shown 0 01 mg/m^3 to be too conservative, therefore, the ACGIH raised the TLV to 0 1 mg/m^3

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

SPILL/LEAK Notify safety personnel, prevent entry into sewers or surface waters Wear respirator where a dusting hazard is anticipated

WASTE DISPOSAL Reclaim or sell waste to a commercial reclaimer

SECTION 8. SPECIAL PROTECTION INFORMATION

GOGGLES are not required unless metal is in the molten state

GLOVES Repeated handling may discolor the skin because of skin rubbing against the metal Cotton gloves will prevent this cosmetic effect.

RESPIRATOR is required where metal dust or fumes are generated with inadequate exhaust ventilation. Air samples should be collected to quantify the exposure levels

VENTILATION is required where air exposures exceed the TLV-TWA'S

OTHER Reclamation of silver from photographic or X-ray film may involve cyanide compounds Proper precautions must be taken when working with cyanide compounds See Genium MSDS #13, Potassium Cyanide, for further information.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

STORAGE SEGREGATION Silver is usually stored in locked cabinets or safes to prevent theft.

ENGINEERING CONTROLS Exhaust ventilation where TLV-TWA is exceeded

EPA Hazardous Substance Designation 40 CFR 260

Data Source(s) Code 2, 4, 6, 14, 59, 82, 84, NFC 1983 DW

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Approvals J.O. Acquaviva, 11/86

Indust Hygiene/Safety [signature] 10-86

Medical Review [signature] 6 Oct 86

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GENIUM PUBLISHING CORP

No 219

SODIUM METAL

Issued November 1987

SECTION 1 MATERIAL IDENTIFICATION

24

Material Name SODIUM METAL

Description (Origin/Uses) Prepared industrially in Down cells and in Castner cells Used as a dehydrating agent, nuclear reactor coolant, reducing agent, conductor in cables, and in organic synthesis, nonglare lighting for highways, radioactive forms in tracer studies and medicine

Other Designations Natrium, Sodium, Sodium, Metallic, Na, NIOSH *RTECS* No VY0686000, CAS No 7440 23 5

Manufacturer Contact your supplier or distributor Consult the latest edition of the *Chemicalweek Buyer s Guide* (Genium Ref 73) for a list of suppliers

HMIS
H 3
F 1
R 2
PPG*
*See sect 8

R 2
I NA
S 4
K 1

SECTION 2. INGREDIENTS AND HAZARDS

	%	EXPOSURE LIMITS
Sodium Metal, CAS No 7440-23 5 Sodium plus water yields sodium hydroxide (NaOH), having the CAS No 1310-73 2 and the NIOSH *RTECS* No WB4900000 with the following exposure limits ACGIH TLV, 1987 88 Ceiling TLV 2 mg/m³ OSHA PEL 8 Hr TWA 2 mg/m³ NIOSH REL 15-Min Ceiling 2 mg/m³	ca 100	Element Sodium No Exposure Limits Established No Toxicity Data is available for element sodium, however as Thyroxine, monosodium salt D- Rabbit, Oral, TD_{LO} 15 mg/kg

SECTION 3. PHYSICAL DATA

Boiling Point 1621 F (883 C)
Water Solubility Reacts Violently with Water
Specific Gravity (H_2O = 1) 0 968
Melting Point 208 F (98°C)
Molecular Weight 22 99 Grams/Mole
pH Water Solution Alkaline (pH >7)

Appearance and Odor Malleable (soft), silver-white solid, oxidizes rapidly in air; waxlike at room temperature Odorless

Comments Solvent solubility sodium decomposes in alcohol, it is insoluble in ether and benzene, and it dissolves in liquid ammonia to produce a blue solution

SECTION 4 FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air	LOWER	UPPER
Flammable Solid	250 F (121°C)	Not Applicable	Not Applicable	Not Applicable

Extinguishing Media Do *not* use water, "alcohol" foam, carbon dioxide, or halogenated extinguishing agents (Halon®) to put out a fire involving sodium metal Use graphite powder, soda ash, powdered sodium chloride, or suitable dry powder (Met L X® or G 1® graphite powders) Pails are adequate for storing extinguishing agents if the material is kept dry **Unusual Fire/Explosion Hazards** Sodium metal is extremely dangerous in contact with moisture or water and releases hydrogen with sufficient heat to cause ignition or explosion It ignites spontaneously in air or with oxygen, and it burns violently accompanied by explosions that can cause the material to spatter **Special Fire-fighting Procedures** Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure demand or positive-pressure mode Fire fighters should move containers from the fire area if possible (see Genium ref 85) Sodium metal may reignite after the fire is extinguished Keep it away from drains or sewers, it may create an additional fire hazard Preplanning and placement of correct extinguishing media is required **Comments** This material is dangerous when exposed to air in a heated environment (fire), it will emit toxic fumes of sodium oxide, which will react with water to produce heat, hydrogen gas and flammable vapors

SECTION 5. REACTIVITY DATA

Sodium metal is not stable and may readily undergo violent chemical change without detonation It will react violently or explosively with water, and it reacts spontaneously in air **Chemical Incompatibilities** Sodium metal reacts vigorously or explosively with oxidizing agents The following materials may cause an explosive reaction acids (hydrochloric acid, hydrogen fluoride, nitric acid [fuming], and sulfuric acid), air, halides such as aluminum bromide, magnesium chloride, aluminum fluoride, and mercuric iodide, carbon dioxide, ammonia, chlorinated hydrocarbons, hydrogen peroxide, lead oxide, phosphorus, potassium oxides, sulfur, sulfur dioxide, and especially water **Conditions to Avoid** Avoid exposing this material to air or moisture It may ignite spontaneously if it is exposed to moist air Its violent reaction with water will produce hydrogen gas. **Hazardous Products of Decomposition** Sodium metal may release these toxic fumes when decomposed sodium oxide, which can react with moisture or steam to produce heat, sodium hydroxide (corrosive), and flammable hydrogen gas
Comments This material is dangerous when exposed to moisture! Keep it dry at all times

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SECTION 6. HEALTH HAZARD INFORMATION

Sodium metal is not listed as a carcinogen by the NTP, IARC, or OSHA

Summary of Risks This material is harmful or fatal if swallowed, inhaled, or absorbed through the skin and mucous membranes It is corrosive to skin and body tissue Inhalation may cause upper respiratory tract irritation, inflammation, and pulmonary damage. It may react violently and explosively on contact with wet tissue and generate heat with resultant chemical and thermal burns The effects of low dosage exposure are usually reversible after exposure has ended **Medical Conditions Aggravated by Long-Term Exposure** None reported **Target Organs** Eyes, skin, mucous membranes, respiratory tract **Primary Entry** Skin and eye contact **Acute Effects** Sodium metal is corrosive to body tissue Alkalies penetrate the skin slowly, therefore the extent of damage depends on the amount and duration of exposure It may cause burns ulcerations, and tissue death (necrosis) Its fumes are highly irritating Eye contact will cause burns, conjunctivitis, corneal damage, and corneal opacification with possible blindness Inhalation of dusts or fumes will cause shortness of breath, headache, nausea and vomiting, and nose and respiratory tract irritation (pneumonitis) If swallowed this material will cause severe pain, vomiting, diarrhea, and possible collapse **Chronic Effects** This material may cause chronic dermatitis, mucous membrane irritation, and lung damage Corrosive effects may result in permanent impairment.

FIRST AID **Eye Contact** Flush eyes, including under the eyelids, promptly and gently with plenty of running water for 15 minutes **Skin Contact** Remove sodium metal-contaminated clothing immediately Wash the affected area with mild soap and water until all the chemical is removed In case of chemical burn, treat as indicated **Inhalation** Remove victim to fresh air If he is not breathing give him artificial respiration, preferably mouth to mouth If breathing is difficult, give him oxygen **Ingestion** If swallowed and victim is conscious, give him water or milk Never give anything by mouth to someone who is unconscious

Comments Sodium metal reacts with moisture to form sodium hydroxide, which is a severe eye, skin, and mucous membrane irritant. Exposure to this may cause permanent eye and skin damage

GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES Seek prompt medical assistance for further treatment, observation, and support after first aid

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak Do not touch spilled sodium metal Shut off ignition sources Do not get water on spilled material or inside material s container because of the danger of violent and explosive reactions Shovel small dry spills into a clean, dry container and cover it. Wear an SCBA and heavy chemical-resistant gloves

Waste Disposal Do not dilute a spill with liquid or dispose of it down any open drain or sewer Contact your supplier or a licensed contractor for recommendations Follow Federal, state, and local regulations

OSHA Designations

Air Contaminant (29 CFR 1910 1000 Subpart Z) Not Listed

EPA Designations (40 CFR 302 4)

RCRA Hazardous Waste, No D003 (Reactivity)

CERCLA Hazardous Substance, Reportable Quantity 10 lbs (4 54 kg)

Comments CERCLA Ratings (Scale 0-3) Health 3, Fire 1, Reactivity 2, Persistence 3

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles Follow the eye and face protection guidelines of 29 CFR 1910 133 Wear chemical splash-proof and dust-resistant safety goggles and/or faceshield with approved safety glasses to prevent eye and face contact There is a potential for violent spattering when using sodium metal **Gloves** Wear appropriate, heavy-duty, chemical resistant gloves **Respirator** Where high levels of sodium metal dust, fume or sodium hydroxide may exist, wear the self-contained breathing apparatus described in section 4 **Other** Wear protective chemical resistant apron boots, and other appropriate protective clothing **Ventilation** Use sodium metal only under a chemical fume hood, under localized ventilation, or where general dilution ventilation is adequate

Safety Stations Make eyewash stations washing facilities, and safety showers available in areas of use and handling because sodium metal is corrosive to eyes and body tissue

Contaminated Equipment Contact lenses pose a special hazard, soft lenses may absorb irritants, and all lenses concentrate them. Particles may cling to contact lenses, causing corneal injury

Comments Practice effective personal hygiene Keep this material off of your clothes and equipment. Avoid transferring this material from hands to mouth wh le eating, drinking, or smoking Do *not* smoke, eat, or drink in any immediate work area. Avoid all contact with sodium metal

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage Segregation Store sodium metal away from sources of heat, ignition, water, and other liquids Store it away from oxidizers

Special Handling/Storage Protect containers against physical damage Store this material in airtight containers under an inert atmosphere such as nitrogen or in naphtha or a similar liquid that does not contain water or free oxygen (e.g., coal oil, kerosene, or other liquid hydrocarbons) *Never store sodium metal under halogenated hydrocarbons* such as Freon®, methylene chloride, or 1,1,1-trichloroethane The storage media is itself a hazard, handle it appropriately An isolated, well-ventilated, fire-resistant building is recommended for large quantity storage Do not store it where automatic sprinklers are present or where water or steam is readily available Provide enough heat in the storage area to keep material sufficiently dry from condensating moisture. Provide appropriate fire extinguishers for the storage area. Water contamination of storage tanks, reactor vessels, etc , must be scrupulously avoided at all costs **Comments** In the absence of water oxygen, or halides, sodium metal is safe to handle Remove only that amount of material immediately needed from the storage area Use a metal container with tightly fitting lid for transport. **Warning** Sodium metal is a highly reactive material and requires a sustained, conscientious effort by all who work with it for its safe use

Transportation Data (49 CFR 172 101-2)

DOT Hazard Class Flammable Solid	**DOT Shipping Name** Sodium Metal	**DOT ID No** UN1428
DOT Label Flammable Solid, Dangerous When Wet	**IMO Label** Dangerous When Wet	**IMO Class.** 4 3

References 1 11, 18, 24, 37 39, 44 73, 82, 84, 87 94 OW/PJI

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Approvals

Indust Hygiene/Safety 5/88

Medical Review 5/88

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Occupational Health Guideline for Soluble Barium Compounds (as Barium)

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information It does not attempt to present all data, rather, it presents pertinent information and data in summary form

APPLICABILITY

The general guidelines contained in this document apply to all soluble barium compounds Physical and chemical properties of several specific compounds are provided for illustrative purposes

SUBSTANCE IDENTIFICATION

Barium nitrate

- Formula $Ba(NO_3)_2$
- Synonyms None
- Appearance and odor Odorless white solid

Barium oxide

- Formula BaO
- Synonyms None
- Appearance and odor Odorless white solid

Barium carbonate

- Formula $BaCO_3$
- Synonyms None
- Appearance and odor Odorless white solid

Barium chloride

- Formula $BaCl_2$
- Synonyms None
- Appearance and odor Odorless white solid

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for soluble barium compounds is 0 5 milligram of soluble barium compounds per cubic meter of air (mg/m^3) averaged over an eight-hour work shift

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Soluble barium compounds can affect the body if they are inhaled or if they come in contact with the eyes or skin They can also affect the body if they are swallowed

- **Effects of overexposure**

1 *Short-term Exposure.* Soluble barium compounds may cause local irritation of the eyes, nose, throat, bronchial tubes, and skin Soluble barium compounds may also cause severe stomach pains, slow pulse rate, irregular heart beat, ringing of the ears, dizziness, convulsions, and muscle spasms Death may occur

2 *Long-term Exposure.* None known

3 *Reporting Signs and Symptoms.* A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to soluble barium compounds

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to soluble barium compounds at potentially hazardous levels

1 *Initial Medical Examination.*

—A complete history and physical examination The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring Examination of the heart, lungs, and nervous system should be stressed The skin should be examined for evidence of chronic disorders

—14" x 17" chest roentgenogram Soluble barium compounds cause human lung damage Surveillance of the lungs is indicated

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These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program However, they may not be sufficient to achieve compliance with all requirements of OSHA regulations

U S DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U S DEPARTMENT OF LABOR
Occupational Safety and Health Administration

in neutral 0 08 to 0 1 M solution on rabbit eyes by injection into the cornea or by dropping for 10 minutes on the eye after the corneal epithelium was removed to facilitate penetration " Grant states that "both the oxide and hydroxide are capable of causing severe alkali burns of the eye, similar to those produced by calcium hydroxide "

MONITORING AND MEASUREMENT PROCEDURES

• **General**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee)

• Method

Sampling and analyses may be performed by collection on a cellulose membrane filter followed by leaching in hot water, solution of sample in acid, and analysis in an atomic absorption spectrophotometer An analytical method for soluble barium compounds is in the *NIOSH Manual of Analytical Methods*, 2nd Ed , Vol 3, 1977, available from the Government Printing Office, Washington, D C 20402 (GPO No 017-033-00261-4)

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level However, there are some exceptions where respirators may be used to control exposure Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation

PERSONAL PROTECTIVE EQUIPMENT

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with barium carbonate, barium chloride, barium nitrate or liquids containing these compounds

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent skin contact with barium oxide or liquids containing barium oxide, where skin contact may occur

• If employees' clothing has had any possibility of being contaminated with barium carbonate, barium chloride, barium nitrate, barium oxide, or liquids containing these compounds, employees should change into uncontaminated clothing before leaving the work premises

• Clothing contaminated with barium carbonate, barium chloride, barium nitrate, or barium oxide should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of contaminant from the clothing If the clothing is to be laundered or otherwise cleaned to remove the contaminant, the person performing the operation should be informed of contaminant's hazardous properties

• Where exposure of an employee's body to barium oxide or liquids containing barium oxide may occur, facilities for quick drenching of the body should be provided within the immediate work area for emergency use

• Non-impervious clothing which becomes contaminated with barium carbonate, barium chloride, barium nitrate, or barium oxide should be removed promptly and not reworn until the contaminant is removed from the clothing

• Employees should be provided with and required to use dust- and splash-proof safety goggles where there is any possibility of barium oxide or liquids containing barium oxide contacting the eyes

• Employees should be provided with and required to use dust- and splash-proof safety goggles where barium carbonate, barium chloride, barium nitrate, or liquids containing these compounds may contact the eyes

• Where there is any possibility that employees' eyes may be exposed to barium oxide or liquids containing barium oxide, an eye-wash fountain should be provided within the immediate work area for emergency use

SANITATION

• Workers subject to skin contact with barium oxide or liquids containing barium oxide should wash any areas of the body which may have contacted barium oxide at the end of each work day

• Skin that becomes contaminated with barium carbonate, barium chloride, or barium nitrate should be promptly washed or showered to remove any contaminant In the case of barium carbonate, employees should use soap or mild detergent and water for washing purposes

• Skin Exposure

If solutions of barium compounds get on the skin, immediately flush the contaminated skin with water If solutions of barium compounds soak through the clothing, remove the clothing immediately and flush the skin with water If irritation persists after washing, get medical attention

• **Breathing**

If a person breathes in large amounts of soluble barium compounds, move the exposed person to fresh air at once If breathing has stopped, perform artificial respiration Keep the affected person warm and at rest Get medical attention as soon as possible

• **Swallowing**

When soluble barium compounds have been swallowed and the person is conscious, give the person large quantities of water immediately After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger Do not make an unconscious person vomit Get medical attention immediately

• **Rescue**

Move the affected person from the hazardous exposure If the exposed person has been overcome, notify some one else and put into effect the established emergency rescue procedures Do not become a casualty Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises

SPILL AND DISPOSAL PROCEDURES

• Persons not wearing protective equipment and clothing should be restricted from areas of spills until cleanup has been completed

• If soluble barium compounds are spilled, the following steps should be taken

1 Ventilate area of spill

2 Collect spilled material in the most convenient and safe manner and deposit in sealed containers for reclamation or for disposal in a secured sanitary landfill Liquids containing soluble barium compounds should be absorbed in vermiculite, dry sand, earth, or a similar material

• Waste disposal method

Soluble barium compounds may be disposed of in sealed containers in a secured sanitary landfill

REFERENCES

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- Formula $Ba(NO_3)_2$
- Synonyms None
- Appearance and odor Odorless white solid

Barium oxide

- Formula BaO
- Synonyms None
- Appearance and odor Odorless white solid

Barium carbonate

- Formula $BaCO_3$
- Synonyms None
- Appearance and odor Odorless white solid

Barium chloride

- Formula $BaCl_2$
- Synonyms None
- Appearance and odor Odorless white solid

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for soluble barium compounds is 0 5 milligram of soluble barium compounds per cubic meter of air (mg/m^3) averaged over an eight-hour work shift.

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Soluble barium compounds can affect the body if they are inhaled or if they come in contact with the eyes or skin They can also affect the body if they are swallowed

- **Effects of overexposure**

1 Short-term Exposure. Soluble barium compounds may cause local irritation of the eyes, nose, throat, bronchial tubes, and skin Soluble barium compounds may also cause severe stomach pains, slow pulse rate, irregular heart beat, ringing of the ears, dizziness, convulsions, and muscle spasms Death may occur

2. Long-term Exposure. None known

3 Reporting Signs and Symptoms. A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to soluble barium compounds

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to soluble barium compounds at potentially hazardous levels

1 Initial Medical Examination.

—A complete history and physical examination The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring Examination of the heart, lungs, and nervous system should be stressed The skin should be examined for evidence of chronic disorders

—14" x 17" chest roentgenogram Soluble barium compounds cause human lung damage Surveillance of the lungs is indicated

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These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program However they may not be sufficient to achieve compliance with all requirements of OSHA regulations

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—FVC and FEV (1 sec) Soluble barium compounds are respiratory irritants Persons with impaired pulmonary function may be at increased risk from exposure Periodic surveillance is indicated

—Electrocardiogram Barium compounds may cause cardiac arrhythmias and may have a direct effect on the cardiac muscle Periodic surveillance of the heart is indicated

2 Periodic Medical Examination The aforementioned medical examinations should be repeated on an annual basis, except that an x-ray is necessary only when indicated by the results of pulmonary function testing, or by signs and symptoms of respiratory disease

• **Summary of toxicology**

Soluble barium salts cause severe gastroenteritis and systemic effects by ingestion Intravenous injection of barium compounds in animals causes a strong, prolonged stimulation of muscle resulting in hyperperistalsis, bladder contraction, vasoconstriction, and irregular contraction of the heart followed by arrest in systole Animals also exhibit stimulation of the central nervous system followed by paralysis Ingestion of barium carbonate by humans causes gastroenteritis, muscular paralysis, slow pulse rate, extrasystoles, and hypokalemia Heavy industrial exposure to dusts of barium sulfate or barium oxides may produce a benign pneumoconiosis, termed baritosis It results in no impairment of ventilatory function, although signs of mild bronchial irritation may occur Characteristic x-ray changes are those of small, dense, circumscribed nodules evenly distributed throughout the lung fields, reflecting the radio-opacity of the barium dust Bronchial irritation has been reported from the inhalation of barium carbonate dust Barium hydroxide and barium oxide are strongly alkaline in aqueous solution, causing severe burns of the eye and irritation of the skin

CHEMICAL AND PHYSICAL PROPERTIES

• **Physical data—Barium nitrate**

1 Molecular weight 261 4

2 Boiling point (760 mm Hg) Greater than 592 C (greater than 1098 F) (decomposes)

3 Specific gravity (water = 1) 3 24

4 Vapor density (air = 1 at boiling point of barium nitrate) Not applicable

5 Melting point 592 C (1098 F)

6 Vapor pressure at 20 C (68 F) Essentially zero

7 Solubility in water, g/100 g water at 20 C (68 F) 9 2

8 Evaporation rate (butyl acetate = 1) Not applicable

• **Physical data—Barium oxide**

1 Molecular weight 153 3

2 Boiling point (760 mm Hg) 2000 C (3632 F)

3 Specific gravity (water = 1) 5 72

4 Vapor density (air = 1 at boiling point of barium oxide) Not applicable

5 Melting point 1921 C (3490 F)

6 Vapor pressure at 20 C (68 F) Essentially zero

7 Solubility in water, g/100 g water at 20 C (68 F) Reacts

8 Evaporation rate (butyl acetate = 1) Not applicable

• **Physical data—Barium carbonate**

1 Molecular weight 197 3

2 Boiling point (760 mm Hg) 1300 C (2372 F) (decomposes)

3 Specific gravity (water = 1) 4 25

4 Vapor density (air = 1 at boiling point of barium carbonate) Not applicable

5 Melting point Decomposes at 1300 C (2372 F)

6 Vapor pressure at 20 C (68 F) Essentially zero

7 Solubility in water, g/100 g water at 20 C (68 F) 0 0022

8 Evaporation rate (butyl acetate = 1) Not applicable

• **Physical data—Barium chloride**

1 Molecular weight 208 3

2 Boiling point (760 mm Hg) 1560 C (2840 F)

3 Specific gravity (water = 1) 3 86

4 Vapor density (air = 1 at boiling point of barium chloride) Not applicable

5 Melting point 963 C (1765 F)

6 Vapor pressure at 20 C (68 F) Essentially zero

7 Solubility in water, g/100 g water at 20 C (68 F) 36

8 Evaporation rate (butyl acetate = 1) Not applicable

• **Reactivity**

1 Conditions contributing to instability For barium nitrate, elevated temperatures may cause melting and decomposition, for the other compounds, none hazardous

2 Incompatibilities Contact of barium oxide with water, carbon dioxide, or hydrogen sulfide may cause fires and explosions Contact of barium carbonate with acids causes formation of carbon dioxide gas that may cause suffocation in enclosed spaces Contact of barium nitrate with organic matter and combustible materials may cause fires and explosions

3 Hazardous decomposition products Toxic gases and vapors (such as oxides of nitrogen and carbon monoxide) may be released in a fire involving barium nitrate

4 Special precautions None

• **Flammability**

1 Flash point Not applicable

2 Autoignition temperature For barium nitrate, data not available, for the the other compounds, not applicable

3 Flammable limits in air, % by volume Not applicable

4 Extinguishant Large amounts of water should be used on adjacent fires

• **Warning properties**

According to Grant, barium chloride causes "considerable iritis, which subsides in a few days" when "tested

in neutral 0 08 to 0 1 M solution on rabbit eyes by injection into the cornea or by dropping for 10 minutes on the eye after the corneal epithelium was removed to facilitate penetration " Grant states that "both the oxide and hydroxide are capable of causing severe alkali burns of the eye, similar to those produced by calcium hydroxide "

MONITORING AND MEASUREMENT PROCEDURES

• **General**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee)

• **Method**

Sampling and analyses may be performed by collection on a cellulose membrane filter followed by leaching in hot water, solution of sample in acid, and analysis in an atomic absorption spectrophotometer An analytical method for soluble barium compounds is in the *NIOSH Manual of Analytical Methods,* 2nd Ed , Vol 3, 1977, available from the Government Printing Office, Washington, D C 20402 (GPO No 017-033-00261-4)

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level However, there are some exceptions where respirators may be used to control exposure Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation

PERSONAL PROTECTIVE EQUIPMENT

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with barium carbonate, barium chloride, barium nitrate, or liquids containing these compounds

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent skin contact with barium oxide or liquids containing barium oxide, where skin contact may occur

• If employees' clothing has had any possibility of being contaminated with barium carbonate, barium chloride, barium nitrate, barium oxide, or liquids containing these compounds, employees should change into uncontaminated clothing before leaving the work premises

• Clothing contaminated with barium carbonate, barium chloride, barium nitrate, or barium oxide should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of contaminant from the clothing If the clothing is to be laundered or otherwise cleaned to remove the contaminant, the person performing the operation should be informed of contaminant's hazardous properties

• Where exposure of an employee's body to barium oxide or liquids containing barium oxide may occur, facilities for quick drenching of the body should be provided within the immediate work area for emergency use

• Non-impervious clothing which becomes contaminated with barium carbonate, barium chloride, barium nitrate, or barium oxide should be removed promptly and not reworn until the contaminant is removed from the clothing

• Employees should be provided with and required to use dust- and splash-proof safety goggles where there is any possibility of barium oxide or liquids containing barium oxide contacting the eyes

• Employees should be provided with and required to use dust- and splash-proof safety goggles where barium carbonate, barium chloride, barium nitrate, or liquids containing these compounds may contact the eyes

• Where there is any possibility that employees' eyes may be exposed to barium oxide or liquids containing barium oxide, an eye-wash fountain should be provided within the immediate work area for emergency use

SANITATION

• Workers subject to skin contact with barium oxide or liquids containing barium oxide should wash any areas of the body which may have contacted barium oxide at the end of each work day

• Skin that becomes contaminated with barium carbonate, barium chloride, or barium nitrate should be promptly washed or showered to remove any contaminant In the case of barium carbonate, employees should use soap or mild detergent and water for washing purposes

• Skin that becomes contaminated with barium oxide should be promptly washed or showered to remove any barium oxide from the skin after all obvious amounts of barium oxide have been removed by other means (e g , by use of oil or vaseline) Employees who are being burned by barium oxide should immediately utilize quick drenching facilities without first removing barium oxide by other means

• Eating and smoking should not be permitted in areas where solid barium carbonate, barium chloride, barium nitrate, or barium oxide, or liquids containing these compounds are handled, processed, or stored

• Employees who handle barium carbonate, barium chloride, barium nitrate, barium oxide, or liquids containing these compounds should wash their hands thoroughly before eating, smoking, or using toilet facilities In the case of barium carbonate, employees should use soap or mild detergent and water for washing purposes

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to soluble barium compounds may occur and control methods which may be effective in each case

Operation	Controls
Manufacture and distribution of soluble barium compounds	Process enclosure, local exhaust ventilation
Use in manufacture of pressed and blown glasssware and flint and crown optical glass, manufacture of ceramic products, use in electronics industry in manufacture of magnets, vacuum tubes, cathodes, x-ray fluorescent screens, TV picture tubes, and dry cell depolarizers	Process enclosure, local exhaust ventilation
Use in manufacture of photographic papers, dyes, and chemicals	Process enclosure, local exhaust ventilation
Use as pesticides, rodenticides, and disinfectants, use in manufacture of explosives, matches, and pyrotechnics as igniter compositions and fireworks	Process enclosure, local exhaust ventilation
Use as an additive in manufacture of grease, and manufacture of lubricating oils, use in refining of vegetable and animal oils	Process enclosure, local exhaust ventilation
Use in case-hardening of steel in metallurgy, in welding aluminum, in electroplating, and in aluminum and sodium refining	Process enclosure, local exhaust ventilation
Use in water treatment and boiler compounds for softening water; use as catalysts, analytical reagents, and purifying agents	Process enclosure, local exhaust ventilation
Use for treatment of textiles, leather, and rubber; use in manufacture of paper and cellulose as a bleaching agent, use in manufacture of pigments, colors, and lakes	Process enclosure, local exhaust ventilation
Use as a depilatory in processing of hides, as a fire-proof and extinguishing agent, in embalming, in sugar refining, in gas and solvent drying, in marble substitutes, in valve manufacture, and as a smoke suppressant in diesel fuels	Process enclosure, local exhaust ventilation
Use in manufacture of pigments, paints, enamels, and printing inks	Process enclosure, local exhaust ventilation

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance

• **Eye Exposure**

If solutions of barium compounds get into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally Get medical attention immediately Contact lenses should not be worn when working with these chemicals

• **Skin Exposure**

If solutions of barium compounds get on the skin, immediately flush the contaminated skin with water If solutions of barium compounds soak through the clothing, remove the clothing immediately and flush the skin with water If irritation persists after washing, get medical attention

• **Breathing**

If a person breathes in large amounts of soluble barium compounds, move the exposed person to fresh air at once If breathing has stopped, perform artificial respiration Keep the affected person warm and at rest Get medical attention as soon as possible

• **Swallowing**

When soluble barium compounds have been swallowed and the person is conscious, give the person large quantities of water immediately After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger Do not make an unconscious person vomit Get medical attention immediately

• **Rescue**

Move the affected person from the hazardous exposure If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures Do not become a casualty Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises

SPILL AND DISPOSAL PROCEDURES

• Persons not wearing protective equipment and clothing should be restricted from areas of spills until cleanup has been completed

• If soluble barium compounds are spilled, the following steps should be taken

1 Ventilate area of spill

2 Collect spilled material in the most convenient and safe manner and deposit in sealed containers for reclamation or for disposal in a secured sanitary landfill Liquids containing soluble barium compounds should be absorbed in vermiculite, dry sand, earth, or a similar material

• Waste disposal method

Soluble barium compounds may be disposed of in sealed containers in a secured sanitary landfill

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RESPIRATORY PROTECTION FOR SOLUBLE BARIUM COMPOUNDS (AS BARIUM)

Condition	Minimum Respiratory Protection* Required Above 0 5 mg/m³
Particulate Concentration	
2 5 mg/m³ or less	Any dust and mist respirator, except single-use **
5 mg/m³ or less	Any dust and mist respirator, except single-use or quarter-mask respirator Any fume respirator or high efficiency particulate filter respirator Any supplied-air respirator Any self-contained breathing apparatus
25 mg/m³ or less	A high efficiency particulate filter respirator with a full facepiece Any supplied-air respirator with a full facepiece, helmet, or hood Any self-contained breathing apparatus with a full facepiece
250 mg/m³ or less	A Type C supplied-air respirator operated in pressure-demand or other positive pressure mode or with a full facepiece, helmet, or hood operated in continuous-flow mode A powered air-purifying respirator with a high efficiency particulate filter
Greater than 250 mg/m³ or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode
Escape	A high efficiency particulate filter respirator Any escape self-contained breathing apparatus

*Only NIOSH-approved or MSHA-approved equipment should be used

**If eye irritation occurs, full-facepiece respiratory protective equipment should be used

STRONTIUM
MSDS/HAZCOM INFORMATION

Physical/Chemical Characteristics	
Vapor pressure	10 mm at 898°F
Solubility in water	nf
Specific gravity	nf
Evaporation rate	nf
Atomic weight	87 62
Freezing point	nf
Boiling point	1366°F
Appearance	Silvery white metal
Odor	nf
Physical Hazards	
Fire	High, ignites spontaneously with air
Explosion	Moderate, in dust form
Reactivity	nf
Health Hazards	
Signs/symptoms of exposure	nf
Medical conditions aggravated	nf
Primary routes of entry	Inhalation and ingestion
OSHA PEL	No OSHA PEL for this substance
ACGIH TLV	No ACGIH TLV for this substance
Carcinogen?	yes
Safe Handling Precaution	nf
Control Measures/Special Protection	nf
Spill Measures	nf
Special Precautions	nf
Other Information	nf

NOTE "nf" indicates that no information was found beyond that already presented

Material Safety Data Sheet

from Genium's Reference Collection
Genium Publishing Corporation
1145 Catalyn Street
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GENIUM PUBLISHING CORP

No 677

1,1,2,2-TETRACHLOROETHANE

Issued November 1988

SECTION 1. MATERIAL IDENTIFICATION 27

Material Name 1,1,2,2-TETRACHLOROETHANE

Description (Origin/Uses) Used as a solvent primarily for cleaning and extraction procedures and as a chemical intermediate in the manufacture of trichloroethylene and tetrachloroethylene, and as an analytic reagent by textile manufacturers in polymer characterization tests

Other Designations. Acetylene Tetrachloride, *sym*-Tetrachloroethane, $CHCl_2CHCl_2$, CAS No 0079-34-5

Manufacturer· Contact your supplier or distributor Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref 73) for a list of suppliers

Genium

HMIS			
H	2	R	1
F	0	I	4
R	0	S	–
PPG*		K	–

*See sect 8

SECTION 2. INGREDIENTS AND HAZARDS

	%	EXPOSURE LIMITS
1,1,2,2-Tetrachloroethane, CAS No 0079-34-5	Ca 100	**OSHA PEL (Skin*)** 8-Hr TWA 1 ppm, 7 mg/m³ **ACGIH TLV (Skin*), 1988-89** TLV-TWA 1 ppm, 7 mg/m³ **Toxicity Data**** Human, Oral, TD_{Lo} 30 mg/kg Human, Inhalation, TC_{Lo} 1000 mg/m³ (30 Mins) Rat, Oral, LD_{50} 800 mg/kg

*This material can be absorbed through intact skin, which contributes to overall exposure
**See NIOSH, *RTECS* (KI8575000), for additional data with references to reproductive, tumorigenic, and irritative effects

SECTION 3. PHYSICAL DATA

Boiling Point 295°F (146°C)
Melting Point. -47°F (-44°C)
% Volatile by Volume Ca 100
Vapor Pressure. 6 Torrs at 77°F (25°C)*
Molecular Weight 168 Grams/Mole
Solubility in Water (%) Insoluble
Specific Gravity (H_2O = 1) 1.58658 at 77°F (25°C)

Appearance and Odor· A colorless, nonflammable, heavy, mobile liquid, sweetish, suffocating, characteristic chloroform odor The odor recognition threshold is reported to be less than 3 ppm.

*At 77°F (25°C) the concentration of 1,1,2,2-tetrachloroethane in saturated air is approximately 7900 ppm

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point*	Autoignition Temperature*	LEL*	UEL*

Extinguishing Media *1,1,2,2-Tetrachloroethane does not burn Use extinguishing agents that will put out the surrounding fire **Unusual Fire or Explosion Hazards** None reported **Special Fire-fighting Procedures.** Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode to protect against the effects of the nearby fire

SECTION 5. REACTIVITY DATA

Stability/Polymerization 1,1,2,2-Tetrachloroethane is stable in closed containers during routine operations at room temperature Hazardous polymerization cannot occur **Chemical Incompatibilities:** Hazardous reactions between 1,1,2,2-tetrachloroethane and 2,4-dinitrophenyl disulfide, nitrogen tetroxide, chemically active metals such as potassium, and strong caustics such as potassium hydroxide, sodium, sodium-potassium alloy, hot iron, aluminum, and zinc in the presence of steam are reported **Conditions to Avoid** Prevent exposure to the incompatible chemicals listed above Contact with water causes appreciable hydrolysis that will degrade and decompose this liquid **Hazardous Products of Decomposition** Thermal-oxidative degradation of 1,1,2,2-tetrachloroethane can produce highly toxic gases such as carbon monoxide (CO) and oxides of chlorine (ClO_2)

SECTION 6. HEALTH HAZARD INFORMATION

Carcinogenicity NIOSH lists 1,1,2,2-tetrachloroethane as a carcinogen
Summary of Risks 1,1,2,2 Tetrachloroethane is absorbed through intact skin in significant amounts, one human fatality has been attributed to this route of exposure This liquid is considered to be one of the most toxic of the common chlorinated hydrocarbons, particularly with respect to the liver Severely acute exposure causes depression of the central nervous system (CNS), which can cause death within 12 hours **Medical Conditions Aggravated by Long-Term Exposure.** None reported **Target Organs** Skin, eyes, respiratory system, CNS, gastrointestinal system, liver, and kidneys **Primary Entry** Inhalation, skin contact/absorption **Acute Effects** The initial symptoms of exposure are lacrimation, salivation, and irritation of the nose and throat, continued exposure can lead to nausea, vomiting, and narcosis Also, low blood pressure and cardiac rhythm abnormalities, respiratory depression, nausea, vomiting, burns of the esophagus, and diarrhea, and anesthesia with dizziness leading to loss of consciousness and coma, plus possible transient liver and kidney changes **Chronic Effects** The two sets of manifestations are (1) malaise, drowsiness, decreased appetite, then nausea and retching, a bad taste in the throat, constipation, headache, pale stools, jaundice, and dark urine, as well as mental confusion, stupor, and coma, and (2) hand

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ECTION 6 HEALTH HAZARD INFORMATION, cont.

sensation of deafness, numbness in hands and feet, a decrease in reflexes, headache, and nausea. FIRST AID Eyes Immediately es, including under the eyelids, gently but thoroughly with flooding amounts of running water for at least 15 minutes Skin Rinse ected areas with flooding amounts of water, then wash it with soap and water **Inhalation.** Remove the exposed person to fresh air; store and/or support his or her breathing as needed. Have qualified medical personnel administer oxygen as required Keep the exposed person warm and at rest until medical help is available **Ingestion** Unlikely Should this type of exposure occur, give the exposed person 3 glasses of water to drink and induce vomiting, then repeat this procedure **Get medical help (in plant, paramedic, community) for all xposures.** Seek prompt medical assistance for further treatment, observation, and support after first aid. Note to Physician Workers xposed to this liquid should be evaluated with a full battery of tests for the liver, kidneys, and CNS systems, as well as the blood

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

pill/Leak Notify safety personnel, evacuate unnecessary personnel, and provide adequate ventilation Cleanup personnel must be properly clothed and equipped to protect the skin and eyes against any contact with the liquid as well as inhalation of its vapor (see sect. 8) Vacuum the spilled 1,1,2,2-tetrachloroethane and pump it into suitable containers for disposal. **Waste Disposal** Contact your supplier or a licensed contractor for detailed recommendations. Follow Federal, state, and local regulations

OSHA Designations
Listed as an Air Contaminant (29 CFR 1910 1000 Subpart Z)
EPA Designations (40 CFR 302 4)
RCRA Waste, No U209
ERCLA Hazardous Substance, Reportable Quantity 1 lb (0 454 kg), per the Clean Water Act (CWA), § 307 (a), and the Resource Conservation and Recovery Act (RCRA), § 3001

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles Always wear protective eyeglasses or chemical safety goggles Where splashing of this liquid is possible, wear a full face shield Follow OSHA eye- and face-protection regulations (29 CFR 1910 133) **Respirator** Use a NIOSH-approved respirator per Genium reference 88 for the maximum-use concentrations and/or the exposure limits cited in section 2 Follow OSHA respirator regulations (29 CFR 1910 134) For emergency or nonroutine operations (spills or cleaning reactor vessels and storage tanks), wear an SCBA **Warning** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres. **Other** Wear impervious gloves, boots, aprons, gauntlets, etc , to prevent skin contact with this liquid **Ventilation** Install and operate general and local ventilation systems ful enough to maintain airborne levels of this material below the OSHA PEL standard cited in section 2. Local exhaust ventilation erred because it prevents dispersion of the contaminant into the general work area by eliminating it at its source Consult the latest edition of Genium reference 103 for detailed recommendations **Safety Stations:** Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work areas **Contaminated Equipment.** Contact lenses pose a special hazard, soft lenses may absorb irritants, and all lenses concentrate them. Do *not* wear contact lenses in any work area. Remove contaminated clothing and launder it before wearing it again, clean this material from your shoes and equipment. **Comments.** Practice good personal hygiene, always wash thoroughly after using this material and before eating, drinking, smoking, using the toilet, or applying cosmetics Keep it off your clothing and equipment. Avoid transferring it from your hands to your mouth while eating, drinking, or smoking Do *not* eat, drink, or smoke in any work area. Do not inhale 1,1,2,2-tetrachloroethane vapor

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation Store 1,1,2,2-tetrachloroethane in closed, airtight containers in a cool, dry, well-ventilated area away from incompatible chemicals (see sect. 5) **Special Handling/Storage** Provide storage areas with adequate ventilation to prevent concentrations of the vapor from building up beyond the occupational exposure limits cited in section 2

Transportation Data (49 CFR 172.101-2)

DOT Shipping Name Tetrachloroethane
DOT Hazard Class ORM-A
ID No UN1702
DOT Packaging Requirements 49 CFR 173 620
DOT Packaging Exceptions 49 CFR 173.505

IMO Shipping Name 1,1,2,2-Tetrachloroethane
IMO Hazard Class 6 1
IMO Label Poison
IMDG Packaging Group II

ences· 1, 38, 84-94, 100, 116, 117, 120, 122

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Occupational Health Guideline for Tetrachloroethylene*

INTRODUCTION

This guideline is intended as a source of information for employees, employers, physicians, industrial hygienists, and other occupational health professionals who may have a need for such information It does not attempt to present all data, rather, it presents pertinent information and data in summary form

SUBSTANCE IDENTIFICATION

- Formula $CCl_2 = CCl_2$
- Synonyms Perchloroethylene, perchlorethylene, tetrachlorethylene, perk
- Appearance and odor Colorless liquid with an odor like chloroform or ether

PERMISSIBLE EXPOSURE LIMIT (PEL)

The current OSHA standard for tetrachloroethylene is 100 parts of tetrachloroethylene per million parts of air (ppm) averaged over an eight-hour work shift, with a ceiling level of 200 ppm and a maximum acceptable peak of 300 ppm for 5 minutes in any three-hour period NIOSH has recommended that the permissible exposure limit be reduced to 50 ppm (339 mg/m³) averaged over a work shift of up to 10 hours per day, 40 hours per week with a ceiling level of 100 ppm (678 mg/m³) averaged over a 15-minute period The NIOSH Criteria Document for Tetrachloroethylene should be consulted for more detailed information

HEALTH HAZARD INFORMATION

- **Routes of exposure**

Tetrachloroethylene can affect the body if it is inhaled or if it comes in contact with the eyes or skin It can also affect the body if it is swallowed

- **Effects of overexposure**

1 Short-term Exposure Tetrachloroethylene may cause headache, nausea, drowsiness, dizziness, incoordination, and unconsciousness It may also cause irritation of the eyes, nose, and throat and flushing of the face and neck In addition, it might cause liver damage with such findings as yellow jaundice and dark urine The liver damage may become evident several weeks after the exposure

2. Long-term Exposure. Prolonged or repeated overexposure to liquid tetrachloroethylene may cause irritation of the skin It might also cause damage to the liver and kidneys

3 Reporting Signs and Symptoms. A physician should be contacted if anyone develops any signs or symptoms and suspects that they are caused by exposure to tetrachloroethylene

- **Recommended medical surveillance**

The following medical procedures should be made available to each employee who is exposed to tetrachloroethylene at potentially hazardous levels

1 Initial Medical Examination

—A complete history and physical examination The purpose is to detect pre-existing conditions that might place the exposed employee at increased risk, and to establish a baseline for future health monitoring Examination of the liver and the cardiovascular and neurological systems should be stressed The skin should be examined for evidence of chronic disorders

—Liver function tests Tetrachloroethylene may cause liver damage A profile of liver function should be obtained by using a medically acceptable array of biochemical tests

—Urinalysis Since kidney damage has also been observed from exposure, a urinalysis should be obtained to include at minimum specific gravity, albumin, glucose, and a microscopic on centrifuged sediment

2 Periodic Medical Examination The aforementioned medical examinations should be repeated on an annual basis

- **Summary of toxicology**

Tetrachloroethylene vapor is a narcotic Rats did not survive when exposed for longer than 12-18 minutes to 12,000 ppm, when exposed repeatedly to 470 ppm they showed liver and kidney injury Cardiac arrhythmias

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These recommendations reflect good industrial hygiene and medical surveillance practices and their implementation will assist in achieving an effective occupational health program However they may not be sufficient to achieve compliance with all requirements of OSHA regulations

U S DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health

U S DEPARTMENT OF LABOR
Occupational Safety and Health Administration

attributed to sensitization of the myocardium to epinephrine have been observed with certain other chlorinated hydrocarbons, but exposure of dogs to concentrations of 5000 and 10,000 ppm tetrachloroethylene did not produce this phenomenon Four human subjects were unable to tolerate 5000 ppm in a chamber for 6 minutes They experienced vertigo, nausea, and mental confusion during the 10 minutes following cessation of exposure In an industrial exposure to an average concentration of 275 ppm for 3 hours, followed by 1100 ppm for 30 minutes, a worker lost consciousness, there was apparent clinical recovery 1 hour after exposure but the monitored concentration of tetrachloroethylene in the patient's expired air diminished slowly over a 2-week period Long-term industrial exposures have been reported to cause various neuropathies, such as numbness, trembling, neuritis, and defects of memory During the second and third post-exposure weeks, the results of liver function tests became abnormal, suggesting that acute exposure had had a significant effect upon the liver Other instances of liver injury following industrial exposure have been reported Other effects on humans of inhalation of various concentrations are as follows 2000 ppm, mild narcosis within 5 minutes, 600 ppm, sensation of numbness around the mouth, dizziness, and some incoordination after 10 minutes In human experiments, 7-hour exposures at 100 ppm resulted in mild irritation of the eyes, nose, and throat, flushing of the face and neck, headache, somnolence, and slurred speech Exposure of the skin to the liquid for 40 minutes resulted in a progressively severe burning sensation beginning within 5 to 10 minutes, the result was marked erythema, which subsided after 1 to 2 hours The liquid sprayed into rabbits' eyes produced immediate pain and blepharospasm, patches of epithelium were lost, but the eyes recovered completely within 2 days

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**
  1 Molecular weight 165 85
  2 Boiling point (760 mm Hg) 121 2 C (250 F)
  3 Specific gravity (water = 1) 1 62
  4 Vapor density (air = 1 at boiling point of tetrachloroethylene) 5 83
  5 Melting point −22 4 C (−8 F)
  6 Vapor pressure at 20 C (68 F) 14 mm Hg
  7 Solubility in water, g/100 g water at 20 C (68 F) 0 015
  8 Evaporation rate (butyl acetate = 1) 2 8
- **Reactivity**
  1 Conditions contributing to instability Heat
  2 Incompatibilities Tetrachloroethylene reacts with strong oxidizers and chemically active metals such as sodium, lithium, and beryllium
  3 Hazardous decomposition products Toxic gases and vapors (such as hydrogen chloride, phosgene, and carbon monoxide) may be released when tetrachloroethylene decomposes
  4 Special precautions Liquid tetrachloroethylene will attack some forms of plastics, rubber, and coatings
- **Flammability**
  1 Not combustible
- **Warning properties**
  1 Odor Threshold Both May and Stern state that 50 ppm is the odor threshold for tetrachloroethylene
  2 Eye Irritation Level Grant reports that "exposure to high concentrations of (tetrachloroethylene) vapor causes mild sensation of irritation to the eyes, but serious injury is not likely " The exact concentrations producing irritation are not mentioned by Grant

  Spector, however, reports that after a 20- to 30-minute exposure to 206 to 235 ppm, eye irritation occurs in humans.

  Patty reports "very slight irritation of the eyes" among humans at 106 ppm
  3 Other Information Spector reports that a 10-minute exposure to 513 to 690 ppm produces nose and throat irritation
  4 Evaluation of Warning Properties Since the odor threshold of tetrachloroethylene is below the permissible exposure limit, and since eye irritation occurs at a concentration only twice the permissible exposure limit, its warning properties are considered to be adequate

MONITORING AND MEASUREMENT PROCEDURES

- **Eight-Hour Exposure Evaluation**

Measurements to determine employee exposure are best taken so that the average eight-hour exposure is based on a single eight-hour sample or on two four-hour samples Several short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee)

- **Ceiling Evaluation**

Measurements to determine employee ceiling exposure are best taken during periods of maximum expected airborne concentrations of tetrachloroethylene Each measurement should consist of a fifteen (15) minute sample or series of consecutive samples totalling fifteen (15) minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee) A minimum of three (3) measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure

- **Peak Above Ceiling Evaluation**

Measurements to determine employee peak exposure should be taken during periods of maximum expected airborne concentration of tetrachloroethylene Each measurement should consist of a 30-minute sample or a series of consecutive samples totalling 30 minutes in the employee's breathing zone (air that would most nearly represent that inhaled by the employee) A minimum of

three measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure

• Method
Sampling and analyses may be performed by collection of vapors using an adsorption tube with subsequent desorption with carbon disulfide and gas chromatographic analysis Also, detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure tetrachloroethylene may be used An analytical method for tetrachloroethylene is in the *NIOSH Manual of Analytical Methods*, 2nd Ed , Vol 3, 1977, available from the Government Printing Office, Washington, D.C 20402 (GPO No 017-033-00261-4)

RESPIRATORS

• Good industrial hygiene practices recommend that engineering controls be used to reduce environmental concentrations to the permissible exposure level However, there are some exceptions where respirators may be used to control exposure Respirators may be used when engineering and work practice controls are not technically feasible, when such controls are in the process of being installed, or when they fail and need to be supplemented Respirators may also be used for operations which require entry into tanks or closed vessels, and in emergency situations If the use of respirators is necessary, the only respirators permitted are those that have been approved by the Mine Safety and Health Administration (formerly Mining Enforcement and Safety Administration) or by the National Institute for Occupational Safety and Health

• In addition to respirator selection, a complete respiratory protection program should be instituted which includes regular training, maintenance, inspection, cleaning, and evaluation

PERSONAL PROTECTIVE EQUIPMENT

• Employees should be provided with and required to use impervious clothing, gloves, face shields (eight-inch minimum), and other appropriate protective clothing necessary to prevent repeated or prolonged skin contact with liquid tetrachloroethylene

• Non-impervious clothing which becomes contaminated with liquid tetrachloroethylene should be removed promptly and not reworn until the tetrachloroethylene is removed from the clothing

• Clothing wet with liquid tetrachloroethylene should be placed in closed containers for storage until it can be discarded or until provision is made for the removal of tetrachloroethylene from the clothing If the clothing is to be laundered or otherwise cleaned to remove the tetrachloroethylene, the person performing the operation should be informed of tetrachloroethylene s hazardous properties

• Employees should be provided with and required to use splash-proof safety goggles where liquid tetrachloroethylene may contact the eyes

SANITATION

• Skin that becomes contaminated with liquid tetrachloroethylene should be promptly washed or showered with soap or mild detergent and water to remove any tetrachloroethylene

• Employees who handle liquid tetrachloroethylene should wash their hands thoroughly with soap or mild detergent and water before eating, smoking, or using toilet facilities.

COMMON OPERATIONS AND CONTROLS

The following list includes some common operations in which exposure to tetrachloroethylene may occur and control methods which may be effective in each case

Operation	Controls
Use as dry cleaning solvent, as degreasing and metal cleaning agent, in vapor degreasing of metal parts	Local exhaust ventilation, general dilution, personal protective equipment
Use as chemical intermediate in production of fluorocarbons, pesticides, and trichloroacetic acid	Process enclosure, local exhaust ventilation, general dilution ventilation
Use as scouring, sizing, desizing, solvent and greaser remover in processing and finishing of textiles	Local exhaust ventilation, general dilution, personal protective equipment
Use as general industrial solvent in rubber, textile, printing, soap, and paint remover industries	Local exhaust ventilation, general dilution, personal protective equipment
Use as extraction agent for vegetable and mineral oils and in pharmaceutical industry, as vermifuge, as laundry treatment for presoaking and as drying medium in metal and wood industries	Local exhaust ventilation, general dilution ventilation, personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, institute first aid procedures and send for first aid or medical assistance

• **Eye Exposure**

If tetrachloroethylene gets into the eyes, wash eyes immediately with large amounts of water, lifting the lower and upper lids occasionally If irritation is present after washing, get medical attention Contact lenses should not be worn when working with this chemical

• **Skin Exposure**

If tetrachloroethylene gets on the skin, promptly wash the contaminated skin using soap or mild detergent and water If tetrachloroethylene soaks through the clothing, remove the clothing promptly and wash the skin using soap or mild detergent and water If irritation persists after washing, get medical attention

• **Breathing**

If a person breathes in large amounts of tetrachloroethylene, move the exposed person to fresh air at once If breathing has stopped, perform artificial respiration Keep the affected person warm and at rest Get medical attention as soon as possible

• **Swallowing**

When tetrachloroethylene has been swallowed, get medical attention immediately If medical attention is not immediately available, get the afflicted person to vomit by having him touch the back of his throat with a finger or by giving him syrup of ipecac as directed on the package This non-prescription drug is available at most drug stores and drug counters and should be kept with emergency medical supplies in the workplace Do not make an unconscious person vomit

• **Rescue**

Move the affected person from the hazardous exposure If the exposed person has been overcome, notify someone else and put into effect the established emergency rescue procedures Do not become a casualty Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises.

SPILL, LEAK, AND DISPOSAL PROCEDURES

• Persons not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed

• If tetrachloroethylene is spilled or leaked, the following steps should be taken

1 Ventilate area of spill or leak

2 Collect for reclamation or absorb in vermiculite, dry sand, earth, or a similar material

Waste disposal method

Tetrachloroethylene may be disposed of by absorbing it in vermiculite, dry sand, earth or a similar material and disposing in a secured sanitary landfill

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• SPECIAL NOTE

Tetrachloroethylene appears on the OSHA "Candidate List" of chemicals being considered for further scientific review regarding its carcinogenicity (*Federal Register*, Vol 45, No 157, pp 5372-5379, 12 August 1980) The International Agency for Research on Cancer (IARC) has evaluated the data on this chemical and has concluded that it causes cancer See *IARC Monographs on the Evaluation of Carcinogenic Risk of Chemicals to Man* Volume 20, 1979

RESPIRATORY PROTECTION FOR TETRACHLOROETHYLENE

Condition	Minimum Respiratory Protection* Required Above 100 ppm
Vapor Concentration	
500 ppm or less	Any chemical cartridge respirator with a full facepiece and an organic vapor cartridge(s)
	A gas mask with a chin-style or a front- or back-mounted organic vapor canister
	Any supplied-air respirator with a full facepiece, helmet, or hood
	Any self-contained breathing apparatus with a full facepiece
Greater than 500 ppm or entry and escape from unknown concentrations	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode
	A combination respirator which includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive pressure or continuous-flow mode and an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode
Fire Fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive pressure mode
Escape	Any gas mask providing protection against organic vapors
	Any escape self-contained breathing apparatus

*Only NIOSH-approved or MSHA-approved equipment should be used

Material Safety Data Sheet

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GENIUM PUBLISHING CORP

No 80

THALLIUM METAL
(Revision A)
Issued December 1980
Revised April 1988

SECTION 1. MATERIAL IDENTIFICATION 25

Material Name THALLIUM METAL

Description (Origin/Uses) Used in semiconductor research, also alloyed with mercury for the manufacture of switches and closures that operate at subzero temperatures

Other Designations Tl, NIOSH *RTECS* No XG3425000, CAS No 7440-28-0

Manufacturer Contact your supplier or distributor Consult the latest edition of the *Chemicalweek Buyers Guide* (Genium ref 73) for a list of suppliers

Comments The hazards of working with thallium metal are associated with cutting, grinding, welding, etc, that produce dust, fumes, powders, and gases

Not Found

HMIS			
H	1		
F	1	R	1
R	1	I	3
PPG*		S	1
*See sect 8		K	-

SECTION 2. INGREDIENTS AND HAZARDS

	%	EXPOSURE LIMITS
Thallium Metal, CAS No 7440-28-0	Ca 100	IDLH* Level 20 mg/m³ (Soluble Compounds) **OSHA PEL (Skin**)** 8-Hr TWA *** 0 1 mg/m³ **ACGIH TLV, 1987-88** TLV-TWA *** 0 1 mg/m³ **Toxicity Data**** Man, Oral, TD_{Lo} 5 714 mg/kg

*Immediately dangerous to life and health (soluble)
**This material or its salts can be absorbed through intact skin, which contributes to overall exposure
***Exposure limit defined for soluble thallium compounds as Tl
****See NIOSH, *RTECS*, for additional data.

SECTION 3. PHYSICAL DATA

Boiling Point 2655 F (1457 C)
Melting Point 579 F (304 C)
Specific Gravity (H_2O = 1) 11 85
Water Solubility (%) Insoluble
Molecular Weight. 204 Grams/Mole

Appearance and Odor· A bluish white, very soft, easily fusible heavy metal, odorless

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air % by Volume	LOWER	UPPER
•	•		•	•

Extinguishing Media *Use dry chemical, "alcohol" foam, carbon dioxide, or water spray to put out thallium fires Contact your supplier for further recommendations

Unusual Fire or Explosion Hazards. Thallium metal dust particles suspended in the air can explode If a thallium dust cloud forms, immediately eliminate all possible sources of ignition such as sparks, open flame, etc., and spray the area with a water mist or fog Working with this material can produce heat and sparks, which can ignite flammable materials and vapors in the workplace

Special Fire-fighting Procedures. Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode.

SECTION 5. REACTIVITY DATA

Thallium metal is stable in closed containers at room temperature under normal storage and handling conditions It does not undergo hazardous polymerization In air, a poisonous coating of thallium oxide (Tl_2O) can develop on the exposed surface of thallium metal

Chemical Incompatibilities This material reacts violently with fluorine

Conditions to Avoid Prevent contact with fluorine Avoid exposure to sources of ignition such as open flame, sparks, and lighted tobacco products

Hazardous Products of Decomposition. During fires thallium can form thallium oxide

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SECTION 6 HEALTH HAZARD INFORMATION

Thallium metal is not listed as a carcinogen by the NTP, IARC, or OSHA

Summary of Risks Thallium is a cumulative poison. It or its salts can be absorbed through intact skin, if they are ingested they are rapidly absorbed by the gastrointestinal (GI) tract. Thallium acts as a mitotic (affecting cell division) agent and a general cellular poison Acute poisoning chiefly affects the central nervous system (CNS) and the GI tract. The ingestion of soluble thallium salts causes more serious effects than the ingestion of the pure metal **Medical Conditions Aggravated by Long-Term Exposure** Disorders of the CNS, GI tract, kidneys, liver, and eyes may be worsened by exposure to thallium Administer preplacement and periodic medical exams emphasizing these organs functions **Target Organs** Eyes, CNS, lungs, liver, kidneys, GI tract. **Primary Entry** Skin absorption or contact, inhalation **Acute Effects** Nausea, vomiting, diarrhea, tingling or pain in the extremities, weakness, coma, convulsions, and death **Chronic Effects** Weakness, pain in the extremities (polyneuritis), loss of hair (alopecia, the most visible sign), and disorders of the cardiac, renal, and endocrine systems **FIRST AID** **Eyes** Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes **Skin** Immediately wash the affected area with soap and water because of the increased hazard from absorption **Inhalation** Remove the exposed person to fresh air; restore and/or support his or her breathing as needed **Ingestion** *Treat as an emergency* Never give anything by mouth to someone who is unconscious or convulsing If the exposed person is responsive, give him or her several glasses of milk or water to drink and then induce vomiting

GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES. Seek prompt medical assistance for further treatment, observation, and support after first aid The treatment recommended in *Genium reference 100 (p 529) includes the following* Maintain fluid and electrolytic balance, administer potassium chloride to replace thallium intracellularly, and use hemoperfusion and hemodialysis as warranted by the specifics of the incident Various chelating therapies have been recommended

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak Notify safety personnel, evacuate all nonessential personnel, and provide adequate ventilation Cleanup personnel need protection against contact with and inhalation of dust (see sect. 8) Prevent skin contact Scoop up spilled thallium into suitable containers for disposal Carefully sweep or vacuum up small spills or residues without creating dust.

Waste Disposal Contact your supplier or a licensed contractor for detailed recommendations Consider recycling Follow Federal, state and local regulations

OSHA Designations

Air Contaminant (29 CFR 1910 1000 Subpart Z, for soluble thallium compounds as Tl)

EPA Designations (40 CFR 302 4)

RCRA Hazardous Waste Listed without Number

CERCLA Hazardous Substance, Reportable Quantity 1000 lbs (454 kg)

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles Always wear protective eyeglasses or chemical safety goggles Follow the eye- and face-protection guidelines in 29 CFR 1910 133 **Respirator** Wear a NIOSH-approved respirator per the *NIOSH Pocket Guide to Chemical Hazards* for the maximum-use concentrations and/or the exposure limits cited in section 2 Follow the respirator guidelines in 29 CFR 1910 134 For emergency or nonroutine use (e g , cleaning reactor vessels or storage tanks), wear an SCBA with a full facepiece operated in the pressure-demand or positive pressure mode **Warning** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres

Other Wear impervious gloves, boots, aprons, and clean, impervious, body-covering clothing to prevent any possibility of skin contact. Barrier creams may be useful to limit the effects of skin contact

Ventilation Install and operate general and local ventilation systems powerful enough to maintain airborne levels of thallium below the OSHA PEL standard cited in section 2

Safety Stations Make eyewash stations, washing facilities, and safety showers available in use and handling areas

Contaminated Equipment Contact lenses pose a special hazard, soft lenses may absorb irritants and all lenses concentrate them. Particles can adhere to contact lenses and cause corneal damage Do *not* wear contact lenses in any work area

Comments Practice good personal hygiene, always wash thoroughly after using this material Avoid transferring it from your hands to your mouth while eating drinking, or smoking Do *not* eat, drink, or smoke in any work area.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation Store thallium metal in a cool, dry, well-ventilated area in closed containers away from oxidizing agents, fluorine, and sources of ignition

Special Handling/Storage Practice good housekeeping techniques that minimize accumulation of dust, cleaning procedures should not create dusty conditions

Transportation Data (49 CFR 172 101-2)

DOT Shipping Name Thallium Salt, Solid, NOS	**DOT Label** Poison	**IMO Label** Poison or St. Andrew s Cross (X)*
DOT ID Nos UN1707, NA1707	**DOT CLass** Poison B	**IMO Class** 6 1

*Harmful-Stow away from Foodstuffs (IMO Label, Materials of Class 6 1 Packaging Group III)

References 1, 2, 12, 73, 84 94, 100, 103

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MATERIAL SAFETY DATA SHEET

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GENIUM PUBLISHING CORP

NO. 74

TIN METAL/POWDER

Date September 1980

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME TIN METAL/POWDER
DESCRIPTION. Two allotropic forms. White tin (β) and gray tin (α)
OTHER DESIGNATIONS Stannum, Sn, GE Material B10E9, CAS #007 440 315
MANUFACTURER Available from several suppliers.

SECTION II. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Tin	>99	8-hr TWA 2 mg/m^3*
*Current OSHA standard , and ACGIH (1980) Intended Changes List for tin, tin oxide, and inorganic compounds (except SnH_4), as Sn STEL is for 4 mg/m^3		Rat, Implant TDLo 7600 mg/kg Carcinogenic Effects Mouse, Implant TDLo 18 gm/kg Neoplastic Effects

SECTION III. PHYSICAL DATA

Boiling point, deg C ---------- 2260-70
Vapor pressure, 1610 deg C, mm Hg - 1
Brinell hardness ---------- 2 9
Solubility in water, g/100 cc --- Insoluble
Melting point, deg C ---------- 231 9

Specific gravity,
α-form (gray tin) ---------- 5.77
β-form (white tin) ---------- 7.29
Atomic weight ---------- 118 69

Appearance and Odor Silver-white, ductile metal, also in powdered form.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits In Air	LOWER	UPPER
	630 C* (cloud) 430 C* (dust layer)	dust cloud explosion	0.19 oz/ft^3	--

Extinguishing Media. (Obtain detailed fire-fighting information from supplier.)
When powdered tin is exposed to heat or ignition sources it is a moderate fire and explosion hazard. Particle size and dispersion in air determine reactivity.
Firefighters should wear self-contained breathing apparatus.

*98% of dust goes thru a 74 micron sieve. Sn dust cloud can be ignited by a 0.080 J spark. Ignition temperature in nitrogen, 900 C. Reaction temperature in CO_2, 720 C.

SECTION V. REACTIVITY DATA

Stable in air, but powder will oxidize (especially in presence of moisture).
Transformation to brittle gray (alpha) at temperatures below 18 C, transition is very slow and at -40 C crumbles to gray amorphous powder.
Incompatible with halogens, cupric nitrate, sodium and potassium peroxide. Can produce incandescence with sulfur.
Reacts slowly with cold dilute HCl, dilute HNO_3, hot dilute H_2SO_4, readily with concentrated HCl, aqua regia. Reacts very slowly with acetic acid.
Oxidizing salt solutions that dissolve tin are potassium peroxysulfate, ferric chloride and sulfate, and aluminum and stannic chlorides.
Metal normally has a protective thin film of stannic oxide which thickens as the temperature is raised.

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SECTION VI. HEALTH HAZARD INFORMATION

TLV (See Sect. II) 2 mg/m^3

Tin is poorly absorbed from the alimentary canal. Completely harmless to rats in oral dosages. Exposure to dust/fumes may cause a mild benign pneumoconiosis. Early diagnosis is possible with a chest x-ray since tin is readily radio-opaque. Tin deposits in lungs may not alter function, and reports show no massive fibrosis, disability, or special complicating factors from dust exposures.

FIRST AID

Eye Contact Flush with running water for 15 minutes, including under eyelids.

Skin Contact. Wash area with soap and water.

Inhalation· Remove to fresh air. Restore or support breathing as required.

Ingestion Induce vomiting, seek medical attention.

Seek medical help for further observation, support and treatment.

SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES

Notify safety personnel of powdered spills. Remove sources of heat or ignition. Keep airborne dust at a minimum.

Valuable as scrap metal

DISPOSAL: Recovered particulates from an electrostatic precipitator can be recycled. Waste slag (inert and insoluble) may be buried in an approved landfill. Maximum concentration of tin discharge to waterways is 2.0 ppm.

Follow Federal, State, and Local regulations.

SECTION VIII. SPECIAL PROTECTION INFORMATION

Provide general and local exhaust ventilation to meet TLV requirements in the workplace where tin powder is used or fume is generated from heated tin.

Avoid eye contact by use of chemical safety goggles where dusty conditions occur.

Eye washing stations and washing facilities should be readily accessible.

Provide employee training in the correct use of personal protective equipment, especially dust masks, and in the case of fumes, proper canister or air-supplied respirators. Respirators should be available for nonroutine or emergency use above the TLV.

Provide preplacement and periodic medical examinations for those regularly exposed to tin, and tin compounds, with emphasis directed toward chest x-ray. See Sect. II.

SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS

Store in a dry, well-ventilated, low fire risk area. Avoid heat and ignition sources.

Use good housekeeping practices to prevent accumulation of dust and follow sound cleaning techniques that will keep airborne particulate at a minimum.

Avoid breathing dust or fume. Minimize skin contact.

Storetin powder in a closed container.

DATA SOURCE(S) CODE· 2,4-7,9-12,40-42

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Industrial Hygiene and Safety 10-9-80

MEDICAL REVIEW· 10/22/80

Material Safety Data Sheet

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GENIUM PUBLISHING CORP

No 317
TOLUENE
(Revision D)

Issued August 1979
Revised April 1986

SECTION 1. MATERIAL IDENTIFICATION

20

MATERIAL NAME TOLUENE

OTHER DESIGNATIONS Methyl Benzene, Methyl Benzol, Phenylmethane, Toluol, C_7H_8, CAS #0108-88-3

MANUFACTURER/SUPPLIER Available from many suppliers, including
Allied Corp., PO Box 2064R, Morristown, NJ 07960, Telephone. (201) 455-4400
Ashland Chemical Co., Industrial Chemicals & Solvents Div., PO Box 2219, Columbus, OH, Telephone. (614) 889-3844

HMIS
H. 2
F 3
R. 0
PPE*
*See sect. 8

R 1
I 3
S 2
K 4

SECTION 2 INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Toluene	ca 100	8-hr TLV 100 ppm, or 375 mg/m^3* (Skin)** Man, Inhalation, TCLo 100 ppm. Psychotropic*** Rat, Oral, LD_{50}. 5000 mg/kg Rat, Inhalation, LCLo 4000 ppm/4 hrs Rabbit, Skin, LD_{50}. 14 gm/kg Human, Eye. 300 ppm

- Current (1985 86) ACGIH TLV The OSHA PEL is 200 ppm with an acceptable ceiling concentration of 300 ppm and an acceptable maximum peak of 500 ppm/10 minutes
- ** Skin designation indicates that toluene can be absorbed through intact skin and contribute to overall exposure
- *** Affects the mind

SECTION 3. PHYSICAL DATA

Boiling Point 231°F (111°C)
Vapor Pressure @ 20°C, mm Hg .. 22
Water Solubility @ 20°C, wt. % 0 05
Vapor Density (Air = 1) 3 14

Evaporation Rate (BuAc = 1) ... 2.24
Specific Gravity (H_2O = 1) 0 866
Melting Point .. -139°F (-95°C)
Percent Volatile by Volume ca 100
Molecular Weight 92 15

Appearance and odor Clear, colorless liquid with a characteristic aromatic odor The odor is detectable to most individuals in the range of 10 to 15 ppm. Because olfactory fatigue occurs rapidly upon exposure to toluene, odor is not a good warning property

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp	Flammability Limits In Air	LOWER	UPPER
40°F (4°C) CC	896°F (480°C)	% by Volume	1.27	7 1

EXTINGUISHING MEDIA Carbon dioxide, dry chemical, alcohol foam. Do not use a solid stream of water because the stream will scatter and spread the fire Use water spray to cool tanks/containers that are exposed to fire and to disperse vapors.

UNUSUAL FIRE/EXPLOSION HAZARDS This OSHA class IB flammable liquid is a dangerous fire hazard It is a moderate fire hazard when exposed to oxidizers, heat, sparks, or open flame Vapors are heavier than air and may travel a considerable distance to an ignition source and flash back.

SPECIAL FIRE FIGHTING PROCEDURES Fire fighters should wear self-contained breathing apparatus with full facepiece operated in a positive-pressure mode when fighting fires involving toluene.

SECTION 5 REACTIVITY DATA

CHEMICAL INCOMPATIBILITIES Toluene is stable in closed containers at room temperature under normal storage and handling conditions It does not undergo hazardous polymerization. This material is incompatible with strong oxidizing agents, dinitrogen tetraoxide, silver perchlorate, tetranitromethane, and uranium hexafluoride Contact with these materials may cause fire or explosion. Nitric acid and toluene, especially in the presence of sulfuric acid, will produce nitrated compounds that are dangerously explosive

CONDITIONS TO AVOID Avoid exposure to sparks, open flame, hot surfaces, and all sources of heat and ignition Toluene will attack some forms of plastics, rubber, and coatings Thermal decomposition or burning produces carbon dioxide and/or carbon monoxide

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SECTION 6 HEALTH HAZARD INFORMATION | TLV

Toluene is not considered a carcinogen by the NTP, IARC, or OSHA SUMMARY OF RISKS Vapors of toluene may cause irritation of the eyes, nose, upper respiratory tract, and skin. Exposure to 200 ppm for 8 hours causes mild fatigue, weakness, confusion, lacrimation (tearing) and paresthesia (a sensation of prickling, tingling, or creeping on the skin that has no objective cause) Exposure to higher concentrations may cause headache, nausea, dizziness, dilated pupils, and euphoria, and, in severe cases, may cause unconsciousness and death. The liquid is irritating to the eyes and skin. Contact with the eyes may cause transient corneal damage, conjunctival irritation, and burns if not promptly removed. Repeated and/or prolonged contact with the skin may cause drying and cracking It may be absorbed through the skin in toxic amounts Ingestion causes irritation of the gastrointestinal tract and may cause effects resembling those from inhalation of the vapor Chronic overexposure to toluene may cause reversible kidney and liver injury FIRST AID EYE CONTACT Immediately flush eyes, including under eyelids, with running water for at least 15 minutes. Get medical attention if irritation persists * SKIN CONTACT Immediately flush skin (for at least 15 minutes) while removing contaminated shoes and clothing Wash exposed area with soap and water Get medical attention if irritation persists or if a large area has been exposed * INHALATION Remove victim to fresh air Restore and/or support breathing as required. Keep victim warm and quiet. Get medical help * INGESTION Give victim 1 to 2 glasses of water or milk. Contact a poison control center Do not induce vomiting unless directed to do so Transport victim to a medical facility Never give anything by mouth to a person who is unconscious or convulsing * GET MEDICAL ASSISTANCE = In plant, paramedic, community Get medical help for further treatment, observation, and support after first aid, if indicated.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

SPILL/LEAK Notify safety personnel of large spills or leaks. Remove all sources of heat and ignition. Provide maximum explosion-proof ventilation. Limit access to spill area to necessary personnel only Remove leaking containers to safe place if feasible Cleanup personnel need protection against contact with liquid and inhalation of vapor (see sect. 8)
WASTE DISPOSAL. Absorb small spills with paper towel or vermiculite Contain large spills and collect if feasible, or absorb with vermiculite or sand. Place waste solvent or absorbent into closed containers for disposal using nonsparking tools Liquid can be flushed with water to an open holding area for handling Do not flush to sewer, watershed, or waterway
COMMENTS Place in suitable container for disposal by a licensed contractor or burn in an approved incinerator Consider reclaiming by distillation Contaminated absorbent can be buried in a sanitary landfill. Follow all Federal, state, and local regulations TLm 96 100-10 ppm. Toluene is designated as a hazardous waste by the EPA The EPA (RCRA) HW No is U220 (40 CFR 261) The reportable quantity (RQ) is 1000 lbs/454 kg (40 CFR 117)

SECTION 8. SPECIAL PROTECTION INFORMATION

Provide general and local exhaust ventilation to meet TLV requirements. Ventilation fans and other electrical service must be nonsparking and have an explosion-proof design. Exhaust hoods should have a face velocity of at least 100 lfm (linear feet per minute) and be designed to capture heavy vapor For emergency or nonroutine exposures where the TLV may be exceeded, use an organic chemical cartridge respirator if concentration is less than 200 ppm and an approved canister gas mask or self-contained breathing apparatus with full facepiece if concentration is greater than 200 ppm.
Safety glasses or splash goggles should be worn in all work areas Neoprene gloves, apron, face shield, boots, and other appropriate protective clothing and equipment should be available and worn as necessary to prevent skin and eye contact. Remove contaminated clothing immediately and do not wear it until it has been properly laundered

Eyewash stations and safety showers should be readily available in use and handling areas

Contact lenses pose a special hazard, soft lenses may absorb irritants and all lenses concentrate them.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

STORAGE SEGREGATION Store in a cool, dry, well-ventilated area away from oxidizing agents, heat, sparks, or open flame. Storage areas must meet OSHA requirements for class IB flammable liquids. Use metal safety cans for handling small amounts. Protect containers from physical damage. Use only with adequate ventilation. Avoid contact with eyes, skin, or clothing Do not inhale or ingest. Use caution when handling this compound because it can be absorbed through intact skin in toxic amounts SPECIAL HANDLING/STORAGE. Ground and bond metal containers and equipment to prevent static sparks when making transfers Do not smoke in use or storage areas Use nonsparking tools ENGINEERING CONTROLS Preplacement and periodic medical exams emphasizing the liver, kidneys, nervous system, lungs, heart, and blood should be provided. Workers exposed to concentrations greater than the action level (50 ppm) should be examined at least once a year Use of alcohol can aggravate the toxic effects of toluene.
COMMENTS Emptied containers contain product residues. Handle accordingly!
Toluene is designated as a hazardous substance by the EPA (40 CFR 116) DOT Classification. Flammable liquid UN1294
Data Source(s) Code 1-9, 12, 16, 20, 21, 24, 26, 34, 81, 82 CR

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Approvals JO Acosta, 11/86
Indust. Hygiene/Safety DW 10-86
Medical Review [signature] Oct 86

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Material Safety Data Sheet

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GENIUM PUBLISHING CORP

No 312
TRICHLOROETHYLENE
(Revision E)

Issued July 1979
Revised August 1987

SECTION 1. MATERIAL IDENTIFICATION

23

MATERIAL NAME TRICHLOROETHYLENE

DESCRIPTION (Origin/Uses) Prepared from *sym*-tetrachloroethane by way of eliminating HCl by boiling with lime Used to manufacture organic chemicals, pharmaceuticals, in degreasing and dry cleaning, and as a solvent for fats, waxes, rubbers, oils, paints, varnishes, ethers, and cellulose esters.

OTHER DESIGNATIONS Ethylene Trichloride, TCE, Trichloroethene, 1,1,2-Trichloroethylene, C_2HCl_3, NIOSH *RTECS* #KX4550000, CAS #0079-01-6

MANUFACTURER/SUPPLIER Available from several suppliers, including Dow Chemical USA, 2020 Dow Center, Midland, MI 48640; Telephone (517) 636-1000, (800) 258-CHEM

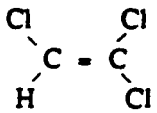
COMMENTS Trichloroethylene is a toxic solvent and a suspected occupational carcinogen.

HMIS			
H	2	R	1
F	1	I	3
R	1	S	1
PPE*		K	0

* See sect. 8

SECTION 2. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Trichloroethylene, CAS #0079-01-6, NIOSH *RTECS* #KX4550000	100	ACGIH Values 1987-88 TLV-TWA* 50 ppm, 270 mg/m^3 TLV-STEL** 200 ppm, 1080 mg/m^3 OSHA PEL 1986*** 8-Hr TWA 100 ppm Ceiling 200 ppm NIOSH REL 1986 10-Hr TWA 25 ppm TOXICITY DATA Human, Oral, LD_{Lo} 7 g/kg Human, Inhalation, TC_{Lo} 6900 mg/m^3 (10 Min) Human, Inhalation, TC_{Lo} 160 ppm/83 Min Human, Inhalation, TD_{Lo} 812 mg/kg



* The TLV-TWA is set to control subjective complaints such as headache, fatigue, and irritability

** The TLV-STEL is set to prevent incoordination and other beginning anesthetic effects from TCE These levels should provide a wide margin of safety in preventing liver injury

*** The OSHA PEL is 300 ppm for 5 minutes in any 2 hours

SECTION 3. PHYSICAL DATA

Boiling Point 188 6°F (87°C)
Vapor Pressure .. 58 Torr at 68°F (20°C)
Water Solubility .. Insoluble
Vapor Density (Air = 1) 4.53
Evaporation Rate Not Listed
Specific Gravity ... 1 4649 at 68°F (20°C)
Melting Point -120 64°F (-84 8°C)
Molecular Weight 131 40 Grams/Mole

Appearance and odor Colorless, nonflammable mobile liquid, sweetish odor like chloroform.

COMMENTS TCE is highly soluble in lipids A high vapor pressure at room temperature provides the potential for TCE vapors to contaminate use areas

SECTION 4 FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air	LOWER	UPPER
Not Listed	770°F (410°C)	% by Volume	8%	10.5%

EXTINGUISHING MEDIA TCE has no flash point in a conventional closed tester at room temperature, but it is moderately flammable at higher temperatures Use dry chemical, carbon dioxide, alcohol foam, or other extinguishing agents suitable for the surrounding fire

OSHA Flammability Class (29 CFR 1910 106) Not Regulated

UNUSUAL FIRE/EXPLOSION HAZARDS During fire conditions TCE emits highly toxic and irritating fumes, including hydrochloric acid and phosgene SPECIAL FIRE-FIGHTING PROCEDURES Wear a self-contained breathing apparatus with a full facepiece operated in a pressure-demand or another positive-pressure mode. At TCE vapor levels of 300-1000 ppm, fire fighters who lack the proper respiratory equipment may experience incoordination and impaired judgment.

DOT Flammability Class (49 CFR 173 115) Not Regulated

SECTION 5 REACTIVITY DATA

Trichloroethylene is stable Hazardous polymerization can occur under certain circumstances (see Conditions to Avoid and Comments, below)

CHEMICAL INCOMPATIBILITIES include magnesium or aluminum powder, NaOH, KOH, or other strong alkaline materials Reactions with alkaline materials may lead to the formation of dangerous explosive mixtures of chloroacetylenes

CONDITIONS TO AVOID When TCE is heated (as in the case with vapor degreasers) or exposed to sunlight, it requires extra stabilization against oxidation, degradation, and polymerization It is slowly decomposed by light when moist.

PRODUCTS OF HAZARDOUS DECOMPOSITION include hydrochloric acid and phosgene under certain conditions at elevated temperatures

COMMENTS TCE is stable under normal handling and storage conditions, and hazardous polymerization is not expected to occur However, failure of the stabilizer at elevated temperatures or other extreme conditions may allow polymerization to take place

SECTION 6 HEALTH HAZARD INFORMATION

Trichloroethylene is listed as a carcinogen by the NTP, IARC, and OSHA. NIOSH recommends that trichloroethylene be treated as an occupational carcinogen. IARC carcinogenic results are animal suspect, animal positive, and human indefinite. SUMMARY OF RISKS Moderate exposures to TCE cause symptoms similar to those of alcohol inebriation. Higher concentrations cause narcotic effects. Ventricular fibrillation has been cited as the cause of death following heavy exposures. TCE-induced hepato cellular carcinomas have been detected in mice during tests conducted by the National Cancer Institute (*Chem & Eng News* 54 [April 5, 1976].4). Organ systems affected by overexposure to TCE are the central nervous system (euphoria, analgesia, anesthesia), degeneration of the liver and kidneys, the lungs (tachypnea), heart (arrhythmia) and skin (irritation, vesication, and paralysis of fingers when immersed in liquid TCE). Contact with the liquid defats the skin, causing topical dermatitis Certain people appear to experience synergistic effects from TCE exposure concomitant with exposure to caffeine, alcohol, and other drugs. When combined with alcohol intake, toxic effects are increased and may cause a red, blotchy facial and upper body rash commonly called degreaser's flush Other reported symptoms of TCE exposure include abnormal fatigue, headache, irritability, gastric disturbances, and intolerance to alcohol Toxic effects from testing of TCE on humans include hallucination, distorted perception, somnolence (general depressed activity), and jaundice. TARGET ORGANS Respiratory system, central nervous system, heart, liver, kidneys, and skin. PRIMARY ENTRY Ingestion, inhalation, skin contact. ACUTE EFFECTS Headache, vertigo, visual disturbance, tremors, nausea, vomiting, dermatitis, dizziness, drowsiness, and irritation to the eyes, nose, and throat. CHRONIC EFFECTS None Reported. MEDICAL CONDITIONS AGGRAVATED BY LONG-TERM EXPOSURE Diseases of the liver, kidneys, lungs, and central nervous system. FIRST AID EYE CONTACT Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes. Get medical help * SKIN CONTACT Wash thoroughly with soap and water Remove and launder contaminated clothing before wearing it again, clean material from shoes and equipment. Get medical help.* INHALATION Remove victim to fresh air, restore and/or support his breathing as needed. Do not give adrenalin to the victim. Get medical help.* INGESTION Call a poison control center Never give anything by mouth to someone who is unconscious or convulsing A professional decision regarding whether or not to induce vomiting is required. Do not give adrenalin to the victim. Get medical help *

*GET MEDICAL ASSISTANCE = IN PLANT, PARAMEDIC, COMMUNITY Get prompt medical assistance for further treatment, observation, and support after first aid.

COMMENTS Workers responses to TCE vary significantly because of many factors, including age, health status, nutrition, and intake of alcohol, caffeine, and medicines. Do not use these substances before, during, or after exposure to TCE. If a worker displays any of the symptoms of exposure to TCE, thoroughly investigate all the possible contributing factors to determine, if possible, how much the work environment levels of TCE are responsible

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

SPILL/LEAK Inform safety personnel of any trichloroethylene spill or leak and evacuate the area for large spills Cleanup personnel must use respiratory and liquid contact protection. Adequate ventilation must be provided Confine the spilled TCE to as small an area as possible Do not allow it to run off to sewers or open waterways Pick up spilled TCE with a vacuum cleaner or an absorbent such as vermiculite

DISPOSAL. Consider reclamation, recycling, or destruction rather than disposal in a landfill

Trichloroethylene is designated as a hazardous substance by the EPA (40 CFR 116.4)

Trichloroethylene is reported in the 1983 EPA TSCA Inventory

EPA Hazardous Waste Number (40 CFR 261.33) U228

EPA Reportable Quantity (40 CFR 117.3) 1000 lbs (454 kgs)

Aquatic Toxicity Rating, TLm 96 Not Listed

SECTION 8 SPECIAL PROTECTION INFORMATION

GOGGLES Always wear protective eyeglasses or chemical safety goggles Follow the eye and face protection guidelines of 29 CFR 1910 133 GLOVES Wear impervious gloves RESPIRATOR Use a NIOSH approved respirator per the *NIOSH Guide to Chemical Hazards* (Genium ref 88) for the maximum-use concentrations and/or the exposure limits cited in section 2 Follow the respirator guidelines in 29 CFR 1910 134 Any detectable concentration of TCE requires an SCBA, full facepiece, and pressure-demand/positive pressure modes WARNING Air-purifying respirators will not protect workers from oxygen-deficient atmospheres OTHER EQUIPMENT Wear rubber boots, aprons, and other suitable body protection appropriate to the existing work environment. VENTILATION Install and operate general and local exhaust ventilation systems of sufficient power to maintain airborne concentrations of TCE below the OSHA PEL standards cited in section 2. SAFETY STATIONS Make eyewash stations, washing facilities, and safety showers available in areas of use and handling Contact lenses pose a special hazard, soft lenses may absorb irritants, and all lenses concentrate them OTHER SPECIAL MODIFICATIONS IN THE WORKPLACE Because of the unresolved controversy about the carcinogenic status of TCE, all existing personal protective equipment and engineering technology should be used to prevent any possibility of worker contact with this material

COMMENTS Practice good personal hygiene Keep material off of your clothes and equipment. Avoid transfer of material from hands to mouth while eating, drinking, or smoking Adhere to the sanitation requirements of 29 CFR 1910 141 and 29 CFR 1910 142

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

STORAGE SEGREGATION Prevent TCE from coming into contact with strong caustics such as NaOH, KOH, chemically active metal like Ba, Li, Na, Mg, Ti, and powdered aluminum or magnesium in acidic solutions SPECIAL HANDLING/ STORAGE Store this material in a cool, dry, well-ventilated area. Avoid elevated temperatures because products of toxic and corrosive decomposition from TCE may form. Monitor the level of any stabilizer component that may be added to the TCE. (Consult the technical data from the supplier to determine the specifics of any added stabilizer) If applicable, follow the supplier s recommendation concerning proper rotation of stock, shelf-life requirements, and levels of stabilizers

ENGINEERING CONTROLS IN THE WORKPLACE Avoid collecting aluminum fines (very small particles) or chips in a TCE vapor degreaser Monitor TCE stabilizer levels regularly Only trained personnel should operate vapor degreasers

TRANSPORTATION DATA (per 49 CFR 172 101 2)

DOT Hazard Class ORM-A	DOT ID No UN1710	IMO Class 6 1
IMO Label St. Andrew s Cross (X)*	DOT Shipping Name Trichloroethylene	DOT Label None

* Harmful - Stow away from foodstuffs (IMO Label, Materials of Class 6 1 Packaging Group III)

References 1 9 12 14 21, 73, 87 94 PI

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Approvals JO Pecurocco

Indust Hygiene/Safety 11-19-87

Medical Review M. L. Hagen

TRITIUM
MSDS/HAZCOM INFORMATION

Physical/Chemical Characteristics	
Boiling Point	nf
Vapor pressure	nf
Solubility in water	nf
Specific gravity	nf
Evaporation rate	nf
Mol weight	nf
Freezing point	nf
Boiling point	nf
Appearance	nf
Odor	nf
Physical Hazards	
Fire	nf
Explosion	nf
Reactivity	nf
Health Hazards	
Signs/symptoms of exposure	nf
Medical conditions aggravated	nf
Primary routes of entry	nf
OSHA PEL	No OSHA PEL for this substance
ACGIH TLV	No ACGIH TLV for this substance
Carcinogen?	nf
Safe Handling Precaution	nf
Control Measures/Special Protection	nf
Spill Measures	nf
Special Precautions	nf
Other Information	nf

NOTE "nf" indicates that no information was found beyond that already presented

MATERIAL SAFETY DATA SHEET

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GENIUM PUBLISHING CORP

NO 124

VANADIUM
METAL/POWDER

DATE October 1983

SECTION I MATERIAL IDENTIFICATION

MATERIAL NAME VANADIUM METAL/POWDER
OTHER DESIGNATIONS V, CAS #007 440 622
MANUFACTURER Available from several suppliers, including
Alpha Products
P O Box 299
Danvers, MA 01923 Tel (617) 777-1970

SECTION II INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Vanadium Metal	-	10-hr TWA 1 0 mg/m^3* (Metal particulate)
Vanadium Pentoxide** (MSDS #88)	-	8-hr TWA 0 05 mg/m^3** (Respirable V_2O_5 dust & fume)

*NIOSH proposed in 1977
**Current ACGIH (1983) TLV for V_2O_5 (When metal is heated oxidation can occur)
For airborne sample analysis vanadium oxides can be dissolved with 0 01N NaOH, leaving metal behind for separate determination

SECTION III PHYSICAL DATA

Boiling point, deg C, 1 atm	3000	Specific gravity, 18 7 C	6 1
Vapor pressure at 2300 C, mm Hg	ca 1 5	Melting point, deg C	ca 1900
Water solubility	Insoluble	Atomic weight	50 9

Appearance & Odor Light gray powder or white, lustrous bulk solid, no odor

SECTION IV FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp	Flammability Limits in Air	Lower	Upper
	Dust* Layer 490 C Cloud 500 C	Vanadium metal dust*	0 22 oz/ft^3	—

Very hot vanadium can burn in air Extinguish metal fire with dry chemical (Contact supplier to obtain fire control recommendations) When dispersed in air as dust, it can be exploded by an ignition source* However, it has a low explosibility index (0 1) and low ignition sensitivity (0 3) on scale of 10
Firefighters need self-contained breathing apparatus with full facepiece, operated in a pressure demand or positive pressure mode when vanadium metal is involved in fire

*Particle size is 100% below 75 µm. Reported minimum ignition energy is 60 mJ for dust cloud

SECTION V REACTIVITY DATA

Massive metal is relatively inert to O_2, N_2, H_2 and H_2O at ambient conditions, but it reacts when heated and still more readily if powdered. When heated in air, vanadium oxidizes to brownish-black trioxide, blue-black tetroxide or yellow-red pentoxide, depending on the temperature It reacts in Cl_2 at 180 C to give VCl_4 It reacts with hot nitric, hydrofluoric, Conc sulfuric, and perchloric acids, but resists hydrochloric and Dil sulfuric acids and alkaline solutions
Vanadium has high solubility in iron (ferrovanadium alloys) and a pronounced tendency to carbide formation It and some of its alloys are deoxidizers in metallurgical processes
Vanadium reaction products can pose toxic hazards The higher valence vanadium compounds generally have the greater toxic potential

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SECTION VI HEALTH HAZARD INFORMATION

TLV 1 0 mg/m^3 for metal (See SectII)

Vanadium is an essential trace element in the chick and rat and may be in man also (controversial) It is ubiquitously present in environment and biological systems.

Inhalation of vanadium metal aerosols is not highly toxic, but when excessive, has produced catarrhal bronchitis, moderate interstitial pneumosclerosis, and, systemically, some adverse liver and kidney effects The chief effects were on the lungs, but no fibrosis or lesions are reported Ingestion produced catarrhal gastritis.

Vanadium pentoxide is a primary irritant and can promote sensitization Its presence increases adverse inhalation and contact effects to the lungs, skin and eyes, "greenish-black tongue" occurs on ingestion. (See MSDS #88).

Ferrovanadium alloy has been found to be more toxic than free vanadium metal, because it increases the solubility of vanadium in biologic material

FIRST AID

Eye Contact Flush immediately and thoroughly with running water for 15 minutes, including under eyelids Get medical help

Skin Contact Wash area with soap and water. Get medical help for irritation

Inhalation Remove to fresh air Restore and/or support breathing. Get medical help

Ingestion Contact physician Gastric lavage may be needed

SECTION VII SPILL LEAK AND DISPOSAL PROCEDURES

Notify safety personnel of spills Clean-up personnel need protection against inhalation of dust or fume Pick up spills and place in appropriate containers for disposal, keeping airborne particulate at a minimum when cleaning up

For vanadium recovery techniques, pollution abatement methods, and detection and treatment processes, see reference #40

DISPOSAL Recover waste when possible and ship to supplier for reprocessing An approved landfill is recommended for waste material that can not be recovered or salvaged.

Follow Federal, State, and Local regulations

SECTION VIII SPECIAL PROTECTION INFORMATION

Provide adequate ventilation to meet TLV requirement in the workplace (Exhaust ventilation may require filtration to protect environment) Approved NIOSH/MESA respirator as specified under provision 30CFR11 Exposure greater than 70 mg/m^3 requires self-contained breathing apparatus with full facepiece operated in positive pressure mode Provide chemical safety goggles and/or faceshield (8 inch min) Wear rubber gloves and protective clothing as needed to avoid skin contact

Provide preplacement and periodic medical examinations including comprehensive medical histories, chest x-ray, pulmonary function tests. Particular emphasis on respiratory tract, skin and eyes Retention of medical records for 30 years after employment has been recommended by NIOSH

SECTION IX SPECIAL PRECAUTIONS AND COMMENTS

Store in closed containers in a cool, dry, well-ventilated area Protect containers from damage Use good housekeeping practices to prevent accumulation of dust and follow cleaning techniques that will keep airborne particulate at a minimum

Avoid inhalation of dust, vapor or fume when generated Prevent contact with eyes and skin Sensitization may occur with repeated or heavy exposures (see Sect. VI)

Use only with adequate ventilation.

Clean work clothes should be supplied daily when vanadium contamination occurs. Follow good personal hygiene practice Chronic exposure effects are not fully known.

Ref "Vanadium Medical and Biological Effects of Environmental Pollutants", National Academy of Sciences, Washington, DC, 1974

DATA SOURCE(S) CODE 2-10,12,14,20,40,41 (MSDS 88)

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APPROVALS MIS/CRD	J. M. Nielsen
INDUST HYGIENE/SAFETY	10-31-83
MEDICAL REVIEW	14 November 1983

Material Safety Data Sheet

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GENIUM PUBLISHING CORP

No 238

URANIUM

Issued August 1988

SECTION 1. MATERIAL IDENTIFICATION

26

Material Name URANIUM

Description (Origin/Uses) Used in nuclear fuels (^{234}U and ^{235}U), in research, and in applications where its high density is useful ^{235}U is used in atom and hydrogen bombs

Other Designations U, CAS No 7440-61-1

NOTE Uranium is regulated by the Nuclear Regulatory Commission (NRC), which should be consulted for specific requirements on all aspects of the production and distribution of this radioactive material

Genium

HMIS			
H	1	R	2
F	1	I	3/4
R	0	S	2
PPG*		K	1

*See sect. 8

SECTION 2. INGREDIENTS AND HAZARDS

	%	EXPOSURE LIMITS
Uranium, CAS No 7440-61-1	Ca 100	**OSHA PEL** 8-Hr TWA 0 05 mg/m³ (Soluble Compounds) 8-Hr TWA 0.25 mg/m³ (Insoluble Compounds) **ACGIH TLVs, 1987-88*** TLV-TWA 0.2 mg/m³ TLV-STEL 0 6 mg/m³ **Toxicity Data** Not Listed**

*Defined for both soluble and insoluble natural uranium compounds
**Monitor NIOSH, *RTECS* (YR3490000), for future data.

SECTION 3. PHYSICAL DATA

Specific Gravity (H_2O = 1)· 19

Water Solubility (%): Insoluble
Molecular Weight: 238 Grams/Mole

Appearance and Odor A silver white, lustrous, heavy, radioactive metal, odor not found.

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air	LOWER	UPPER
•	•	% by Volume	•	•

Extinguishing Media *Use "alcohol" foam, dry chemical, or carbon dioxide to fight uranium fires

Unusual Fire or Explosion Hazards Finely divided turnings, shavings, or chips of uranium are much more reactive than uranium in bulk form. If these are present during fires, do not disperse them into a dust cloud, which may be explosive

Special Fire-fighting Procedures Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode

SECTION 5 REACTIVITY DATA

Uranium is stable in closed containers at room temperature under normal storage and handling conditions It cannot undergo hazardous polymerization.

Chemical Incompatibilities Uranium can react dangerously with air, carbon tetrachloride, chlorine, fluorine, nitric acid, nitric oxide, selenium, sulfur, and water

Conditions to Avoid Prevent contact with incompatible chemicals Do not create dusty working conditions

Hazardous Products of Decomposition Uranium metal fume and/or oxides of uranium (UO_2) can be produced during uranium fires

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SECTION 6. HEALTH HAZARD INFORMATION

Uranium is not listed as a carcinogen by the NTP, IARC, or OSHA

Summary of Risks Uranium and its salts are highly toxic and radioactive. Dermatitis, renal damage, acute necrotic arterial lesions, and even death may occur from exposure. Inhalation of fine uranium particles presents increased radiation hazards, isolated uranium particles in the lungs may be a long-term carcinogenic hazard. The more soluble uranium compounds are considered to be more toxic, especially to the kidneys Dusts of uranium compounds are respiratory irritants, coughing, shortness of breath, etc., are possible Prolonged skin contact with uranium compounds can cause radiation damage to the basal cells **Note:** Radioactivity is the property of the spontaneous emission of alpha or beta particles and sometimes gamma rays by the disintegration of the nuclei of the atoms **Medical Conditions Aggravated by Long-Term Exposure** None reported **Target Organs·** Skin, eyes, liver, kidneys, blood, respiratory system, lymphatic system, and bone marrow **Primary Entry:** Inhalation, skin or eye contact. **Acute Effects.** Nausea, vomiting, shortness of breath, and coughing **Chronic Effects.** Primarily the effects of radiation from insoluble compounds Possibilities include pneumoconiosis, pulmonary fibrosis, lymphoma, osteosarcoma, and lung cancer

FIRST AID· Eyes. Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes **Skin.** Immediately wash the affected area with soap and water Decontaminate body surfaces following radiation standards (procedures) **Inhalation** Remove the exposed person to fresh air; restore and/or support his or her breathing as needed. **Ingestion** Never give anything by mouth to someone who is unconscious or convulsing Seek medical assistance

GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES. Seek prompt medical assistance for further treatment, observation, and support after first aid. Follow the established procedures for handling radioactive materials, including radiation-monitoring programs NOTE TO PHYSICIAN: Following ingestion, gastric lavage with a 2% bicarbonate solution is recommended. A 5% bicarbonate solution has been used by some poison control specialists in radiation treatment.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak Accidental leaks or spills of uranium and its compounds must be planned for well in advance of starting any work procedure Special radiation procedures are required and professional assistance may be needed. Notify safety personnel, evacuate all nonessential personnel, and provide adequate ventilation. Cleanup personnel need protection against contact with and inhalation of dust (see sect. 8)

Waste Disposal Follow all current regulations on the disposal of radioactive products Contact your supplier or a licensed contractor for detailed recommendations Follow Federal, state, and local regulations Special laws governing the disposal of radioactive waste and contaminated items are applicable

OSHA Designations
Air Contaminant (29 CFR 1910 1000 Subpart Z)

EPA Designations (40 CFR 302 4) Not Listed

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles Always wear protective eyeglasses or chemical safety goggles Follow OSHA eye- and face-protection regulations (29 CFR 1910 133) **Respirator** Consult the *NIOSH Pocket Guide to Chemical Hazards* (Genium ref 88) for general recommendations on respirators Follow OSHA respirator regulations (29 CFR 1910 134) For emergency or nonroutine operations (leaks or cleaning reactor vessels and storage tanks), wear an SCBA with a full facepiece operated in the pressure-demand or positive-pressure mode **Warning** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres **Other** Wear impervious gloves (natural rubber, neoprene, or PVC), boots, aprons, etc , as required by the work environment to prevent prolonged or repeated skin contact. **Ventilation** Install and operate general and local exhaust-ventilation systems powerful enough to maintain airborne levels of uranium below the OSHA PEL cited in section 2 **Safety Stations** Make emergency eyewash stations, safety/quick-drench showers, and washing facilities available in work areas **Contaminated Equipment** Contact lenses pose a special hazard, soft lenses may absorb irritants and all lenses concentrate them. Particles can adhere to contact lenses and cause corneal damage Do *not* wear contact lenses in any work area

Comments Practice good personal hygiene, always wash thoroughly after using this material Avoid transferring it from your hands to your mouth while eating, drinking, or smoking Do *not* eat, drink, or smoke in any work area Do not inhale uranium dust.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation Store uranium in closed containers in a cool, dry, well-ventilated area away from sources of ignition and incompatible chemicals (see sect 5)

Special Handling/Storage Do not allow moisture contamination of storage facilities Follow established state and Federal regulations for the use and storage of radioactive materials

Transportation Data (49 CFR 172 101-2)
DOT Shipping Name Uranium Metal Pyrophoric
DOT Label Radioactive and Flammable Solid
DOT Hazard Class Radioactive Material
DOT ID No UN2979

References 1, 38, 84 94, 100 112, 113, 114

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OCCUPATIONAL SAFETY AND HEALTH GUIDELINE FOR VINYL CHLORIDE

POTENTIAL HUMAN CARCINOGEN

INTRODUCTION

This guideline summarizes pertinent information about vinyl chloride for workers, employers, and occupational safety and health professionals who may need such information to conduct effective occupational safety and health programs Recommendations may be superseded by new developments in these fields, therefore, readers are advised to regard these recommendations as general guidelines

SUBSTANCE IDENTIFICATION

- **Formula** C_2H_3Cl
- **Structure.** $CH_2{=}CHCl$
- **Synonyms.** Chlorethene, chlorethylene, monochlorethylene, chloroethylene
- **Identifiers** CAS 75-01-4, RTECS KU9625000, DOT 1086, label required "Flammable Gas"
- **Appearance and odor** Colorless gas with a sweet odor

CHEMICAL AND PHYSICAL PROPERTIES

- **Physical data**

1 Molecular weight 62 50
2 Boiling point (at 760 mmHg) -14°C (7°F)
3 Specific gravity (water = 1) 0 9121
4 Vapor density (air = 1 at boiling point of vinyl chloride) 2 15
5 Melting point -155 7°C (-243 4°F)
6 Vapor pressure at 20°C (68°F) 2,580 mmHg
7 Solubility in water, g/100 g water at 24°C (75°F) 0 11
8 Ionization potential 9 995 eV

- **Reactivity**

1 Incompatibilities Atmospheric oxygen and strong oxidizers may react with vinyl chloride to produce peroxide, which can initiate a violent polymerization reaction
2 Hazardous decomposition products Toxic vapors and gases (e g , hydrogen chloride and carbon monoxide) may be released in a fire involving vinyl chloride
3 Caution Check valves for leaks

- **Flammability**

1 Flash point -78°C (-108°F) (open cup)
2 Autoignition temperature 472°C (882°F)
3 Flammable limits in air, % by volume Lower, 3.6, Upper, 33.0
4 Class IA Flammable Liquid Gas (29 CFR 1910.106), Flammability Rating 4 (NFPA)

- **Warning properties**

1 Odor threshold 3,000 ppm
2 Evaluation of warning properties for respirator selection Warning properties are not considered in recommending respirators for use with carcinogens

EXPOSURE LIMITS

The current Occupational Safety and Health Administration (OSHA) permissible exposure limit (PEL) for vinyl chloride is 1 part of vinyl chloride per million parts of air (ppm) as a time-weighted average (TWA) concentration over an 8-hour workshift, and the ceiling concentration which shall at no time be exceeded is 5 ppm as determined in any 15-minute sampling period The National Institute for Occupational Safety and Health (NIOSH) recommends that vinyl chloride be controlled and handled as a potential human carcinogen in the workplace, and the NIOSH recommended exposure limit (REL) is that exposure be minimized to the lowest feasible limit The American Conference of Governmental Industrial Hygienists (ACGIH) has designated vinyl chloride as an A1 substance (suspected human carcinogen) with an assigned threshold limit value, TLV® of 5 ppm [10 milligrams of vinyl chloride per cubic meter of air (mg/m³)] as a TWA for a normal 8-hour workday and a 40-hour workweek (Table 1)

U S DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service Centers for Disease Control
National Institute for Occupational Safety and Health
Division of Standards Development and Technology Transfer

Table 1 —Occupational exposure limits for vinyl chloride

	Exposure limits	
	ppm	mg/m³
OSHA PEL TWA	1	—
Ceiling (15 min)	5	—
NIOSH REL (Ca)*	Lowest feasible limit	
ACGIH TLV® TWA (A1a)†	5	10

* (Ca) NIOSH recommends treating as a potential human carcinogen
† (A1a) Human carcinogen with an assigned TLV

HEALTH HAZARD INFORMATION

• Routes of exposure
Vinyl chloride may cause adverse health effects following exposure via inhalation, ingestion, or dermal or eye contact

• Summary of toxicology
1 *Effects on animals* Acute inhalation of vinyl chloride by multiple species of animals caused central nervous system depression coma, and death, acute inhalation by dogs also caused cardiac arrhythmias In mice, rats, and hamsters, chronic inhalation or oral administration of vinyl chloride produced cancers of the liver, kidney, central nervous system, skin, and mammary and ear duct glands
2 *Effects on humans* Acute exposure of workers to vinyl chloride has caused narcotic and anesthetic effects Repeated exposure of workers to vinyl chloride has caused increased blood pressure decreased blood platelet counts, increased liver enzyme levels, restricted blood flow, bone degeneration in the fingers, liver and spleen enlargement, nervous system disturbances, central nervous system depression, decreased respiratory function, and emphysema Cancer of the liver has been associated with exposure of workers to vinyl chloride during the polyvinyl chloride production process Cancers of the lung, brain, skin, nervous system, gall bladder, mouth, and pharynx have also been observed in workers with a history of exposure to vinyl chloride An increase in fetal mortality has been reported among wives of workers who had been exposed to vinyl chloride

• Signs and symptoms of exposure
1 *Short-term (acute)* Exposure to vinyl chloride can cause dizziness, light-headedness, nausea, dullness of visual and auditory responses drowsiness, and unconsciousness Irritation of the skin and eyes can also occur Skin contact with the liquid can cause frostbite
2 *Long term (chronic)* Exposure to vinyl chloride can cause thickening of the skin contact and allergic dermatitis, fatigue coughing and sneezing abdominal pain gastrointestinal bleeding nausea vomiting indigestion diarrhea, jaundice, weight loss anorexia and a cold and tingling sensation of the hands and feet

RECOMMENDED MEDICAL PRACTICES

• Medical surveillance program
Workers with potential exposures to chemical hazards should be monitored in a systematic program of medical surveillance intended to prevent or control occupational injury and disease The program should include education of employers and workers about work-related hazards, placement of workers in jobs that do not jeopardize their safety and health, earliest possible detection of adverse health effects, and referral of workers for diagnostic confirmation and treatment The occurrence of disease (a "sentinel health event," SHE) or other work-related adverse health effects should prompt immediate evaluation of primary preventive measures (e g , industrial hygiene monitoring, engineering controls, and personal protective equipment) A medical surveillance program is intended to supplement, not replace, such measures

A medical surveillance program should include systematic collection and epidemiologic analysis of relevant environmental and biologic monitoring, medical screening, morbidity, and mortality data This analysis may provide information about the relatedness of adverse health effects and occupational exposure that cannot be discerned from results in individual workers Sensitivity, specificity, and predictive values of biologic monitoring and medical screening tests should be evaluated on an industry-wide basis prior to application in any given worker group Intrinsic to a surveillance program is the dissemination of summary data to those who need to know, including the employers, occupational health professionals, potentially exposed workers, and regulatory and public health agencies

• Preplacement medical evaluation
Prior to placing a worker in a job with a potential for exposure to vinyl chloride, the physician should evaluate and document the worker's baseline health status with thorough medical, environmental, and occupational histories, a physical examination, and physiologic and laboratory tests appropriate for the anticipated occupational risks These should concentrate on the function and integrity of the skin, liver, kidneys, and cardiovascular, hematopoietic (blood cell forming), nervous, and respiratory systems Medical surveillance for respiratory disease should be conducted by using the principles and methods recommended by NIOSH and the American Thoracic Society (ATS)

A preplacement medical evaluation is recommended in order to detect and assess preexisting or concurrent conditions which may be aggravated or result in increased risk when a worker is exposed to vinyl chloride The examining physician should consider the probable frequency, intensity, and duration of exposure, as well as the nature and degree of the condition in placing such a worker Such conditions which should not be regarded as absolute contraindications to job placement include chronic diseases of the liver The physician should obtain baseline values for serological tests of liver function and markers for infection with Hepatitis B virus

• Periodic medical screening and/or biologic monitoring
Occupational health interviews and physical examinations

should be performed at regular intervals Additional examinations may be necessary should a worker develop symptoms that may be attributed to exposure to vinyl chloride The interviews, examinations, and appropriate medical screening and/or biologic monitoring tests should be directed at identifying an excessive decrease or adverse trend in the integrity and physiologic function of the skin, liver, kidneys, and cardiovascular, hematopoietic, nervous, and respiratory systems as compared to the baseline status of the individual worker or to expected values for a suitable reference population The following test should be used and interpreted according to standardized procedures and evaluation criteria recommended by NIOSH and ATS standardized questionnaires and test of lung function

• **Medical practices recommended at the time of job transfer or termination**

The medical, environmental, and occupational history interviews, the physical examination, and selected physiologic and laboratory tests which were conducted at the time of placement should be repeated at the time of job transfer or termination Any changes in the worker's health status should be compared to those expected for a suitable reference population Because occupational exposure to vinyl chloride may cause diseases of prolonged induction-latency, the need for medical surveillance may extend well beyond termination of employment

• **Sentinel health events**

Delayed-onset SHE's include Liver cancer (hemangiosarcoma) and "white finger" (Raynaud's syndrome, secondary to vasculitis)

MONITORING AND MEASUREMENT PROCEDURES

• **Method**

Sampling and analysis may be performed by collecting vinyl chloride vapors with tandem charcoal tubes followed by desorption with carbon disulfide and analysis by gas chromatography Direct-reading devices calibrated to measure vinyl chloride may also be used if available A detailed sampling and analytical method for vinyl chloride may be found in the *NIOSH Manual of Analytical Methods* (method number 1007)

PERSONAL PROTECTIVE EQUIPMENT

Chemical protective clothing (CPC) should be selected after utilizing available performance data, consulting with the manufacturer, and then evaluating the clothing under actual use conditions

Workers should be provided with and required to use CPC, gloves, and other appropriate protective clothing necessary to prevent skin contact with vinyl chloride

SANITATION

Clothing which is contaminated with vinyl chloride should be removed immediately and placed in sealed containers for storage until it can be discarded or until provision is made for the removal of vinyl chloride from the clothing If the clothing is to be laundered or cleaned, the person performing the operation should be informed of vinyl chloride s hazardous properties Reusable clothing and equipment should be checked for residual contamination before reuse or storage.

A change room with showers, washing facilities, and lockers that permit separation of street and work clothes should be provided

Workers should be required to shower following a workshift and prior to putting on street clothes Clean work clothes should be provided daily

Skin that becomes contaminated with vinyl chloride should be promptly washed with soap and water

The storage, preparation, dispensing, or consumption of food or beverages, the storage or application of cosmetics, the storage or smoking of tobacco or other smoking materials, or the storage or use of products for chewing should be prohibited in work areas

Workers who handle vinyl chloride should wash their faces, hands, and forearms thoroughly with soap and water before eating, smoking, or using toilet facilities

COMMON OPERATIONS AND CONTROLS

Common operations in which exposure to vinyl chloride may occur and control methods which may be effective in each case are listed in Table 2

Table 2.—Operations and methods of control for vinyl chloride

Operations	Controls
During the manufacture of monomer, polymer, copolymer, and terpolymer	Process enclosure, personal protective equipment
During the transfer of monomer to tank cars or polymerization reactors, during maintenance work on tanks or reactors	Local exhaust ventilation, personal protective equipment
During the cleaning of polymerization reaction tanks	Process enclosure, personal protective equipment

EMERGENCY FIRST AID PROCEDURES

In the event of an emergency, remove the victim from further exposure send for medical assistance and initiate emergency procedures

• **Eye exposure**

Where there is any possibility of a worker's eyes being exposed to vinyl chloride, an eye-wash fountain should be

provided within the immediate work area for emergency use

If vinyl chloride gets into the eyes flush them immediately with large amounts of water for 15 minutes, lifting the lower and upper lids occasionally Get medical attention as soon as possible Contact lenses should not be worn when working with this chemical

• **Skin exposure**
Where there is any possibility of a worker's body being exposed to vinyl chloride, facilities for quick drenching of the body should be provided within the immediate work area for emergency use

If vinyl chloride gets on the skin, wash it immediately with soap and water If vinyl chloride penetrates the clothing, remove the clothing immediately and wash the skin with soap and water Get medical attention promptly

• **Rescue**
If a worker has been incapacitated, move the affected worker from the hazardous exposure Put into effect the established emergency rescue procedures Do not become a casualty Understand the facility's emergency rescue procedures and know the locations of rescue equipment before the need arises

SPILLS AND LEAKS

Workers not wearing protective equipment and clothing should be restricted from areas of spills or leaks until cleanup has been completed

If vinyl chloride is spilled or leaked, the following steps should be taken

1 Stop the flow of gas If the source of the leak is a cylinder and the leak cannot be stopped in place, remove the leaking cylinder to an area with local exhaust ventilation and repair the leak or allow the cylinder to empty
2 Remove all ignition sources
3 Ventilate area of spill or leak

WASTE REMOVAL AND DISPOSAL

U S Environmental Protection Agency, Department of Transportation and/or state and local regulations shall be followed to assure that removal, transport, and disposal are in accordance with existing regulations

RESPIRATORY PROTECTION

It must be stressed that the use of respirators is the least preferred method of controlling worker exposure and should not normally be used as the only means of preventing or minimizing exposure during routine operations However, there are some exceptions for which respirators may be used to control exposure when engineering and work practice controls are not technically feasible when engineering controls are in the process of being installed or during emergencies and certain maintenance operations including those requiring confined space entry (Table 3)

In addition to respirator selection, a complete respiratory protection program should be instituted which as a minimum complies with the requirements found in the OSHA Safety and Health Standards 29 CFR 1910 134 A respiratory protection program should include as a minimum an evaluation of the worker's ability to perform the work while wearing a respirator, the regular training of personnel, fit testing, periodic environmental monitoring, maintenance, inspection, and cleaning The implementation of an adequate respiratory protection program, including selection of the correct respirators, requires that a knowledgeable person be in charge of the program and that the program be evaluated regularly

Only respirators that have been approved by the Mine Safety and Health Administration (MSHA, formerly Mining Enforcement and Safety Administration) and by NIOSH should be used Remember! Air-purifying respirators will not protect from oxygen-deficient atmospheres.

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Table 3.—Respiratory protection for vinyl chloride

Condition	Minimum respiratory protection*
Any detectable concentration	Any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode
	Any supplied-air respirator with a full facepiece and operated in a pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in a pressure-demand or other positive pressure mode
Planned or emergency entry into environments containing unknown or any detectable concentration	Any self-contained breathing apparatus with a full facepiece and operated in a pressure-demand or other positive pressure mode
	Any supplied-air respirator with a full facepiece and operated in a pressure-demand or other positive pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive pressure mode
Firefighting	Any self-contained breathing apparatus with a full facepiece and operated in pressure-demand or other positive pressure mode
Escape only	Any air-purifying full facepiece respirator (gas mask) with a chin-style or front- or back-mounted canister providing protection against the compound of concern
	Any appropriate escape-type self-contained breathing apparatus

* Only NIOSH/MSHA-approved equipment should be used

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Material Safety Data Sheet

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No 318

XYLENE (Mixed Isomers)
(Revision D)
Issued November 1980
Revised August 1988

SECTION 1. MATERIAL IDENTIFICATION

26

Material Name XYLENE (Mixed Isomers)

Description (Origin/Uses) Used as a raw material for the production of benzoic acid, phthalic anhydride, isophthalic and terephthalic acids and their dimethyl esters in the manufacture of polyester fibers, in sterilizing catgut, with Canadian balsam as oil-immersion in microscopy, and as a cleaning agent in microscopic techniques

Other Designations Dimethylbenzene, Xylol, C_8H_{10}, CAS No 1330-20-7

Manufacturer Contact your supplier or distributor Consult the latest edition of the *Chemicalweek Buyers' Guide* (Genium ref 73) for a list of suppliers

Comments Although there are three different isomers of xylene (*ortho*, *meta*, and *para*), the health and physical hazards of all three isomers are very similar This MSDS is written for a xylene mixture of all three isomers, which is usually commercial xylene.

NFPA: 3 / 2 / 0 / -

HMIS
H 2
F 3
R 0
PPG*
*See sect 8

R 1
I 3
S 2
K 3

SECTION 2. INGREDIENTS AND HAZARDS

Xylene (Mixed Isomers), CAS No 1330-20-7*

*o-Xylene, CAS No 0095-47-6
m-Xylene, CAS No 0108-38-3
p-Xylene, CAS No 0106-42-3

**Check with your supplier to determine if there are additions, contaminants, or impurities (such as benzene) that are present in reportable quantities per 29 CFR 1910

***Immediately dangerous to life and health.

**** See NIOSH, *RTECS* (No ZE2100000), for additional data with references to reproductive, irritative, and mutagenic effects.

%	EXPOSURE LIMITS
**	IDLH*** Level. 1000 ppm **OSHA PEL** 8-Hr TWA 100 ppm, 435 mg/m³ **ACGIH TLVs, 1987-88** TLV-TWA 100 ppm, 435 mg/m³ TLV-STEL. 150 ppm, 655 mg/m³ **Toxicity Data**** Human, Inhalation, TC_{Lo} 200 ppm Man, Inhalation, LC_{Lo} 10000 ppm/6 Hrs Rat, Oral, LD_{50} 4300 mg/kg

SECTION 3. PHYSICAL DATA

Boiling Point 275°F to 293°F (135°C to 145°C)*
Melting Point· -13°F (-25°C)
Evaporation Rate 0 6 Relative to BuAc = 1
Specific Gravity (H_2O = 1) 0 86

Water Solubility (%): Insoluble
Molecular Weight: 106 Grams/Mole
% Volatile by Volume: Ca 100
Vapor Pressure· 7 to 9 Torrs at 68°F (20°C)
Vapor Density (Air = 1) 3 7

Appearance and Odor A clear liquid, aromatic hydrocarbon odor

*Materials with wider and narrower boiling ranges are commercially available

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	Flammability Limits in Air	LOWER	UPPER
81°F to 90°F (27°C to 32°C)	867°F (464°C)	% by Volume	1%	7%

Extinguishing Media Use foam, dry chemical, or carbon dioxide Use water sprays to reduce the rate of burning and to cool containers

Unusual Fire or Explosion Hazards. Xylene vapor is heavier than air and may travel a considerable distance to a low-lying source of ignition and flash back

Special Fire-fighting Procedures Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode

SECTION 5. REACTIVITY DATA

Xylene is stable in closed containers during routine operations. It does not undergo hazardous polymerization

Chemical Incompatibilities This material may react dangerously with strong oxidizers

Conditions to Avoid Avoid any exposure to sources of ignition and to strong oxidizers

Hazardous Products of Decomposition Carbon monoxide (CO) may be evolved during xylene fires

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SECTION 6 HEALTH HAZARD INFORMATION

Xylene is not listed as a carcinogen by the IARC, NTP, or OSHA

Summary of Risks Liquid xylene is a skin irritant and causes erythema, dryness, and defatting, prolonged contact may cause blistering Inhaling xylene can depress the central nervous system (CNS), and ingesting it can result in gastrointestinal disturbance, and possibly hematemesis (vomiting blood) Effects on the eyes, kidneys, liver, lungs, and the CNS are also reported. **Medical Conditions Aggravated by Long-Term Exposure** Problems with eyes, skin, central nervous system, kidneys, and liver may be worsened by exposure to xylene **Target Organs:** CNS, eyes, gastrointestinal tract, blood, liver, kidneys, skin. **Primary Entry:** Inhalation, skin contact/absorption. **Acute Effects·** Dizziness, excitement, drowsiness, incoordination, staggering gait, irritation of eyes, nose, and throat, corneal vacuolization, anorexia, nausea, vomiting, abdominal pain, and dermatitis **Chronic Effects·** Reversible eye damage, headache, loss of appetite, nervousness, pale skin, and skin rash

FIRST AID Eyes Immediately flush eyes, including under the eyelids, gently but thoroughly with plenty of running water for at least 15 minutes. **Skin** Immediately wash the affected area with soap and water **Inhalation** Remove the exposed person to fresh air; restore and/or support his or her breathing as needed Have a trained person administer oxygen. **Ingestion.** Never give anything by mouth to someone who is unconscious or convulsing Vomiting may occur spontaneously, but do not induce it. If vomiting should occur, keep exposed person's head below his or her hips to prevent aspiration (breathing the liquid xylene into the lungs) Severe hemorrhagic pneumonitis with grave, possibly fatal, pulmonary injury can occur from aspiring very small quantities of xylene

GET MEDICAL HELP (IN PLANT, PARAMEDIC, COMMUNITY) FOR ALL EXPOSURES. Seek prompt medical assistance for further treatment, observation, and support after first aid. If exposure is severe, hospitilization for at least 72 hours with careful monitoring for delayed onset of pulmonary edema is recommended

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Spill/Leak Notify safety personnel, provide ventilation, and eliminate all sources of ignition immediately Cleanup personnel need protection against contact with and inhalation of xylene vapor (see sect. 8) Contain large spills and collect waste or absorb it with an inert material such as sand, earth, or vermiculite Use nonsparking tools to place waste liquid or absorbent into closable containers for disposal. Keep waste out of sewers, watersheds, and waterways.

Waste Disposal Contact your supplier or a licensed contractor for detailed recommendations Follow Federal, state, and local regulations

OSHA Designations

Air Contaminant (29 CFR 1910 1000 Subpart Z)

EPA Designations (40 CFR 302 4)

RCRA Hazardous Waste, No U239

CERCLA Hazardous Substance, Reportable Quantity 1000 lbs (454 kg), per the Clean Water Act (CWA), section 311 (b) (9)

SECTION 8. SPECIAL PROTECTION INFORMATION

Goggles Always wear protective eyeglasses or chemical safety goggles Where splashing is possible, wear a full face shield as a supplementary protective measure Follow OSHA eye- and face-protection regulations (29 CFR 1910 133) **Respirator:** Use a NIOSH-approved respirator per the *NIOSH Pocket Guide to Chemical Hazards* for the maximum-use concentrations and/or the exposure limits cited in section 2 Follow OSHA respirator regulations (29 CFR 1910 134) For emergency or nonroutine use (leaks or cleaning reactor vessels and storage tanks), wear an SCBA with a full facepiece operated in the pressure-demand or positive-pressure mode **Warning** Air-purifying respirators will *not* protect workers in oxygen-deficient atmospheres **Other** Wear impervious gloves, boots, aprons, gauntlets, etc , as required by the specifics of the work operation to prevent prolonged or repeated skin contact with xylene **Ventilation** Install and operate general and local maximum, explosion-proof ventilation systems powerful enough to maintain airborne levels of xylene below the OSHA PEL standard cited in section 2 Local exhaust ventilation is preferred because it prevents dispersion of xylene into general work areas by eliminating it at its source Consult the latest edition of Genium reference 103 for detailed recommendations **Safety Stations** Make eyewash stations, safety/quick-drench showers, and washing facilities available in areas of use and handling **Contaminated Equipment** Contact lenses pose a special hazard, soft lenses may absorb irritants and all lenses concentrate them. Do *not* wear contact lenses in any work area Remove contaminated clothing and launder it before wearing it again, clean xylene from shoes and equipment **Comments** Practice good personal hygiene, always wash thoroughly after using this material. Keep it off of your clothing and equipment Avoid transferring it from your hands to your mouth while eating, drinking, or smoking Do *not* eat, drink, or smoke in any work area Do not inhale xylene vapor

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Storage/Segregation· Store xylene in a cool, dry, well-ventilated area away from sources of ignition and strong oxidizers. Protect containers from physical damage

Special Handling/Storage. Make sure all engineering systems (production, transportation) are of maximum explosion-proof design Ground and bond all containers, pipelines, etc., used in shipping, transferring, reacting, producing, and sampling operations

Transportation Data (49 CFR 172 101-2)

DOT Shipping Name Xylene	**DOT Label** Flammable Liquid	**IMO Label** Flammable Liquid
DOT ID No UN1307	**DOT Hazard Class** Flammable Liquid	**IMO Class** 3 2 or 3 3

References 1, 2, 12, 73, 84 94, 100, 103

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Material Safety Data Sheet

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GENIUM PUBLISHING CORP

No 176

ZINC METAL/POWDER

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SECTION 1. MATERIAL IDENTIFICATION

19

MATERIAL NAME ZINC METAL/POWDER

OTHER DESIGNATIONS Spelter, CAS #7440-66-6, ASTM B-69, Zn

DESCRIPTION Shining white, malleable, blue-gray metal, bars, sheets, wire, foil, flake, and powder

HMIS
H 1
F 1
R 1
PPE •
• See Sect. 8

R 0
I 2
S 1
K -

MANUFACTURERS Available from several suppliers, including Meadowbrook Corp, 30 Rockefeller Plaza, New York City, NY 10112, Telephone)(212) 582-0420

COMMENTS Commonly used for galvanizing iron and other metals, electroplating, battery cells, and as an alloying component of brass or bronze Zinc oxide is used as a pigment in cosmetics and ointments

SECTION 2. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
ZINC, CAS #7440-66-6	>98	OSHA PEL* as Zinc Oxide 5 mg/m^3
• Current ACGIH (1985-86) TWA is 5 mg/m^3 as ZnO fume, while STEL for ZnO is 10 mg/m^3 Metallic zinc particulates can be considered a nuisance dust.		---------- Human, Inhalation TCLo 1 hr

SECTION 3. PHYSICAL DATA

Boiling Point 1664 6 F (907 C)
Melting Point 788°F (420°C)
Vapor Pressure 736°C mm Hg 100
Percent Volatile by Volume Not Found
Water Solubility Insoluble

Molecular Weight 65 38
Vapor Density (Air = 1) Not Found
Evaporation Rate Not Found
Specific Gravity (H_2O = 1) 7 14

Appearance and odor Bright gray-white metallic solid, foil or particulate. No odor

SECTION 4. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp	Flammability Limits In Air	LOWER	UPPER
Not Found	Powder/650 millijoules	Dust Cloud Exp Level		

NFPA CLASSIFICATION 1

EXTINGUISHING MEDIA Special mixtures of dry chemical or clean, dry sand. Dust will form explosive mixtures with air Bulk dust in a damp state may generate heat through chemical reaction and hydrogen gas. UNUSUAL FIRE/EXPLOSION HAZARDS Zn may generate toxic fumes when heated, causing metal fume fever (see sect. 6) Fire fighters should use self-contained breathing apparatus when fighting fires involving zinc or zinc powder SPECIAL FIRE FIGHTING PROCEDURES Zinc and zinc powder will burn in chlorine gas. Care should be taken to ensure that fires involving bulk quantities of zinc powder that are extinguished with water do not generate heat or possible hydrogen gas with subsequent reignition through the reaction of zinc powder and water Concentrations of zinc oxide powder should remain open and not be sealed to allow safe drying

SECTION 5. REACTIVITY DATA

Zinc metal/powder is stable Hazardous polymerization cannot occur

CHEMICAL INCOMPATIBILITIES Contact with acids or alkaline hydroxides will yield hydrogen gas Zinc may react with halogenated hydrocarbon solvents to form salts and hydrogen gas The combination of zinc and carbon disulfide will result in an incandescent reaction

CONDITIONS TO AVOID Bulk zinc dust should be kept in dry, well-ventilated storage to prevent reaction with water and generation of hydrogen gas Zn powder reacts explosively with manganese chloride Zn is resistant to fluorine, chlorine, and bromine, but it reacts strongly with these halogens in the presence of water vapor

HAZARDOUS DECOMPOSITION PRODUCTS Zinc and zinc powder will react with water to generate hydrogen gas

COMMENTS When combined with oxygen, zinc or zinc powder will generate a fume that can result in metal fume fever (see sect. 6)

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SECTION 6. HEALTH HAZARD INFORMATION | TLV

This product is not considered a carcinogen by the NTP, OSHA, or IARC

SUMMARY OF RISKS Zinc metal in most forms is not toxic and is not readily absorbed through the skin, GI tract, or lungs Zn is considered essential to life Although most inorganic Zn compounds are potential causes of gastroenteric irritation, a high-level dose is relatively nontoxic when ingested Inhalation of zinc fumes normally generated by zinc and extreme heat may cause metal fume fever, which is accompanied by dryness and irritation of the throat, coughing and dyspnea, a feeling of weakness, muscle pain, and general malaise Removal from exposure will normally alleviate symptoms, with no residual or chronic effects

TARGET ORGANS Lungs, skin PRIMARY ENTRY inhalation, dermal contact.

ACUTE EFFECTS Inhalation of high levels of zinc fumes may cause metal fume fever

CHRONIC EFFECTS Prolonged skin contact may cause a drying dermatitis. Zinc and zinc powder have little history of causing chronic effects

FIRST AID EYE CONACT Flush well with running water to remove particulates, get medical attention if irritation persists * SKIN CONTACT For cuts, dermal abrasion, irritation, or thermal burns, get medical attention.* INHALATION Remove person to fresh air; get medical attention if symptoms persist.* INGESTION Get medical help if large amount is ingested

* GET MEDICAL ASSISTANCE = In plant, paramedic, community

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

SPILL/LEAK Notify safety personnel of large powder spills Clean up, minimizing dust generation, heat, sources of ignition, and moisture Approved, grounded vacuum cleaners may be used for final cleanup Place picked-up powder in closed, pressure vented, dry metal containers

DISPOSAL Deposit unsalvageable waste in an approved landfill per Federal, state, and local regulations Zinc powder should not be shipped if it is wet.

COMMENTS Consider EPA Code D 001 or D 003 for Zn powder disposal

SECTION 8. SPECIAL PROTECTION INFORMATION

GOGGLES Wear safety goggles to prevent eye contact with particulates

GLOVES Wear tightly woven, nonstatic-generating, protective clothing Special protective clothing is needed for work with hot or molten Zn

RESPIRATOR Use NIOSH-approved respirator when dust/fume exceeds the TLV

VENTILATION Provide local (explosion-proof) exhaust ventilation to meet TLV requirements An approved dust-collection system is needed to gather airborne particulates

OTHER Preplacement and periodic examination of personnel is suggested Eyewash stations should be accessible outside the use area. Use of contact lenses in areas of Zn particulate generation should be prohibited because they pose a special hazard, soft lenses may absorb and all lenses concentrate irritants

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

STORAGE SEGREGATION Solid zinc metal does not need special storage segregation, however, zinc powder should be stored dry in a storage area free from ignition sources, chlorine, bromine, or fluorine gas and/or acids.

SPECIAL HANDLING/STORAGE Follow approved cleaning techniques for zinc powder Good handling is necessary to control powder dispersal and prevent generation of airborne particulates.

ENGINEERING CONTROLS Facilities for handling large amounts of zinc powder require special design, approved procedures, use of grounded, electrical, nonsparking tools, and emergency planning for fire and spills

COMMENTS See NFPA 491M

NOT designated as a hazardous substance by EPA (40 CFR 116)

DOT Classification Zn Powder - Flammable Solid

UN1436

Data Source(s) Code 2-12, 14, 26, 31, 37, 41, 59, 61, 62, 82, 84, OW

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Approvals	[illegible] 6/86
Indust Hygiene/Safety	DJW 6/86
Medical Review	July 86

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of water, or two tablespoons of bleach per gallon of water. A two-minute immersion disinfects the respirators.

- Aqueous solution of iodine (50 ppm of iodine) made by adding approximately 0.8 milliliters of tincture of iodine per liter of water, or one teaspoon of tincture of iodine per gallon of water. Again, a two-minute immersion is sufficient.

If the respirators are washed by hand, a separate disinfecting rinse may be provided. If a washing machine or dishwasher is used, the disinfectant must be added to the rinse cycle; the amount of water in the machine at that time will have to be measured to determine the correct amount of disinfectant.

To prevent damaging the rubber and plastic in the respirator facepieces, the cleaning water should not exceed 140°F, but it should not be less than 120°F to ensure adequate cleaning. In addition, if commercial or domestic dishwashers are used, the drying cycle should be eliminated, since the temperatures reached in these cycles may damage the respirators.

203.5.2 Rinsing

The cleaning and disinfected respirators should be rinsed thoroughly in water (140°F maximum) to remove all traces of detergent and disinfectants. This is very important for preventing dermatitis.

203.5.3 Drying

The respirators may be allowed to dry in room air on a clean surface. They may also be hung from a horizontal wire, like drying clothes, but care must be taken not to damage or distort the facepieces. Another method is to equip a standard steel storage cabinet with an electric heater that has a built-in circulating fan, and to replace the solid steel shelves with steel mesh.

203.5.4 Reassembly and Inspection

The clean, dry respirator facepieces should be reassembled and inspected in an area separate from the disassembly area to avoid contamination. The inspection procedures have been discussed; special emphasis should be given to inspecting the respirators for detergent or soap residue left by inadequate rinsing. This appears most often under the seat of the exhalation valve, and can cause valve leakage or sticking.

The respirator should be thoroughly inspected and all defects corrected. New or retested cartridges and canisters should be installed, and the completely reassembled respirator should be tested for leaks.

203.6 Maintenance and Repair

Maintenance personnel must be thoroughly trained. They must be aware of the limitations and never try to replace components or make repairs and adjustments beyond the manufacturer's recommendations, unless they have been specially trained by the manufacturer.

These restrictions apply primarily to maintenance of the more complicated devices, especially closed- and open-circuit SCBA, and more specifically, regulator valves and low pressure warning devices. These devices should be returned to the manufacturer or to a trained technician for adjustment or repair. There should be no major problems in repairing and maintaining most respirators, particularly the commonly used air-purifying type.

An important aspect of any maintenance program is having enough spare parts on hand. Only continual surveillance of replacement rates will determine what parts and quantities should be kept in stock. It is desirable to have a recording system to indicate spare parts usage and the inventory on hand.

For SCBA devices, the facepiece should be combined with the tested regulator and the fully charged cylinder, and an operational check performed.

203.7 Respirator Storage

Damage and contamination of respirators may take place if they are stored on a workbench, or in a tool cabinet or toolbox, among heavy tools, greases and dirt. Freshly cleaned respirators should be placed in heat-sealed, ziplock, or other reusable plastic bags until reissue. They should be stored in a clean, dry location away from direct sunlight. They should be placed in a single layer with the facepiece and exhalation valve in an undistorted position to prevent rubber or plastic from taking a permanent distorted "set".

Air-purifying respirators kept ready for non-routine or emergency use should be stored in a cabinet with individual compartments. The storage cabinet should be readily accessible, and all workers should be made aware of its location, as is done for fire extinguishers. Preventing serious injury from the inhalation of a toxic substance depends entirely on how quickly workers can get to the emergency respirators.

A chest or wall-mounted case may be used for storing SCBA for use in emergencies. Again, the location of SCBA should be well-known and clearly marked. Unlike fire extinguishers, however, they should be located in an area that will predictably remain uncontaminated. Putting on a SCBA in a highly contaminated atmosphere such as might be created by massive release of a toxic material may take too long a time to perform safely in that area. Therefore, the first reaction should be to escape to an uncontaminated area, then put on the SCBA, that should be located there, and re-enter the hazardous area for whatever task must be done. Exceptions to this rule may be encountered, and only a thorough evaluation of the process and escape routes will permit a final decision about the correct storage location for SCBA. Respirators should be stored in a plastic bag inside a rigid container.

Workers who are adequately trained should develop a respect for respirators that will be an automatic incentive to protect respirators from damage. Besides providing better assurance of adequate protection, this training will lower maintenance costs by decreasing damage.

203.8 Recordkeeping

Records should be maintained to document that proper care and maintenance has been performed on respiratory protection devices. Records should indicate when and what was done to each respirator, and also by whom.

203.9 References

U.S. Department of Labor, OSHA, Safety and Health for General Industry (29 CFR Part 1910), Respiratory Protection 1910.134, U.S. Department of Labor Occupational Safety and Health Administration.

American National Standard, Practices for Respiratory Protection, ANSI Z88.2-1980, American National Standards Institute.

Birkner, L.R., Respiratory Protection A Manual and Guideline, American Industrial Hygiene Association, 1980.

TABLE 3-1. MEDICAL EXAMINATION PROTOCOL.

Test	Testing Frequency Baseline	Annual	Other	Remarks
1. Cardiogram	X		X	Preplacement Every 3 years for less than or equal to 40 years old Every year for more than 40 years old
2. Chest X-Ray	X		X	Preplacement Every 3 years for less than or equal to 40 years old Every 2 years for more than or equal to 40 years old to less than or equal to 55 years old Every year for more than 55 years old
3. Audiogram	X	X		
4. Blood Lead	X	X		
5. Blood Chemistry Panel	X	X		
Required.				
Glucose				
Sodium				
Potassium				
Chloride				
BUN				
Creatinine				
Uric Acid				
Phosphate				
Calcium				
Cholesterol				
Triglycerides				
Total Protein				
Albumin				
Globulin				

TABLE 3-1. MEDICAL EXAMINATION PROTOCOL, CONTINUED.

Test	Testing Frequency Baseline	Annual	Other	Remarks
5. Blood Chemistry Panel (Continued)	X	X		
Required:				
Total Bilirubin				
Direct Bilirubin				
Alk. Phosphatase				
G-Glutamyl Transpep.				
Transaminase, SGO				
Transaminase, SGP				
LDH				
Iron				
Optional:				
Magnesium				
Albumin/Globulin Ratio				
BUN/Creatinine Ratio				
6. CBC Count (Hemogram)	X	X		
WDC				
RBC				
HGB				
HCT				
MCV				
MCH				
MCHC				
Diffenential White Count				
Seg				
Band				
Lymph				
Mono				
Eosin				
Baso				
Platelets				
Platelets Count				
Reticulocyte Count				

TABLE 3-1. MEDICAL EXAMINATION PROTOCOL, CONTINUED.

Test	Testing Frequency Baseline	Annual	Other	Remarks
7. Serum iron and total iron binding capacity (TIBC)	X			
8. Was a Verification of the Blood Chemistry Tests Done (Y/N/U)	X	X		
9. Urinalysis	X	X		
Appearance				
Color				
pH				
Ketones				
Direct Bilirubin				
Total Bilirubin				
Glucose				
Blood				
Urobilinogen				
L. Esterase				
WDC				
RBC				
Casts				
Mucus				
Bacteria				
Eiptherlial				
Crystals				
Yeast				
MCG/DL				
10. Morphology (Present, Absent, Unknown)	X	X		
Anisocytosid				
Poikilocytosis				
Hypochromia				
Polychromasia				
Basophilic Stippling				
11. Serum and RBC cholinesterase	X	X		

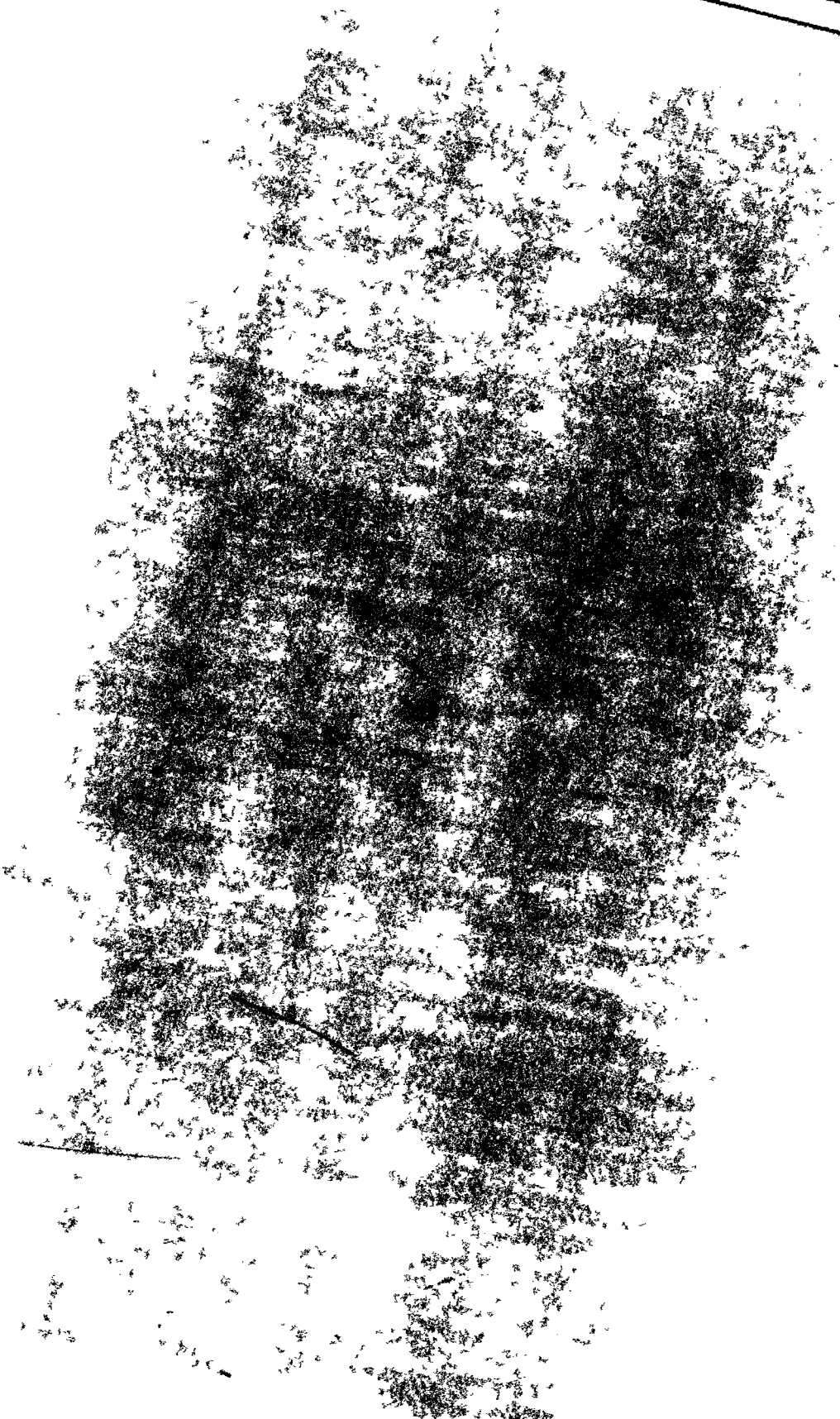
TABLE 3-1. MEDICAL EXAMINATION PROTOCOL, CONTINUED.

Test	Testing Frequency Baseline	Annual	Other	Remarks
12. Treadmill	*	*		*Only If: • Abnormal EKG (except sinus bradicardia, unless an otherwise healthy person) or • History of angina or • History of myocardio infarction (MI) or • History of cardiac surgery
13. Vision test (R&L)	X	X		
Near-corrected and Uncorrected Far-corrected and Uncorrected Peripheral (Visual Field) Color Depth Perception				
14. Height and Weight	X	X		
15. Blood Pressure	X	X		
16. Pulse (resting)	X	X		
17. Temperature (oral) Fahrenheit	X	X		
18. Pulmonary Function Test (as on Rees-Stealy's form)	X	X		
19. Stool for Occult Blood	X	X		

TABLE 3-1. MEDICAL EXAMINATION PROTOCOL, CONTINUED.

Test	Testing Frequency Baseline	Annual	Other	Remarks
12. Treadmill	*	*		*Only If: • Abnormal EKG (except sinus bradicardia, unless an otherwise healthy person) or • History of angina or • History of myocardio infarction (MI) or • History of cardiac surgery
13. Vision test (R&L)	X	X		
Near-corrected and Uncorrected Far-corrected and Uncorrected Peripheral (Visual Field) Color Depth Perception				
14. Height and Weight	X	X		
15. Blood Pressure	X	X		
16. Pulse (resting)	X	X		
17. Temperature (oral) Fahrenheit	X	X		
18. Pulmonary Function Test (as on Rees-Stealy's form)	X	X		
19. Stool for Occult Blood	X	X		

ATTACHMENT D
WCC ACCIDENT/INCIDENT REPORT FORM



(4002-140-39)(HEADERS.ATT)(05/16/90)

FORM HS-502
WCC HEALTH AND SAFETY INCIDENT REPORT

Project Name _____

Project Number _____

Date of Incident _____

Time of Incident _____

Location _____

TYPE OF INCIDENT (Check all applicable items)

☐ Illness ☐ Injury ☐ Fire, explosion, flash ☐ Vehicular accident

☐ Property Damage ☐ Unexpected exposure ☐ Health & safety infraction

☐ Other (describe) _____

PROJECT NAME _____ **LOCATION** _____

DESCRIPTION OF INCIDENT (Describe what happened and possible cause identify individuals involved, witnesses, and their affiliations, and describe emergency or corrective action taken)

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Reporter _____ _____ _____
Print Name Signature Date

Reporter must deliver this report to the Business Unit Health and Safety Officer within 24 hours of the reported incident for medical treatment cases and within five days for other incidents.

Reviewed by _____ _____
Business Unit Health & Safety Officer Date

Distribution.

___ Corporate Health and Safety Administrator
___ Corporate Health and Safety Officer
___ Project Manager
___ Personnel Office (medical treatment cases only)

OPERATING PROCEDURE NO. HS-102

102.0 Heat Stress

102.1 Purpose

The purpose of this OP is to provide general information on heat stress and the methods that can be utilized to prevent or minimize the occurrence of heat stress.

Adverse climatic conditions are important considerations in planning and conducting site operations. Ambient temperature effects can include physical discomfort, reduced efficiency, personal injury, and increased accident probability. Heat stress is of particular concern while wearing impermeable protective garments, since these garments inhibit evaporative body cooling.

102.2 Requirements

The NIOSH criteria document for heat stress recommends that environmental monitoring and other preventive measures be adopted in hot work environments. However, the provisions are not directly applicable to employees who are required to wear impermeable protective clothing. The reason for this exception is that impermeable clothing prevents the evaporation of sweat, which is one of the most important cooling mechanisms of the body. There is no recognized health standard protection for workers wearing impermeable protective clothing and respirators in hot environments.

The ACGIH has adopted a TLV for heat stress. These guides relate to work/rest regimes.

102.3 Additional Hazard

The use of Personal Protective Equipment of the types commonly used for hazardous waste work can place stress on the body. One common problem with the use of personal protective equipment especially in hot environments is heat stress. Protective clothing can cause excessive sweating and can prevent the body from properly regulating body temperature.

102.4 Types of Heat Stress

Heat stress is the aggregate of environmental and physical work factors that constitute the total heat load imposed on the body. The environmental factors of heat stress are the air temperature, radiant heat exchange, air movement, and water vapor pressure. Physical work contributes to the total heat stress of the job by producing metabolic heat in the body in proportion to the intensity of the work. The amount and type of clothing also affect the heat stress.

Heat strain is the series of physiological responses to heat stress. When the strain is excessive for the exposed individual, a feeling of discomfort or distress may result, and, finally, a heat disorder may ensue. The severity of strain will depend not only on the magnitude of the prevailing stress, but also on the age, physical fitness, degree of acclimatization, and dehydration of the worker.

Heat disorder is a general term used to describe one or more of the following heat-related disabilities or illnesses:

- Heat cramps - painful intermittent spasms of the voluntary muscles following hard physical work in a hot environment. Cramps usually occur after heavy sweating, and often begin at the end of a work shift.
- Heat exhaustion - profuse sweating, weakness, rapid pulse, dizziness, nausea, and headache. The skin is cool and sometimes pale and

clammy with sweat. Body temperature is normal or subnormal. Nausea, vomiting, and unconsciousness may occur.

- Heat stroke - sweating is diminished or absent. The skin is hot, dry, and flushed. Increased body temperature, which, if uncontrolled, may lead to delirium, convulsions, coma, and even death. Medical care is urgently needed.

102.5 Methods of Controlling Heat Stress

As many of the following control measures as are appropriate to site conditions should be utilized to aid in controlling heat stress:

- Provide for adequate liquids to replace lost body fluids and replace water and salt lost from sweating. Encourage personnel to drink more than the amount required to satisfy thirst. Thirst satisfaction is not an accurate indicator of adequate salt and fluid replacement.
- Replace fluids with water, commercial mixes such as Gatorade or Quick Kick, or a combination of these.
- Establish a work regimen that will provide adequate rest periods for cooling down. This may require additional shifts of workers.
- Wear cooling devices such as vortex tubes or cooling vests beneath protective garments.
- Take all breaks in a cool rest area (77°F is best).
- Remove impermeable protective garments during rest periods.
- Do not assign other tasks to personnel during rest periods.
- Inform personnel of the importance of adequate rest, acclimation, and proper diet in the prevention of heat stress.

102.6 Monitoring

102.6.1 Temperature

The heat stress of an area can be monitored by the Wet Bulb Globe Temperature Index (WBGT) technique. Where heat stress monitoring is required, a heat stress monitoring device, such as the Wibget Heat Stress Monitor (Reuter Stokes) shall be utilized.

The WBGT shall be compared to the Threshold Limit Values (TLV) outlined by the ACGIH TLV guides, and a work-rest regimen shall be established in accordance with the WBGT. Note that 5°C must be subtracted from the TLVs for heat stress listed to compensate for the wearing of impermeable protective clothing.

102.6.2 Medical

In addition to the provisions of the WCC medical surveillance program, on-site medical monitoring of personnel shall be performed by qualified medical personnel for projects where heat stress is a major concern. Blood pressure, pulse, body temperature (oral), and body weight should be taken and recorded a minimum of three times daily (prior to work, at mid-shift, and after work).

102.4 References

American Conference of Governmental Industrial Hygienists, Threshold Limit Values for Chemical Substances in the Work Environment, 1984-85.

Olishifski, J.B., Fundamentals of Industrial Hygiene, National Safety Council, 1983.

National Institute for Occupational Safety and Health, The Industrial Environment - Its Evaluation and Control, 1973.

OPERATING PROCEDURE NO. HS-103

103.0 Cold Stress

103.1 Purpose

The purpose of this OP is to provide information on cold stress and procedures for preventing and dealing with cold stress. Adverse climatic conditions of cold are important considerations in planning and conducting site operations. Ambient temperature effects can include physical discomfort, reduced efficiency, personal injury, and increased accident probability.

103.2 Types of Cold Stress Effects

Persons working outdoors in temperatures at or below freezing may be frostbitten. Extreme cold for a short time may cause severe injury to the surface of the body, or result in profound generalized cooling, causing death. Areas of the body that have high surface-area-to-volume ratio such as fingers, toes, and ears, are the most susceptible.

Local injury resulting from cold is included in the generic term frostbite. There are several degrees of damage. Frostbite of the extremities can be categorized into:

- Frost nip or initial frostbite: characterized by suddenly blanching or whitening of skin.
- Superficial frostbite: skin has a waxy or white appearance and is firm to the touch, but tissue beneath is resilient.
- Deep frostbite: tissues are cold, pale, and solid; extremely serious injury.

Another form of cold stress that can be quite serious is hypothermia. Hypothermia results when the body loses heat faster than it can produce it. When this situation first occurs, blood vessels in the skin constrict in an attempt to conserve vital internal heat. Hands and feet are first affected. If the body continues to lose heat, involuntary shivers begin. This is the body's way of attempting to produce more heat, and it is usually the first real warning sign of hypothermia. Further heat loss produces speech difficulty, forgetfulness, loss of manual dexterity, collapse, and finally death.

Systemic hypothermia is caused by exposure to freezing or rapidly dropping temperature. Its symptoms are usually exhibited in five stages:

1. shivering;
2. apathy, listlessness, sleepiness, and (sometimes) rapid cooling of the body to less than 95°F;
3. unconsciousness, glassy stare, slow pulse, and slow respiratory rate;
4. freezing of the extremities; and finally
5. death.

103.3 Climatic Factors

Two factors influence the development of a cold injury: ambient temperature and the velocity of the wind. Wind chill is used to describe the chilling effect of moving air in combination with low temperature. For instance, 10°F with a wind of 15 miles per hour (mph) is equivalent in chilling effect to still air at -18°F. See the wind chill chart in Table 103-1.

As a general rule, the greatest incremental increase in wind chill occurs when a wind of 5 mph increases to 10 mph. Additionally, water conducts heat 240 times faster than air. Thus, the body cools suddenly when chemical-protective equipment is removed if the clothing underneath is perspiration soaked.

103.4 Exposure Limits

Typical exposure limits for work in cold are presented in Table 103-2, as a guide for establishing work schedules.

103.5 Control Measures

The dead air space between the warm body and clothing and the outside air is essential. Clothing is worn to keep the body warmth in and the cold out. Usually, no one type of clothing is best for all weather conditions. Denim is relatively loosewoven, that not only allows water to penetrate, but permits wind to blow away the body heat that should remain trapped between the body and clothing worn. Duck or goose down is good for stopping wind, but is of little use when wet. Clear plastic or closely woven nylon is good protection from wind and rain but offers little insulation against cold.

Many layers of relatively light clothing with an outer shell of windproof material maintain body temperature much better than a single heavy outer garment worn over ordinary indoor clothing. The more air cells each of these clothing layers has, the more efficient it insulates against body heat loss. Make sure that clothing allows some venting of perspiration. Because wet skin will freeze more rapidly than dry skin, use all feasible means to keep as dry as possible. Make full use of windbreaks and avoid exposing skin to direct effects of the wind. Problems are created by the need to wear layers of special clothing that make the wearer very clumsy in performing many routine work procedures. Increased body dimensions must also be considered if tight spaces are encountered.

103.6 References

Olishefsky, J.B., Fundamentals of Industrial Hygiene, National Safety Council, 1983.

TABLE 103-1. WIND CHILL CHART.

Wind Speed (in mph)	Actual Thermometer Reading (F)									
	50	40	30	20	10	0	-10	-20	-30	-40
calm	50	40	30	20	10	0	-10	-20	-30	-40
5	48	37	27	16	6	-5	-15	-26	-36	-47
10	40	28	16	4	-9	-21	-33	-46	-58	-70
15	36	22	9	-5	-18	-36	-45	-58	-72	-83
20	32	18	4	-10	-25	-39	-53	-67	-82	-96
25	30	16	0	-15	-29	-44	-59	-74	-88	-104
30	28	13	-2	-18	-33	-48	-63	-79	-94	-109
35	27	11	-4	-20	-37	-53	-69	-85	-100	-116
40	26	10	-6	-21	-37	-53	-69	-85	-100	-116
Over 40 mph (little added effect)	LITTLE DANGER (for properly clothed person				INCREASING DANGER (danger from of exposed			GREAT DANGER freezing flesh)		

The human body senses "cold" as a result of both the air temperature and the wind velocity. Cooling of exposed flesh increases rapidly as the wind velocity goes up. Frostbite can occur at relatively mild temperatures if wind penetrates the body insulation. For example, when the actual air temperature of the wind is 40 F (4.4 C) and its velocity is 30 mph (48 km/h), the exposed skin would perceive this situation as an equivalent still air temperature of 13 F (-11 C).

TABLE 103-2 MAXIMUM DAILY TIME LIMITS FOR EXPOSURE AT LOW TEMPERATURES.

Temperature Range		Maximum Daily Exposure
Celcius (degrees)	Fahrenheit (degrees)	
0 to -18	30 to 0	No limit, providing that the person is properly clothed.
-18 to -34	0 to -30	Total work time; 4 hours. Alternate one hour in and one hour out of the low-temperature area.
-34 to -57	-30 to -70	Two periods of 30 minutes each, at least 4 hours apart. Total low temperature work time allowed: one hour. (Note that some difference exists among individuals: one report recommends 15-minute periods--not over four periods per work 8-hour shift; another limits periods to one hour out of every four, with a low chill factor, i.e., no wind; a third says that continuous operation for 3 hours at -53 has been experienced without ill effect.
-57 to -73	-70 to -100	Maximum permissible work time: 5 minutes during an 8-hour working day. At these extreme temperatures, completely enclosed headgear, equipped with a breathing tube running under the clothing and down the leg to preheat the air, is recommended.

Source. NSC Data Sheet 465, Cold Room Testing of Gasoline and Diesel Engines.

OPERATING PROCEDURE NO. HS-203

203.0 Respirator Inspection, Care, Maintenance, and Storage

203.1 Purpose

The purpose of this document is to provide guidance on the proper care and use of respiratory protective devices, to assist in adequately protecting personnel as well as complying with OSHA respiratory protection standard 1910.134. Guidance in the selection of respiratory devices is provided in OP No. HS 201.

203.2 Applicability

This procedure is applicable for use in caring for half-face and full-face respirators of either air-purifying or air supplying type. Proper care of respirators is essential for their satisfactory performance. Of importance is respirator inspection, care, maintenance, and storage.

203.3 Requirements

OSHA requires, as part of an inspection program, that all respirators be leak checked, a determination that the complete assembly is gas tight. Follow field inspection procedures to examine the freshly cleaned, reassembled respirator.

Cleaning and Disinfecting - OSHA 1910.134 states "routinely used respirators shall be collected, cleaned and disinfected as frequently as necessary to ensure that proper protection is provided..." and that emergency use respirators "shall be cleaned and disinfected after each use."

The OSHA standard states that "replacement or repair shall be done by experienced persons with parts designed for the respirator". Besides being contrary

to OSHA requirements, substitution of parts from a different brand or type of respirator invalidates approval (i.e., NIOSH, MSHA) of the device.

OSHA requires that respirators be stored to protect against:

- dust;
- sunlight;
- heat;
- extreme cold;
- excessive moisture;
- damaging chemicals; and
- mechanical damage.

The OSHA standard suggests that respirators be in their original cartons, however, this may provide only minimal protection from mechanical damage.

203.4 Inspection

203.4.1 Air-Purifying Respirators

Routinely used air-purifying respirators should be checked as follows before and after each use:

1. Examine the facepiece for:

   - excessive dirt
   - cracks, tears, holes or physical distortion of shape from improper storage
   - inflexibility of rubber facepiece (stretch and knead to restore flexibility)
   - cracked or badly scratched lenses in full facepieces

- incorrectly mounted full facepiece lenses, or broken or missing mounting clips
- cracked or broken air-purifying element holder(s), badly worn threads or missing gasket(s), if required.

2. Examine the head straps or head harness for:

- breaks
- loss of elasticity
- broken or malfunctioning buckles and attachments
- excessively worn serrations on head harness, that might permit slippage (full facepieces only)

3. Examine the exhalation valve for the following after removing its cover:

- foreign material, such as detergent residue, dust particles or human hair under the valve seat
- cracks, tears or distortion in the valve material
- improper insertion of the valve body in the facepiece
- cracks, breaks, or chips in the valve body, particularly in the sealing surface
- missing or defective valve cover
- improper installation of the valve in the valve body

4. Examine the air-purifying element for:

- incorrect cartridge, canister or filter for the hazard
- incorrect installation, loose connections, missing or worn gasket or cross threading in the holder
- expired shelf-life date on the cartridge or canister

- cracks or dents in the outside case of the filter, cartridge or canister, indicated by the absence of sealing material, tape, foil, etc., over the inlet.

5. If the device has a corrugated breathing tube, examine it for:

   - broken or missing end connectors
   - missing or loose hose clamps
   - deterioration, determined by stretching the tube and looking for cracks.

6. Examine the harness of a front- or back-mounted gas mask for:

   - damage or wear to the canister holder, that may prevent its being held in place
   - broken harness straps for fastening.

203.4.2 Atmosphere-Supplying Respirators

For a routinely used atmosphere-supplying device, use the following procedures:

1. If the device is a tight-fitting facepiece, use the procedures outlined under air-purifying respirators, except those pertaining to the air-purifying elements.
2. If the device is a hood, helmet, blouse or full suit, use the following procedures:
   - examine the hood, blouse or full suit for rips and tears, seam integrity, etc.
   - examine the protective headgear, if required, for general condition with emphasis on the suspension inside the headgear.

- examine the protective face shield, if any, for cracks or breaks or impaired vision
- make sure the protective screen is intact and secured correctly over the face shield.

3. Examine the air supply systems for:

- integrity and good condition of air supply lines and hoses, including attachment and end fittings
- correct operation and condition of all regulators, or other air flow regulators.

In addition to the above, for self-contained breathing apparatus (SCBA) units also determine that:

- The high pressure cylinder of compressed air or oxygen is sufficiently charged for the intended use, preferably fully charged.
- On closed circuit SCBA, a fresh canister of CO_2 (carbon dioxide) sorbent is installed.
- On open circuit SCBA, the cylinder has been recharged if less then 25 percent of the useful service time remains.

All SCBAs are required to have a warning device that indicates when the 25 percent level is reached. However, it is recommended that an open-circuit SCBA be fully charged before use.

203.4.3 Respirator Disassembly

The used respirators should be collected and deposited in a central location. They are taken to an area where the filters, cartridges or canisters are removed and discarded. Canisters should be damaged or marked to prevent accidental reuse. If facepieces are equipped with reusable dust filters, they may be cleaned

with compressed air in a hood. This prevents dust from getting into the room and affecting the respirator personnel. If SCBA are used, tanks are removed and connected to an area where the SCBA regulators and low-air warning devices are tested. SCBA facepieces are cleaned like air-purifying respirator facepieces.

203.4.4 Defects Found in Field Inspection

If defects are found during any field inspection, two remedies are possible. If the defect is minor, repair and/or adjustment may be made on the spot. If it is major, the device should be removed from service until it can be repaired. (A spare unit should replace the unit removed from service.) Under no circumstances should a device that is known to be defective remain in the field.

203.4.5 Inspection During Cleaning

Because respirator cleaning usually involves some disassembly, it presents a good opportunity to examine each respirator thoroughly. The procedures outlined above for a field inspection should be used. Respirators should be inspected after cleaning operations and reassembly have been accomplished.

203.5 Respirator Care

When used routinely, respirators should be exchanged daily for cleaning and inspection. Where respirators are used only occasionally, the exchange period could be weekly or monthly. Workers maintaining their own respirators should be thoroughly briefed on cleaning and disinfecting them. Although workers may not be required to maintain their own respirators, briefing on the cleaning procedure will encourage their acceptance of a respirator by providing knowledge of what is a clean, disinfected, properly maintained device. This is particularly important where respirators are not individually assigned.

Where respirators are individually assigned (a practice to be encouraged), they should be identified to ensure that the worker always receives the same device. Identification markers must not penetrate the facepiece, block the filter, cartridge parts or exhaust valves.

When a relatively small number of respirators are used, or where workers clean their own respirators, the generally accepted procedure is washing with detergent and warm water using a brush, thoroughly rinsing in clean water, and drying in a clean place. Precautions should be taken to prevent damage from rough handling during this procedure.

When large numbers of respirators are used, it is recommended that centralized cleaning and maintenance be performed and that specialized equipment and personnel trained in respirator maintenance be utilized.

203.5.1 Cleaning and Sanitizing

The actual cleaning may be done in a variety of ways. A commercial dishwasher can be used. A standard domestic clothes washer may also be used if a rack is installed around the agitator to hold the facepieces in fixed positions. If the facepieces are placed loose in the washer, the agitator may damage them. A standard domestic dishwasher may be used, but it is not preferred because it does not immerse the facepieces. Any good detergent may be used followed by a disinfecting rinse or a combination disinfectant-detergent for a one step operation. Disinfection is not absolutely necessary if the respirator is reused by the same person. However, where individual issue is not practical, disinfection is strongly recommended. Reliable, effective disinfectants may be made from readily available household solutions, including:

- Hypochlorite solution (50 ppm of chlorine) made by adding approximately two milliliters of bleach (such as Chlorox) to one liter

DRAFT

1.0
TITLE PAGE

STANDARD OPERATING PROCEDURE No. 5

LEVEL D PERSONNEL DECONTAMINATION

Rocky Flats

Contract No BA 65731PB

WCFS Project Number 4002

WCC Project Number 22415

Approvals	Date
W Michael Sams Originator	23 March 1990
[illegible] Peer Reviewer	23 March 1990
Randy Brooman QA/QC Officer	23 March 1990
Charles W. [illegible] Project Manager	3/24/90

2.0
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3 0
PURPOSE AND SCOPE

The purpose of this document is to define the standard operating procedure (SOP) for the Woodward-Clyde decontamination activities associated with the Surface Water Data Collection activity at Rocky Flats Plant (RFP) This SOP specifically addresses personnel decontamination activities. Decontamination of personnel is carried out to provide a safe and healthy working environment. Decontamination of equipment and containers is conducted to prevent contamination of personnel who handle them after they leave the sampling sites and cross-contamination of samples

The goal of the sampling program, and therefore the aim of this procedure, is to provide samples that meet acceptable standards of accuracy, precision, comparability, representativeness, and completeness while maintaining the highest standards of personnel protection. This procedure is intended to provide information and details so that personnel who follow these procedures will deliver reliable and consistent levels of decontamination.

This procedure describes the equipment and personnel decontamination procedures necessary to conduct decontamination at RFP This procedure applies to all decontamination by Woodward-Clyde personnel or their subcontractors

4 0
RESPONSIBILITIES AND QUALIFICATIONS

The project manager or task leader is responsible for assigning project staff to complete decontamination activities at the Rocky Flats Plant (RFP) The task leader is also responsible for assuring that this and any other appropriate procedures are followed by all project personnel.

The project staff members assigned to the decontamination tasks are responsible for completing these tasks according to this and other appropriate procedures Also, each individual is responsible for his or her own personal decontamination. All staff are responsible and encouraged to identify improved procedures to the task leader, project manager, site safety officer, or project quality assurance/quality control (QA/QC) officer

Only qualified personnel shall be allowed to perform this procedure Qualifications are based on education, previous experience, or on the job training and supervision by another qualified person The project manager shall document personnel qualifications related to this procedure

5.0
TYPES OF CONTAMINATION

5 1 PERSONNEL EXPOSURE

Contaminants can be located on the surface of personal protective equipment (PPE) or can permeate the PPE material. Surface contaminants may be easy to detect and remove, however, contaminants that have permeated a material are difficult or impossible to detect and remove If contaminants that have permeated a material are not removed by decontamination, they may continue to permeate the surface of the material where they can cause an unexpected exposure

Four major factors affect the extent of permeation.

- Contact time The longer a contaminant is in contact with an object, the greater the probability and extent of permeation. For this reason, minimizing contact time is one of the most important objectives of a decontamination program

- Concentration. Molecules flow from areas of high concentration to areas of low concentration As concentrations of waste increase, the potential for permeation of personal protective clothing increases

- Temperature. An increase in temperature generally increases the permeation rate of contaminants

- Physical state of wastes As a rule, gases, vapors, and low-viscosity liquids tend to permeate more readily than high-viscosity liquids

5.2 SITE AND/OR SAMPLE CROSS-CONTAMINATION

The overall objective of a sampling program is to obtain samples that accurately depict the chemical, physical, and/or biological conditions at the sampling site Extraneous contaminant materials can be brought onto the sampling location or introduced into the medium of interest during the sampling program (e g , by collecting samples with equipment previously contaminated at another sampling site) Thus, trace quantities of contaminant materials can be captured in a sample and lead to false positive analytical results and, ultimately, to an incorrect assessment of the contaminant conditions associated with the site Decontamination procedures for sampling equipment (e g., bailers, pumps, tubing) and major field support equipment (e g., vehicles) are therefore essential in any sampling program to ensure that sampling cross-contamination is minimized. General equipment decontamination is addressed in SOP No 4

6.0 PREVENTION OF CONTAMINATION

6 1 PERSONNEL EXPOSURE

The first step in decontamination is to minimize contact with waste and thus the potential for contamination. Examples might include

- Stress work practices that minimize contact with water being monitored (e.g., do not walk through areas of obvious contamination)
- Use remote sampling techniques whenever practical
- Wear disposable outer garments and use disposable equipment where appropriate.

Proper procedures for dressing before entering the water to be monitored will minimize the potential for contaminants to bypass the protective clothing. In general, all fasteners should be used (i e., zippers fully closed, all buttons fastened, all snaps closed, etc.) Gloves and boots should be tucked under the sleeves and legs of outer clothing. All junctures should be taped to prevent contaminants from penetrating gloves and boots

Any injuries to the skin surface, such as cuts and scratches, may enhance the potential for chemicals or infectious agents that directly contact the worker's skin to penetrate the body Particular care should be taken to protect these areas. Workers with large areas of damaged skin should be kept from working on site until the skin heals Before each use, the personal protective equipment (PPE) should be checked to ensure that it contains no cuts or punctures that could expose workers to wastes A PPE checklist follows and should be followed each time PPE is worn.

CLOTHING

Before use

- Determine that the clothing material is correct for the specific task at hand

- Visually inspect for
  - Imperfect seams
  - Tears
  - Malfunctioning closures

- Hold up to light and check for pinholes.

During the work task, periodically inspect for

- Evidence of chemical attack such as discoloration, swelling, stiffening, and softening Keep in mind, however, that chemical permeation can occur without any visible effects

- Closure failure

- Tears

- Punctures

- Seam discontinuities

GLOVES

- Before use, pressurize glove to check for pinholes Either blow into glove, then roll gauntlet toward fingers, or inflate glove and hold under potable water In either case, no air should escape

7.0 PROCEDURE

7 1 EQUIPMENT LIST

The following is a list of equipment that may be needed to perform personnel site decontamination for one sampling crew

- Brushes
- Wash tubs
- Buckets
- Hand-pumped pressure sprayer
- Disposal drums
- Detergent (Alconox, bleach solution, or equivalent)
- Potable water
- Scrapers
- Sponges or paper towels
- Moist towelettes

7.2 EXCLUSION, CONTAMINATION REDUCTION, AND SUPPORT ZONES

Three zones/levels of contamination, an exclusion zone, a contamination reduction zone, and a support zone, are specified in 29 CFR 1910 120 However, it will not be necessary to erect physical barriers around each sampling site due to the low concentrations of contaminants present and the brief time required to complete data gathering at each site Nonetheless, personnel must be decontaminated before leaving the sampling site This practice will limit the risk of exposure to personnel and limit the buildup of contaminants within vehicles by muddied boots and sample site water runoff from boots

Decontamination sites should be selected by the team leader considering that the location should be as close as practical to the data gathering site without being affected (i e , muddied) by the water being monitored

The Site Safety Officer will provide assistance in situations where a decontamination location is not readily definable

7.3 PERSONNEL DECONTAMINATION

These procedures assume that a combination of the following items of PPE will be worn.

- Disposable boot covers
- Rubber boots (knee boots, hip or chest waders)
- Tyvek
- Protective gloves (rubber, nitrile or butyl)

Personnel will be decontaminated each time they leave a data gathering site Personnel decontamination will be performed as follows

- Boot covers and outer gloves will be washed with long-handled brushes in a wash tub containing detergent water

- Boot covers and outer gloves will then be rinsed with water using long-handled brushes in a wash tub containing potable water or by using a sprayer if available

- Tape that was used to seal the gloves and boots will be removed and placed in the dedicated disposal drum for contaminated material

- Boot covers (if worn) will be removed and placed in the dedicated disposal container for contaminated material

- Gloves will be removed and placed in a dedicated disposal container

- Suits will be removed and placed in the dedicated disposal container

- Under-boots will be inspected and checked for further decontamination, as needed.

Contaminated personal protective equipment (PPE) will be placed in the appropriate containers at the trailer site after a day's data gathering activities are completed.

Water used for decontamination will be emptied at the vehicle decontamination pad at the end of the day and the tubs and brushes will be decontaminated as described in SOP No 4, Decontamination of Sampling Equipment

7 4 EMERGENCY DECONTAMINATION

In addition to routine decontamination procedures, emergency decontamination procedures must be established In an emergency, the primary concern is to prevent the loss of life or severe injury to site personnel If immediate medical treatment is required to save a life, decontamination should be delayed until the victim is stabilized. If decontamination can be performed without interfering with essential life-saving techniques or first aid, or if a worker has been contaminated with an extremely toxic or corrosive material that could cause severe injury or loss of life, decontamination must be performed immediately If an emergency caused by heat-related illness develops, protective clothing should be removed from the victim immediately to reduce the heat stress. During an emergency, provisions must also be made for protecting medical personnel and disposing contaminated clothing and equipment.

8.0 DOCUMENTATION

8.1 FIELD LOGS

The team leader will be responsible for making log entries regarding decontamination site location and noting whether or not procedures established by this SOP were followed. Deviation from this SOP must be approved by the Site Safety Officer (SSO) before being implemented. The SSO will make log entries of when the deviation occurred, what it was, who was involved, and justification for permitting the deviation

8.2 REVIEW

The field book will be reviewed and checked for completeness by the task leader or the task leader's designee on a job completion basis or on a weekly basis at a minimum

OPERATING PROCEDURE NO. HS-205

205.0 Site Safety Orientation/Training Meetings

205.1 Purpose

To establish minimum requirements regarding the conduct and content of site safety orientation/training meetings.

205.2 Responsibilities

Project managers are responsible for (1) convening the meetings; (2) obtaining qualified speakers/instructors; (3) identifying and notifying attendees; and (4) documenting proceedings and attendance and providing the documents to the business unit health and safety officers (HSO). Business unit managers are responsible for ensuring that project managers comply with this OP. HSO are responsible for providing assistance to the project managers as needed.

205.3 Requirements

205.3.1 Meeting Schedule

Site safety orientation/training meetings must be convened before (1) the field team begins work at any hazardous waste site covered by a site safety plan; (2) implementing modifications to safety plan provisions applicable to field personnel; and (3) additional staff begin field work.

205.3.2 Meeting Attendance

Meetings shall be attended by personnel identified by the project manager. Personnel required to attend a meeting may be notified verbally or in writing. A list of notified personnel should be provided to the HSO.

205.3.3 Meeting Agenda

As a minimum, the meeting agenda must include:

- review of the site safety plan or modifications to the plan
- verification of medical and safety training clearances, including respirator fit testing
- respirator fit tests (required for personnel who have not been fit tested with the brand or size of respirator available for the project)
- distribution of site safety plan or modifications
- attendee signatures acknowledging receipt and understanding of site safety plan/modifications and agreement to comply.

205.3.4 Documentation

A record of the meeting, including attendees, should be maintained within the project file.

OPERATING PROCEDURE NO. HS-503

503.0 Site Control

503.1 Purpose

The purpose of this OP is to provide guidance in establishing site control during hazardous waste site investigations. Site control consists of providing for security, communications, layout of site investigation facilities (i.e., command post, decontamination area, etc.) setting up work zones, and monitoring of weather conditions.

503.2 Security

Site security should be established to prevent unauthorized personnel from entering the site area. The following options should be considered when providing site security:

- The site should be secured with fencing (i.e., chain link fence, wire, or barriers), as appropriate.
- A security guard should be provided as necessary, and be located in the vicinity of the command post (office trailer).
- A controlled access to the regulated zones should be established. This controlled access should be through a decontamination unit or area.
- Only authorized personnel should be permitted to enter regulated zones. No one shall enter the site without appropriate authorization.
- All persons entering the regulated zones shall be equipped with appropriate personal protective devices.
- All persons entering the regulated zones must be familiar with and abide by the health and safety plan.

503.3 Communications

Methods of maintaining communications on site between site investigation personnel should be provided. Communication between the command post and personnel working in regulated zones should be provided. Communication, as well as visual contact, should be maintained between personnel in regulated zones. Use of the "buddy" system shall be practiced. The following methods of communication should be utilized as appropriate:

- radios
- hand signals
- air horns
- bells
- flags
- boards, signs.

503.4 Site Layout

In developing a site layout for site investigation activities and establishing command post, decontamination facilities, etc., the following criteria should be considered:

- site location and ownership;
- location of roads, powerlines, etc.;
- terrain (line-of-sight, avenues of approach, ingress and egress);
- prevailing wind direction;
- location of sources of water and power;
- proximity to inhabitants or residents; and
- location of emergency facilities.

503.5 Work Zones

Areas known or suspected to be of high potential should be designated as regulated or exclusion zones. The immediate areas (e.g., 25-foot radius) around intrusive activities (i.e., drilling, excavating, etc.) may be classified as regulated or exclusionary. Decontamination areas should also be regulated. Appropriate personal protective equipment should be worn by personnel in regulated zones, in accordance with the site specific safety plan for the site. Command posts should be in clean areas upwind of contaminated or exclusionary zones.

503.6 Weather Conditions

Monitoring of weather conditions should be performed during site investigation activities as may be appropriate. Monitoring for the following should be considered.

- wind direction (vane, wind sock, flagging);
- temperature for heat stress conditions; and
- temperature for cold stress conditions.

503.7 Documentation

Site control requirements and a site map showing work zones, access areas, telephones, fences, and security guarded stations must be presented in the site health and safety plan. Weather monitoring data must be recorded in the site safety logbook.

OPERATING PROCEDURE NO. HS-504

504.0 Emergency Preparedness

504.1 Purpose

The purpose of this OP is to provide guidance in preparing for emergency situations during conduct of field activities.

504.2 Types of Emergencies

There are three major categories of emergencies that can occur during hazardous waste site investigations. They are: (1) illnesses and physical injuries; (2) fires and explosions; and (3) safety equipment problems.

504.2.1 Medical Emergencies

Medical emergencies can be described as situations that present a significant threat to the health of personnel involved in site investigations. These can result from chemical exposures, heat stress, cold stress, and poisonous insect or snake bites. Medical emergencies must be dealt with immediately and proper care should be administered. This may be in the form of first aid and emergency hospitalization.

504.2.2 Accidents

Accidents can result from physical hazards on a site. These hazards can include tripping, catching, cutting, and may be associated with debris on a site or heavy equipment used in the investigation. Injuries may include:

- broken bones
- burns
- sprains

- escape routes
  - on-site escape (rapid evacuation to safe area)
  - off-site escape (best means of evacuation from site).

504.4 Training

Investigative teams should include personnel with training in first aid and CPR. Personnel should become familiar with site area, available equipment, and emergency services available.

504.5 Medical Surveillance Information

Personnel should be aware of any special medical problems of individual team members. This may include allergies, insect stings, poison plants, penicillin, etc.

504.6 Emergency Equipment

Provisions should be made to have appropriate emergency equipment available and in proper working condition. This equipment may include:

- first aid kits
- eye wash kits - fill and pressurize
- fire extinguisher
- emergency oxygen
- splints
- stretcher
- blankets
- life vests.

Equipment should be checked before commencing site investigation activities, and defective equipment repaired or replaced before performing site investigation. Provisions should be made for redundant or back-up safety equipment.

OPERATING PROCEDURE NO. HS-505

505.0 Personnel Assignments

Hazardous waste site investigations require a variety of expertise and scientific support to insure safe entry and data collection. The composition of the field investigation team should be tailored to the potential hazards and type of site. The team normally consists of multidisciplined individuals (e.g., environmental scientist, geologist, chemist, or engineer). Often, an individual will fulfill the responsibilities of a number of positions.

Team size is dependent upon site organization, levels of protection, work objectives, and site hazards. Additional team members can always be added according to the roles required.

The two-person team is the minimum for a hazardous substance site investigation, but its capabilities are limited to work at Level D sites only. The three-person team normally is employed for site inspection. This team is adequate for sites requiring Level C protection and can be extended to Level B protection, although there are some limitations. A three-person team implies a two-person entry team and one person remaining at the command post. For some sites, it could be difficult to maintain line-of-sight with the command post without a fourth person. In addition, the quantity of equipment needed to perform the field observations, monitoring, sampling, and documentation is probably too much for the two-person entry team. For this reason, if the site requires Level B protection, a four- or five-person team is recommended.

ATTACHMENT F
EXPOSURE LIMITS

	29 CRF 1910-1000 Table Z-1-A Final Rule Limits							
	TWA (a)		STEL (b)		CEILING (c)			
	ppm	mg/m3 (d)	ppm	mg/m3	ppm	mg/m3	Skin (e) Designation	NIOSH IDLH (f)
Acetone	750	1800 00	1000	2400				20,000 ppm
Aluminum (A1)		5 00						NA
Anthracene (Synonym Coal Tar Pitch Volatiles)		0 20						NL
Antimony (Sb)		0 5						80 mg/m3
Aroclor 1254 (Synonym Polychlorinated Biphenyl)		0 50					X	NL
Arsenic (Organic Compounds)		0 50						NL
Barium (Ba)(Soluble Compounds)		0 5						250 mg/m3
Benzene (29 CFR 1910-1028)	1 00							NL
Benzo(b) Fluoranthene	1							
Benzo(k) Fluoranthene	1							
Benzo(a) Pyrene uG/kg (Synonym Coal Tar Pitch Volatiles)		0 20						NL
Benzo(g,h,i) Perylene, Methyl	1							
Beryllium (Be)	0 002		0 005		0 025			NL
Beta-BHC	1							
bis (2-Ethylhexyl) Phthalate		5 00		10 00				NL
Cadmium (Dust) "Transitional Limit"		0 20				0 60		NL
Calcium (Ca) (Total Dust/Respirable Fraction)		15/5						NA
Carbon Tetrachloride	2 00	12 60						NL
Chloroform	2 00	9 78						NL
Chloromethane (Synonym Methyl Chloride)	50 00	105 00	100 00	205 00				NL
Chromium		1 00						NA (h)
Chrysene (Synonym Coal Tar Pitch Volatiles)		0 20						NL
Cobalt (Co)		0 05						20 mg/m3

	29 CRF 1910-1000 Table Z-1-A Final Rule Limits							
	TWA (a)		STEL (b)		CEILING (c)			
	ppm	mg/m3 (d)	ppm	mg/m3	ppm	mg/m3	Skin (e) Designation	NIOSH IDLH (f)
Copper (Dusts and Mists)		1 00						NA
Cresol, All Isomers	5 00	22 00						250 ppm
1,1-Dichloroethane	100 00	400 00						4000ppm
1,1-Dichloroethylene (Synonym Vinylidene Chloride)	1 00	4 00						
1,2-Dichloroethylene	200 00	790 00						4000ppm
di-n-Octyl Phthalate	1							
Ethyl Benzene	100 00	435 00						2000ppm
Fluoranthene	1							
Indeno(1,2,3-cd) Pyrene	1							
Iron (Fe)		10 00						NA
Lead, Inorganic (20 CFR 1910 1025)		50ugm/M						
Lithium (Li)		0 025						55 mg/m3
Magnesium (Mg)(Total Dust/Respirable Fraction)		15/5						NA
Manganese (Mn)						5		10,000 mg/m3
Mercury, Inorganic								
Methyl Chloroform	350 00	1900 00	450 00	2452 00				1000ppm
Methyl Ethyl Ketone (Synonym 2-Butanone)	200 00	590 00	300 00	885 00				3,000ppm
Methylene Chloride "6(b)" Rulemaking underway	100 00				200 00			
Methyl Isobutyl Ketone (Synonym Hexone)	50 00	205 00	75 00	300 00				3000ppm
Molybdenum (Mo)(Soluble Compounds)		5 00						NA
Nickel (Ni)		0 1						NL
Phenanthrene (Synonym Coal Tar Pitch Volatiles)		0 20						NL
Phenol	5 00	19 00					X	250ppm
Potassium (K)	1							
Pyrene (Synonym Coal Tar Pitch Volatiles)		0 20						NL
Selenium (Se)		0 20						100 mg/m3

	29 CRF 1910-1000 Table Z-1-A Final Rule Limits							
	TWA (a)		STEL (b)		CEILING (c)			
	ppm	mg/m3 (d)	ppm	mg/m3	ppm	mg/m3	Skin (e) Designation	NIOSH IDLH (f)
Silver (Ag)		0 01						NA
Sodium (Na)	1							
1,1,2,2-Tetrachloroethane	1 00	7 00						NL
Tetrachloroethylene (Synonym Perchloroethylene)	250 00	170 00						NL
Thallium (Soluble Compounds)		0 1					X	20 mg/m3
Tin (Sn) (Inorganic Compounds)		2 00						400 mg/m3
Trichloroethylene (Tricloroethene)	50 00	270 00	200 00	1080 00				NL
Toluene	100 00	375 00	150 00	560 00				2000ppm
Vanadium (V)		0 05						70 mg/m3
Vinyl Chloride	1 00		5 00					NL
Xylene (O-, M-, P-Isomers)	100 00	435 00	150 00	655 00				1000ppm
Zinc (Total dust/respirable fraction)		10/5						NA

NOTES

a TWA (Time Weighted Average) is the employee's average airborne exposure in any 8-hour work shift of a 40-hour work week, which shall not be exceeded

b STEL (Short Term Exposure Limit) is the employee's 15-minute time weighted average exposure, which shall not be exceeded at any time during a work day

c Ceiling is the employee's exposure, which shall not be exceeded during any part of the work day If instantaneous monitoring is not feasible, then the ceiling shall be assessed as a 15-minute time weighted average exposure, which shall not be exceeded at any time over a working day

d Approximate number of milligrams of substance per cubic meter of air

e An "X" in the Skin Designation column indicates a substance capable of being adsorbed through intact skin

f IDLH (Immediately Dangerous to Life or Health) values and codes have been adapted from the "Pocket Guide to Chemical Hazards," second edition, National Institute of Occupational Safety and Health (NIOSH)

g NL (Not Listed) is used when NIOSH has recommended the substance be treated as a potential human carcinogen and therefore, an IDLH level may not be appropriate

h NA (Not Assigned) is used when IDLH has not been assigned

i Neither a government mandated/recommended or national consensus standard for occupational exposures via the inhalation route exists

IONIZING RADIATION

Exposure Limits

	Rems per Calendar Quarter
Whole body head and trunk, active bloodforming organs, lens of eyes, or gonads	1 1/4
Hands and forearms, feet and ankles	18 3/4
Skin of whole body	7 1/2

An individual in a restricted area may receive a total occupational dose to the whole body greater than that specified above, provided

1 During any calendar quarter, the total occupational dose to the whole body shall not exceed 3 rems (30 mSv)
2 The dose to the whole body, when added to the accumulated occupational dose to the whole body, shall not exceed 5(N-18) rems (50(N-18) mSv) where "N" equals the individual's age in years at his last birthday
3 In all cases, personnel will utilized the principals of time, distance, and shielding to ensure exposures are maintained as low as reasonable achievable (ALARA)

Maximum Radioisotope Concentration in Air and Water (μC:/ml)		
	Air	Water
Uranium-233	4×10^{-12}	3×10^{-5}
Uranium-234	4×10^{12}	3×10^{-5}
Uranium-235	4×10^{12}	3×10^{5}
Uranium-238	3×10^{-12}	4×10^{-5}
Strontium-89	3×10^{-10}	3×10^{-6}
Strontium-90	3×10^{11}	3×10^{-7}
Plutonium-239	6×10^{-14}	5×10^{-6}
Americium-241	2×10^{-3}	4×10^{-6}
Cesium-137	5×10^{10}	2×10^{-5}
Radium-226	2×10^{12}	3×10^{-8}
Radium-228	1×10^{12}	3×10^{-8}

ATTACHMENT G
MATERIAL SAFETY DATA SHEETS FOR LABORATORY WORK

Material Safety Data Sheet

from Genium's Reference Collection
Genium Publishing Corporation
1145 Catalyn Street
Schenectady, NY 12303-1836 USA
(518) 377-8855

GENIUM PUBLISHING CORP

No 30A

HYDROCHLORIC ACID
(Revision B)
Issued October 1977
Revised November 1988

SECTION 1. MATERIAL IDENTIFICATION

27

Material Name HYDROCHLORIC ACID

Description (Origin/Uses) Used in the production of chlorides, in refining ore in the production of tin and tantalum, for the neutralization of bases, for pickling and cleaning metal products, for oil- and gas-well treatments, and in removing scale from boilers and heat-exchange equipment.

NFPA: 3 / 0 / 0 / -

Other Designations Aqueous Hydrogen Chloride, Muriatic Acid, HCl/H_2O, CAS No 7647-01-0

Manufacturer Contact your supplier or distributor Consult the latest edition of the *Chemicalweek Buyers Guide* (Genium ref 73) for a list of suppliers

HMIS			
H	3	R	1
F	0	I	4
R	0	S	4
PPG*		K	0
*See sect 8			

SECTION 2. INGREDIENTS AND HAZARDS

	%	EXPOSURE LIMITS
Hydrogen Chloride, CAS No 7647-01-0	38 or Less	**OSHA PEL** Ceiling 5 ppm, 7 mg/m³
Water	Balance*	**ACGIH TLV, 1988-89** TLV-Ceiling 5 ppm, 7 mg/m³
*Impurities such as iron chlorine, and traces of organic matter may be present in small amounts, depending on the grade of acid **See NIOSH *RTECS* (MW4025000), for additional data with references to reproductive and mutagenic effects Continue to monitor NIOSH, *RTECS* (MW40300000), for toxicity data on hydrochloric acid itself		**Toxicity Data**** Human, Inhalation, LC_{Lo} 1300 ppm (30 Mins) Rat, Inhalation, LC_{50} 3124 ppm (1 Hr) Rabbit, Oral, LD_{50} 900 mg/kg

SECTION 3. PHYSICAL DATA

Boiling Point 227 F (109 C) (20 22%)
Melting Point -85 F (65°C) (20 69%)
Vapor Density (Air = 1) 1 268
pH Strong Mineral Acid
Molecular Weight Not Applicable
Solubility in Water (%) Complete
Specific Gravity (H_2O = 1) >1
% Volatile by Volume Ca 100

Appearance and Odor A clear, colorless-to-lightly yellowed, fuming liquid, sharp, pungent, characteristic, irritating odor of hydrogen chloride gas This odor is detectable at 1 to 5 ppm and becomes unpleasant and irritating at 5 to 10 ppm, however, the odor serves as a good warning property

Comments The specific physical properties of aqueous hydrochloric acid solutions vary with the amount of dissolved hydrogen chloride gas Hydrochloric acid forms a constant boiling azeotrope (a mixture of hydrochloric acid and water that behaves like a single substance in that its vapor has the same composition as the mixture itself) with water (at 227 F or 109 C) that contains 20 22% hydrogen chloride and has a density of 1 096 Boiling weaker or stronger aqueous solutions results in the loss of either component until the constant boiling acid is produced

SECTION 4 FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temperature	LEL	UEL
*	*	*	*

Extinguishing Media *Hydrochloric acid solutions do not burn Use extinguishing agents that will put out the surrounding fire **Unusual Fire or Explosion Hazards** Use a water spray to cool fire-exposed containers of hydrochloric acid to prevent ruptures Explosive hydrogen gas can be produced by the reaction of hydrochloric acid with metals such as iron Neutralize spilled hydrochloric acid with limestone, slaked lime, or soda ash to minimize the possible generation of hydrogen gas **Special Fire-fighting Procedures** Wear a self-contained breathing apparatus (SCBA) with a full facepiece operated in the pressure-demand or positive-pressure mode Special neutralization procedures, if applicable include the application of chemically basic substances such as soda ash or slaked lime

SECTION 5 REACTIVITY DATA

Stability/Polymerization Hydrochloric acid is stable in closed containers during routine operations at room temperature Hazardous polymerization cannot occur **Chemical Incompatibilities** Hydrochloric acid reacts dangerously with acetic anhydride, 2-aminoethanol ammonium hydroxide calcium phosphide chlorosulfonic acid, ethylene diamine, ethylenimine, oleum, perchloric acid, ß-propiolactone propylene oxide silver perchlorate and carbon tetrachloride, sodium hydroxide, sulfuric acid, uranium phosphide, vinyl acetate, sodium, and many carbide compounds (Genium ref 84) This material is a strong mineral acid that is very reactive with bases **Conditions to Avoid** Avoid exposure to incompatible chemicals and to any other material whose compatibility with hydrochloric acid or its vapor has not yet been established The corrosive action of hydrochloric acid on most metals can liberate extremely flammable/explosive hydrogen gas (H_2), piping systems and containment systems must be chosen carefully **Hazardous Products of Decomposition** During fires hydrochloric acid may decompose by reacting with certain metals to produce very flammable and explosive hydrogen gas (H_2) Significant amounts of hydrogen chloride gas (HCl) are given off at room temperature, the rate of this generation increases as the temperature and the strength (1%) by weight of HCl in H_2O increase **Comments** Reactions between hydrochloric acid and cyanides sulfides and formaldehyde will produce extremely toxic hydrogen cyanide (HCN), hydrogen sulfide (H_2S), sulfur dioxide (SO_2) and *bis*chloromethylether, respectively

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
[illegible]5 CATALYN ST , SCHENECTADY, NY 12303 USA (518) 377-8854

From Genium s MSDS Collection to be used as a reference

MSDS # 3
SODIUM HYDROXIDE
Revision B

Issued September, 1977
Revised August, 1985

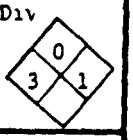
SECTION 1 MATERIAL IDENTIFICATION

17

MATERIAL NAME SODIUM HYDROXIDE
OTHER DESIGNATIONS Caustic Soda, Soda Lye, NaOH, CAS #1310-73-2
MANUFACTURER Available from many suppliers including

Dow Chemical USA, Inorganic Chemicals Dept
2020 Dow Center
Midland, MI 48640
(517) 630-1000

Diamond Shamrock Co , Chlor-Alkali Div
351 Phelps Court, Box 152300
Irving, TX 75015-2300
(800) 241-3134



SECTION 2 INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Typical content		
Sodium Hydroxide (NaOH)	>96	Ceiling limit 2 mg/m^3*
IMPURITIES		
Sodium Carbonate (Na_2CO_3)	0 5-2 5	
Sodium Chloride (NaCl)	0 01-2 1	Skin, Rabbit
Sodium Sulfate (Na_2SO_4)	0 02-0 1	50 mg/24H - Severe
Potassium, Calcium, Magnesium	0 1	irritation
Silicon Dioxide (SiO_2)	0 03	----------
Other metals (Total)	0 01	Eye, Rabbit
		0 05 mg/24H - Severe
* Current (1985-86) ACGIH TLV The current OSHA PEL is 2 0 mg/m^3 averaged over 8 hours		irritation

SECTION 3 PHYSICAL DATA

Boiling Point, 1 atm	1388°C	Volatiles	non volatile @ room temperature
Melting point	318°C	Water solubility, g/100cc	
Specific gravity (20/4°C)	2 13	@ 0°C	42
Vapor pressure, mmHg @ 739°C	1	@ 100°C	347
		Molecular weight	40

APPEARANCE & ODOR White or off-white hygroscopic solid No odor

DESCRIPTION Anhydrous alkaline solid (flake, pellet, etc)

SECTION 4 FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp	Flammability Limits in Air	Lower	Upper
None - non combustible	N/A	N/A	N/A	N/A

Although this material is not combustible, it can be hazardous if present in a fire area It can melt and flow when heated (m p 318°C) The hot or molten material can react violently with water (spattering) and can cause ignition of combustible materials It can also react with certain metals, such as aluminum, to generate flammable hydrogen gas (Also see Section 5)

Firefighters should wear self-contained breathing apparatus and full protective gear when fighting fires involving this material

SECTION 5 REACTIVITY DATA

This material is stable under normal conditions of storage and handling It does not undergo hazardous polymerization nor does it evolve any hazardous decomposition products It slowly absorbs moisture from the air and reacts with carbon dioxide from the air to form sodium carbonate
Sodium hydroxide reacts violently with water, strong acids and with many organic chemicals, especially with nitrocarbons and chlorocarbons It will react with trichloroethylene to form spontaneously flammable dichloroacetylene Considerable heat is generated when it dissolves in water
Avoid contact with leather and wool Contact with aluminum, tin, zinc, and alloys that contain these metals causes the formation of hydrogen gas (flammable)

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SECTION 6 HEALTH HAZARD INFORMATION

TLV (Ceiling limit) 2mg/m^3

Sodium Hydroxide is a strong alkali and is dangerous when improperly handled It can be destructive to all human tissue it contacts, producing severe burns Eye contact causes severe, permanent injury Skin contact causes irritation and, if not removed immediately, severe burns with scarring The effects of inhalation of the dust or mist vary from mild irritation to destructive burns Pneumonitis may occur Ingestion causes severe burns of the mouth, throat and stomach and may be fatal

FIRST AID EYE CONTACT Wash eyes immediately with plenty of running water for no less than 15 minutes, including under the eyelids and all surfaces Speed in rinsing out the eyes with water after contact is extremely important if permanent injury is to be avoided Get medical attention promptly SKIN CONTACT Wash contaminated area promptly with large quantities of water Remove contaminated clothing while washing Prolong washing in serious cases until medical help arrives - even for an hour or longer Physician should see all cases other than minor exposures to small areas of the skin INHALATION Remove from exposure to mist or dust and get prompt medical help INGESTION Immediately give person large quantities of water or milk to drink (never give anything by mouth to an unconscious person) DO NOT induce vomiting Obtain medical assistance immediately

SECTION 7 SPILL, LEAK AND DISPOSAL PROCEDURES

Clean-up personnel should wear protective equipment to prevent skin and eye contact Promptly shovel up spilled solid sodium hydroxide into suitable containers for reclaim Avoid dust generation! Clean-up spills promptly as moisture absorption from air may make clean-up difficult Flush contaminated surfaces with water and neutralize with dilute acid, preferably acetic acid, to remove final traces Finally, rinse with water

DISPOSAL Waste caustic should never be discharged directly into drains, sewers or surface waters Dilute well with water and carefully neutralize with acid Follow all applicable Federal, State and local regulations

EPA HAZARDOUS WASTE NUMBER D002, corrosive (solns c̄ pH $\geq$ 12 5 - 40CFR261 22)
REPORTABLE SPILL QUANTITY 1000 lbs (40CFR117)

SECTION 8 SPECIAL PROTECTION INFORMATION

Provide adequate general and/or local exhaust ventilation to meet TLV requirements, especially where dusting or misting conditions can exist Use a NIOSH approved respirator for dust/mist where needed
Use chemical safety goggles, A plastic face shield in addition to safety goggles is also desirable where misting/splashing may occur Use rubber gloves, rubber apron or protective suit, and rubber boots where needed to prevent contact with sodium hydroxide, especially when preparing solutions
Eye wash stations and safety showers must be immediately available

This is a special hazard to contact lenses wearers, soft lenses may absorb and all lenses concentrate irritants
Contact between caustic and contact lenses will severely hamper contact lens removal due to the slippery nature of this caustic

SECTION 9 SPECIAL PRECAUTIONS AND COMMENTS

Store in well-sealed containers in a dry location Protect containers from physical damage Avoid handling conditions that may lead to spills or leaks or the formation of mist or dust Wherever this material is stored, unloaded, handled or used, abundant water (preferably running water) should be available for emergency use
Drains servicing areas where this material is stored or used should have retention basins for pH adjustment and dilution of spills and flushings before discharge Workers handling this material should be trained in proper handling and emergency procedures
DOT HAZARD CLASSIFICATION Corrosive Material
DOT LABEL CORROSIVE
DOT ID NUMBER UN1823
DATA SOURCE(S) CODE (See Glossary) 2, 4, 9, 11, 12, 27, 55, 58, MSDS 3 (rev A), V

Judgements as to the suitability of information herein for purchaser's purposes are necessarily purchaser's responsibility Therefore although reasonable care has been taken in the preparation of such information Genium Publishing Corporation extends no warranties makes no representations and assumes no responsibility as to the accuracy or suitability of such information for application to purchaser's intended purposes or for consequences of its use

APPROVALS J O Barocco, 12/85
INDUST HYGIENE/SAFETY [signature] 1-86
MEDICAL REVIEW [signature] Jan 86

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MATERIAL SAFETY DATA SHEET

DATE August 1985

CALGON
CALGON CARBON CORPORATION

PRODUCT NAME FILTRASORB 500 ACTIVATED CARBON

SECTION I

MANUFACTURER'S NAME	Calgon Carbon Corporation
EMERGENCY TELEPHONE NO	412-787-6700
ADDRESS	P.O. Box 717 Pittsburgh, PA 15230-0717
CHEMICAL NAME AND SYNONYMS	Carbon
FORMULA	C

SECTION II HAZARDOUS INGREDIENTS

PRINCIPAL HAZARDOUS COMPONENT (S)	CAS #	% BY WEIGHT	ORAL LD_{50}	DERMAL LD_{50}	TLV (Units) ACGIH	OSHA	OTHER
Chemical Name: Carbon Common Name: Activated Carbon	7440-44-0	100%	>10g/Kg* (rat)	--	N/A	N/A	N/A
Chemical Name Common Name							
Chemical Name Common Name							
Chemical Name Common Name							
Chemical Name Common Name							

*No animal mortalities during course of 14-day study.

CAUTION!! Wet activated carbon removes oxygen from air causing a severe hazard to workers inside carbon vessels and enclosed or confined spaces. Before entering such an area, sampling and work procedures for low oxygen levels should be taken to ensure ample oxygen availability, observing all local, state, and federal regulations.

This product is non-hazardous according to the definitions for "health hazard" and "physical hazard" provided in the OSHA Hazard Communication Law (29 CFR part 1910).

SECTION III PHYSICAL DATA

BOILING POINT (°F)	N/A	SPECIFIC GRAVITY (H_2O=1)	2.3g/cc real density
VAPOR PRESSURE (mmHg)	N/A	PERCENT VOLATILE BY VOLUME (%)	N/A
VAPOR DENSITY (AIR=1)	N/A	pH	N/A
SOLUBILITY IN WATER	insoluble	OTHER packing density	0.4 to 0.7g/cc

APPEARANCE AND ODOR black particulate solid

While this information and recommendations set forth herein are believed to be accurate as of the date hereof, CALGON CARBON CORPORATION MAKES NO WARRANTY WITH RESPECT HERETO AND DISCLAIMS ALL LIABILITY FROM RELIANCE THEREON.

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method Used)	N/A
XTINGUISHING MEDIA	If involved in fire, flood with plenty of water.
CIAL FIRE FIGHTING CEDURES	None
NUSUAL FIRE AND XPLOSION HAZARDS	Contact with strong oxidizers such as ozone, liquid oxygen, chlorine, permanganate, etc. may result in fire.

SECTION V HEALTH HAZARD DATA

EFFECT OF OVEREXPOSURE

A. ACUTE

1 INGESTION

The product is non-toxic through ingestion. The acute oral LD_{50} (rat) is >10g/Kg.

2 INHALATION

The acute inhalation LC_{50} (rat) is >204.4 mg/l (nominal concentration) for activated carbon.

3 DERMAL EXPOSURE

a TOXIC

Non-toxic

b IRRITATION

The product is not a primary skin irritant. The primary skin irritation index (rabbit) is 0.

c SENSITIZATION

None

4 EYE IRRITATION

The physical nature of the product may produce eye irritation.

B. SUBCHRONIC, CHRONIC, OTHER

The effects of long-term, low-level exposures to this product have not been determined. Safe handling of this material on a long-term basis should emphasize the avoidance of all effects from repetitive acute exposures.

FIRST AID

A EYE

Flush with plenty of water for at least 15 minutes.

B SKIN

Wash with soap and water.

C INGESTION

D INHALATION

SECTION VI REACTIVITY DATA

BILITY	STABLE	X	CONDITIONS TO AVOID	None
	UNSTABLE			

N ATABILITY
M s to Avoid) Strong oxidizers such as ozone, liquid oxygen, chlorine, permanganate, etc.

HAZARDOUS DECOMPOSITION PRODUCTS

Carbon monoxide may be generated in the event of fire.

SECTION VII SPILL OR LEAK PROCEDURES

REPORTABLE QUANTITIES (RQ) LBS OF EPA HAZARDOUS SUBSTANCES IN PRODUCT

1 N/A
2
3

NOTIFY EPA OF PRODUCT SPILLS EQUAL TO OR EXCEEDING N/A LBS

STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED

Sweep up unused carbon and discard in refuse container or repackage

WASTE DISPOSAL METHOD

Dispose of unused carbon in refuse container. Dispose of in accordance with local, state, and federal regulations.

SECTION VIII HANDLING & STORAGE

PROTECTIVE GLOVES

Rubber gloves recommended

EYE PROTECTION

Safety glasses or goggles recommended

PROTECTIVE CLOTHING

Not required

RESPIRATORY PROTECTION

A NIOSH approved particulate filter respirator is recommended if excessive dust is generated.

VENTILATION	LOCAL EXHAUST	OTHER
	Recommended	
	MECHANICAL (General) Recommended	

STORAGE & HANDLING

CAUTION!! Wet activated carbon removes oxygen from air causing a severe hazard to workers inside carbon vessels and enclosed or confined spaces. Before entering such an area, sampling and work procedures for low oxygen levels should be taken to ensure ample oxygen availability, observing all local, state, and federal regulations.

OTHER PRECAUTIONS

Wash thoroughly after handling. Exercise caution in the storage and handling of all chemical substances.

PREPARED BY S. D. Cifrulak

MATERIAL SAFETY DATA SHEET

DATE August 1985

CALGON
CALGON CARBON CORPORATION

PRODUCT NAME FILTRASORB 400 ACTIVATED CARBON

SECTION I

MANUFACTURER'S NAME	Calgon Carbon Corporation	EMERGENCY TELEPHONE NO	412-787-6700
ADDRESS	P.O. Box 717 Pittsburgh, PA 15230-0717		
CHEMICAL NAME AND SYNONYMS	Carbon	FORMULA	C

SECTION II HAZARDOUS INGREDIENTS

PRINCIPAL HAZARDOUS COMPONENT (S)	CAS #	% BY WEIGHT	ORAL LD_{50}	DERMAL LD_{50}	TLV (Units) ACGIH	OSHA	OTHER
Chemical Name: Carbon Common Name: Activated Carbon	7440-44-0	100%	>10g/Kg* (rat)	--	N/A	N/A	N/A
Chemical Name Common Name							
Chemical Name Common Name							
Chemical Name Common Name							
Chemical Name Common Name							

*No animal mortalities during course of 14-day study.

CAUTION!! Wet activated carbon removes oxygen from air causing a severe hazard to workers inside carbon vessels and enclosed or confined spaces. Before entering such an area, sampling and work procedures for low oxygen levels should be taken to ensure ample oxygen availability, observing all local, state, and federal regulations.

This product is non-hazardous according to the definitions for "health hazard" and "physical hazard" provided in the OSHA Hazard Communication Law (29 CFR part 1910).

SECTION III PHYSICAL DATA

BOILING POINT (°F)	N/A	SPECIFIC GRAVITY (H_2O=1)	2.3g/cc real density
VAPOR PRESSURE (mmHg)	N/A	PERCENT VOLATILE BY VOLUME (%)	N/A
VAPOR DENSITY (AIR=1)	N/A	pH	N/A
SOLUBILITY IN WATER	insoluble	OTHER packing density	0.4 to 0.7g/cc

APPEARANCE AND ODOR black particulate solid

While this information and recommendations set forth herein are believed to be accurate as of the date hereof, CALGON CARBON CORPORATION MAKES NO WARRANTY WITH RESPECT HERETO AND DISCLAIMS ALL LIABILITY FROM RELIANCE THEREON.

SECTION IV FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method Used)	N/A
EXTINGUISHING MEDIA	If involved in fire, flood with plenty of water.
SPECIAL FIRE FIGHTING PROCEDURES	None
UNUSUAL FIRE AND EXPLOSION HAZARDS	Contact with strong oxidizers such as ozone, liquid oxygen, chlorine, permanganate, etc. may result in fire.

SECTION V HEALTH HAZARD DATA

EFFECT OF OVEREXPOSURE

A. ACUTE

1 INGESTION

The product is non-toxic through ingestion. The acute oral LD_{50} (rat) is >10g/Kg.

2 INHALATION

The acute inhalation LC_{50} (rat) is >64.4 mg/ℓ (nominal concentration) for activated carbon.

3 DERMAL EXPOSURE

a TOXIC

Non-toxic

b IRRITATION

The product is not a primary skin irritant. The primary skin irritation index (rabbit) is 0.

c SENSITIZATION

None

4 EYE IRRITATION

The physical nature of the product may produce eye irritation.

B SUBCHRONIC, CHRONIC, OTHER

The effects of long-term, low-level exposures to this product have not been determined. Safe handling of this material on a long-term basis should emphasize the avoidance of all effects from repetitive acute exposures.

FIRST AID

A. EYE

Flush with plenty of water for at least 15 minutes.

B SKIN

Wash with soap and water.

C INGESTION

D INHALATION

MATERIAL SAFETY DATA SHEET

MATT-SON, INC.
Barrington, IL 60010

Emergency Phone: (312) 382-7810

1. PRODUCT NAME: FILOX™ MEDIA

Effective Date: January 1, 1988 Date Printed: February 11, 1988

2. PHYSICAL DATA:

Boiling Point: Not applicable
Vap. Press.: Not applicable
Decomposition: 995°F
Reactivity/Water: None
Appearance: Slate black as chip or powder
Specific Gravity: 1/94 gm/cc
Bulk Density: 120 lbs/cu.ft.
Odor: Not applicable

3. FIRE AND EXPLOSION HAZARD DATA:

Filox Media is not combustible.

Unusual Fire and Explosion Hazards: Will act as a strong oxidizer in circumstances of contact with unstable chemicals or in the presence of fire and substances easily oxidized (metals, combustibles, organics).

Special Fire Fighting Procedures: Treat as chemical fire, using water in large quantity for heat removing and dispersion purposes.

4. HEALTH HAZARD DATA:

Threshold Limit Value: C 5.0 mg/m (OSHA/ACGIH)

Effects of Overexposure: Long term exposure can result in central nervous system disorders. When handling fine powders or in dusty conditions respiratory protection must be used.

Emergency and First Aid Procedures:

Skin Contact: Wash dust from skin with soap and water to prevent long term exposure.

Eye Contact: Wash dust from eyes with water. Seek medical assistance if discomfort persists.

Inhalation: Move from area to fresh air.

SECTION VI REACTIVITY DATA

BILITY	STABLE	X	CONDITIONS TO AVOID
	UNSTABLE		None

OMPATABILITY (Materials to avoid)

Strong oxidizers such as ozone, liquid oxygen, chlorine, permanganate, etc.

ZARDOUS DECOMPOSITION ODUCTS

Carbon monoxide may be generated in the event of fire.

SECTION VII SPILL OR LEAK PROCEDURES

ORTABLE QUANTITIES (RQ) LBS OF EPA HAZARDOUS STANCES IN PRODUCT

1 N/A

2

3

NOTIFY EPA OF PRODUCT SPILLS EQUAL TO OR EXCEEDING N/A LBS

PS TO BE TAKEN IN CASE TERIAL IS RELEASED SPILLED

Sweep up unused carbon and discard in refuse container or repackage.

STE DISPOSAL METHOD

Dispose of unused carbon in refuse container. Dispose of in accordance with local, state, and federal regulations.

SECTION VIII HANDLING & STORAGE

OTECTIVE GLOVES	EYE PROTECTION
Rubber gloves recommended	Safety glasses or goggles recommended

HE TECTIVE OTH Not required

SPIRATORY PROTECTION

A NIOSH approved particulate filter respirator is recommended if excessive dust is generated.

NTILATION	LOCAL EXHAUST	OTHER
	Recommended	
	MECHANICAL (General) Recommended	

ORAGE & HANDLING

CAUTION!! Wet activated carbon removes oxygen from air causing a severe hazard to workers inside carbon vessels and enclosed or confined spaces. Before entering such an area, sampling and work procedures for low oxygen levels should be taken to ensure ample oxygen availability, observing all local, state, and federal regulations.

THER PRECAUTIONS

Wash thoroughly after handling. Exercise caution in the storage and handling of all chemical substances.

PREPARED BY S. D. Cifrulak

TOTAL P 09

4 EYE IRRITATION

The physical nature of the product may produce eye irritation.

B SUBCHRONIC, CHRONIC, OTHER

The effects of long-term, low-level exposures to this product have not been determined. Safe handling of this material on a long-term basis should emphasize the avoidance of all effects from repetitive acute exposures.

FIRST AID

A EYE

Flush with plenty of water for at least 15 minutes.

B SKIN

Wash with soap and water.

C INGESTION

D INHALATION