



**INTERIM REMEDIAL MEASURES
WORK PLAN**

FOR

**THE FORMER GLENWOOD POWER PLANT
YONKERS, NEW YORK 10701**

April 2007

Prepared for:

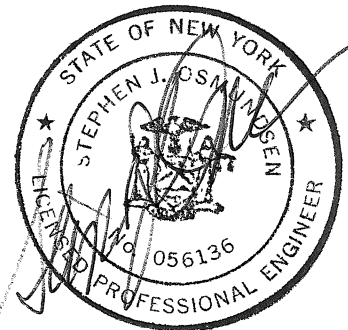
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April 24, 2007

NYSDEC

Division of Environmental Remediation
625 Broadway
Albany, New York 12233-7015

Attention: Robert Cozzy

Re: **NYSDEC Brownfield Cleanup Program
Interim Remedial Measures (IRM) Work Plan
Former Glenwood Power Plant
Yonkers, NY**

Dear Mr. Cozzy:

Attached is our Interim Remedial Measures Work Plan for the above-referenced property, an abandoned power plant located along the Hudson River in Westchester County, NY. The purpose of this Work Plan is to incorporate required environmental remedial actions into the planned redevelopment of this property. Primarily, this includes:

- interior demolition within the existing structures;
- classifying the generated waste materials for off-site disposal;
- and disposal of the various demolition debris.

We understand that additional sampling and analysis will be required as part of a Site Investigation which will be performed as a separate and independent effort.

If you have any questions or comments, please feel free to contact our office.

Sincerely,

CA Rich Consultants, Inc.

A handwritten signature in black ink, appearing to read 'Eric Weinstock', written over a horizontal line.

Eric Weinstock
Vice President

A handwritten signature in black ink, appearing to read 'Stephen Osmundsen', written over a horizontal line.

Stephen Osmundsen
Senior Engineer

cc: Lawrence Schnapf, Esq.
Erik Kaiser
Eric Bodner

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**INTERIM REMEDIAL MEASURES WORK PLAN
FORMER GLENWOOD POWER PLANT
YONKERS, NEW YORK 10701**

1.0 INTRODUCTION

The following Interim Remedial Measures (IRM) Work Plan has been prepared by CA RICH Consultants, Inc. (CA RICH) on behalf of REMI Companies of Hoboken, New Jersey. The purpose of this Work Plan is to incorporate required environmental remedial actions into the planned redevelopment of this property. Primarily, this includes: interior demolition within the existing structures; classifying the generated waste materials for off-site disposal; and disposal of the various demolition debris. It is understood that additional sampling and analysis will be required as part of a Site Investigation which will be performed as a separate and independent effort.

Based on previous investigations performed at this site, the contaminants of concern are:

- **Semi-Volatile Organic Compounds (SVOCs)** – Numerous detections including: Benzo (a) anthracene, Benzo (b) fluoranthene, Benzo (g, h, i) perylene, and Chrysene exceeded the NYSDEC TAGM limits.
- **Metals** – Numerous detections with Arsenic, Cadmium, Copper, Lead, Mercury and Zinc exceeding the NYSDEC TAGM limits. Lead -- a component of coal, coal ash and fly ash -- was the highest of the metals detected.
- **PCBs** – Aroclor 1260 was detected above the NYSDEC TAGM limits of 1,000 uk/kg.

During 2006, two previous investigations were performed at this site by CA RICH Consultants, Inc. The following is a list of documents that summarize these investigations.

<u>Document</u>	<u>Date</u>
Phase I ESA, Former Glenwood Power Plant, Yonkers, New York 10701, CA RICH Consultants, Inc. (Ref. 1)	June 2006
Phase II ESA Former Glenwood Power Plant, Yonkers, New York 10701, CA RICH Consultants, Inc. (Ref. 2)	September 2006

1.1 Site Description

The Property is situated on the east side of the Hudson River and is located west of the Glenwood Railroad Station and southwest of Trevor Park and the JFK Marina. It includes four acres -- two of which are below the water level of the Hudson River -- and is improved with an inactive and vacant electric power generation plant. The three story brick structure was initially constructed and operated by the Consolidated Edison Company (Con Ed) in the early 1900's. The facility was vacated in 1964. After Con Ed vacated the site, a contractor used the premises for the storage of construction materials. We understand that no underground tanks are known to have existed at the site and that the Property was serviced by municipal water. Based on the age of the structure and the analysis of samples collected during the Phase II ESA, asbestos building materials, such as pipe insulation, are known to exist at the Property.

The majority of the property above the Hudson River high water mark is comprised of structures. This includes a long and narrow three story building located along the northern property boundary that housed former offices, equipment & material storage and mechanical blowers. An open courtyard area exists directly south of this building. The courtyard contains electrical transformers and foundations for equipment. A larger, rectangular shaped building exists directly south of the courtyard. The northern portion of this building housed the former power generation area while the adjoining southern portion of the building housed the former coal ovens that fueled the power plant. A triangular portion of land exists between the southern structure and the Hudson River. A property location map is included as Figure 1.

The property is currently in extreme disrepair. The windows are broken and there is debris scattered throughout the property. A waste container inventory log was prepared for the Property as part of the Phase II ESA. The following items, which are shown on Figure 2, were identified on the Property:

Courtyard Area

- One rusty 15-gallon drum of water and petroleum;
- Seven rusty 5-gallon pails of roofing tar;
- Approximately 50 rusty 1-gallon cans of paint; and
- Approximately 25 rusty 1-pint cans of paint.

Former Coal Oven Area

- Two rusty 55-gallon drums, which appeared to contain petroleum; and
- Two rusty 55-gallon drums identified as containing a caustic soda powder.

Second Floor of North Building

- Five gas cylinders believed to contain nitrogen.

1.2 Current and Future Land Use

The property consists of a vacant coal-fired power plant which dates back to the early 1900s. The power plant was taken out of service in the 1960s. Since then it has been used as a contractor's material storage yard or has remained vacant.

The proposed future use of the property will include a combination of commercial units on the ground level of the structure and residential units on the upper levels of the renovated building. It will also provide waterfront access for area residents. The property is also located adjacent to the Glenwood Station of the MTA's Metro North Rail Road line.

2.0 PHYSICAL CHARACTERISTICS

2.1 Site Topography

The Site is relatively flat having an elevation of approximately 10 feet above mean sea level (MSL). Elevations within a 1/4-mile of the Site increase significantly in an eastward direction to approximately 250 feet MSL. The Metro North right-of-way runs along the eastern perimeter of the Site and has an elevation of approximately 10 feet above mean sea level. Directly west of the property lies the Hudson River.

2.2 Site Geology

The majority of the property situated above river level is comprised of a bulk headed steel, brick and concrete structure. A small triangular portion of wooded land exists along the southern portion of the site. The bedrock underlying the structure, the wooded area and the portions of the property located below river level is the Fordham Gneiss. The depth to bedrock is not known at this time.

3.0 INTERIM REMEDIAL MEASURES

The goal of this IRM is to allow for the internal demolition and renovation of the existing vacant structure as part of the overall redevelopment of the property. The IRM proposed for this facility consists of the following elements:

- Development of the anticipated waste streams that will be generated during the internal demolition and renovation of the existing vacant structure and selection of disposal facilities;
- Removal of asbestos, the contaminated soils in the court yard area, and the unwanted sediment & debris from within the structure; and
- Proper off-site disposal of the removed materials.

3.1 Development of the Anticipated Waste Streams and Selection of Disposal Facilities

We envision that there will be several waste streams from this site that may or may not require waste characterization testing prior to off-site disposal. As part of the Phase II ESA, a preliminary round of waste characterization samples were collected and analyzed. The results of those tests are included on Table 1 and incorporated into the text below.

Construction & Demolition (C&D) Debris - This includes items such as concrete, asphalt & brick. A demolition contractor will most likely be able to dispose of this material without additional testing.

Scrap Steel - This should not require additional testing and should have a salvage value.

Asbestos - Many of the pipes are insulated with suspect asbestos containing materials (ACM). These insulating materials are a regulated waste, which require testing. A total of seven bulk asbestos samples were collected from select areas of the site during the Phase II ESA and determined that asbestos was present in the sampled materials. The laboratory results indicate that five of the seven samples tested positive for ACM. Pipe and blower insulation materials tested contained between 9% and 40% chrysotile and amosite asbestos. The ACM sample locations are identified in Figure 2.

These samples were collected only to serve as a screening tool to determine if asbestos is present in the building. A comprehensive asbestos survey, which was beyond the scope of the Phase II ESA, will be required prior to the proposed renovation of the building.

Abandoned Drums, Gas Cylinders and Containers – Numerous drums, gas cylinders, and containers were identified in the Phase II ESA. An inventory log, which is included in Section 1.1 of this Plan, was generated documenting the quantity, size, and any pertinent information contained on a label that may identify the substance. A waste disposal contractor will be retained

to combine smaller containers of similar composition into larger, DOT approved containers suitable for shipping and to perform the testing necessary to arrange for their proper off-site disposal.

Soil, Sediment and Former Coal Oven Residues - These will likely be either regulated or hazardous wastes. During the Phase II ESA, one composite soil, sediment or residue sample was collected from each of these three areas which are illustrated on Figure 3:

1. the courtyard area consisting of samples CY-1 through CY-4;
2. the former power generation area consisting of samples PG-1 through PG-4; and
3. the former coal oven area consisting of samples CO-1 through CO-10.

The samples, identified with the suffix WC, were collected and submitted for chemical analysis by Accutest Laboratories (a State-Certified laboratory) of Dayton, New Jersey. The samples were analyzed for Volatile Organic Compounds (VOCs) via EPA Method 8260, Semivolatile Organic compounds (SVOCs) via EPA Method 8270, PCBs via EPA Method 8082, TCLP analyses, RCRA characteristics and numerous other parameters required by local disposal facilities.

The laboratory results, included on Table 1 indicate some of the samples contained elevated concentrations of lead in both the total and TCLP analyses. As such, the soil should be classified as follows based on the data compiled to date:

Courtyard area – Based on the test results, this soil is classified as a non-hazardous, regulated waste.

Coal Oven area – The material in the coal ovens is classified as a non-hazardous, regulated waste.

Power Generation area – The TCLP lead results for sample PG-WC contained lead at 79.7 mg/l which exceeds the regulatory level of 5 mg/l. As such, this material is classified as a hazardous waste.

The analytical data collected to date will be provided to several candidate disposal facilities for approval. Once the disposal facilities that will be used for the project have been selected, additional testing will be required prior to the disposal of these materials. The number of additional samples will be directly proportional to the volume of material that requires disposal and the requirements of the selected disposal facility. If additional sampling for TCLP lead in the power generation area does not exceed 5 mg/l, some of this material may be disposed of as a non-hazardous, regulated waste. Similarly, if additional sampling for TCLP lead in the coal oven area does exceed 5 mg/l, some of this material may have to be disposed of as a hazardous waste.

3.2 Removal of Asbestos, the Contaminated Soils in the Court Yard Area and the Unwanted Sediment & Debris from within the Structure

We anticipate removal of asbestos containing materials and other contaminated materials to occur concurrently with the demolition of any building structures. The stabilization of the building will be address prior to beginning demolition. The phasing of the demolition will allow the removal or shoring of unstable portion of the building prior to access for removal of asbestos and other material. Prior to the initiation of the IRM activities at this property, a structural engineer will inspect the building and determine which areas can safely accessed by workers and equipment.

3.2.1 Asbestos - All asbestos containing materials will be saturated or otherwise encapsulated to minimize the spread of the friable materials during removal. Transite roof panels shall be removed in one piece via crane. Pipe, boiler and other insulation materials shall be saturated in-place, cut or otherwise removed from the surface and placed in bags within a contained environment. These materials will be removed from the building by use of a conveyor system equipped with a misting device to control fugitive dust. Air monitoring will be conducted at the off-load point to ensure adjacent properties and uses are not exposed to fugitive dust. All asbestos containing material shall be placed and stored in covered container(s) prior to transport off-site.

3.2.2 Contaminated Sediments and Debris - Contaminated sediments and debris shall be excavated using a Bobcat™, backhoe, front-end loader or other similar type of equipment and stockpiled inside the building or within the court yard area on plastic or other approved impervious liner material and covered with plastic until removed from site. Stockpiles outdoors shall be located on level surfaces with minimum exposure to wind and rain. All outdoor stockpiles shall be surrounded by hay bales or other approved sediment control measure to prevent the migration of sediment should the stockpile be exposed to water.

Soil end-point samples will be collected from the courtyard area using a clean sampling scoop and placed directly into laboratory issued jars. A grid of one sample every 50 feet will be setup to cover the excavation area in the courtyard. These samples will be analyzed for VOCs, SVOCs, PCBs, and the metals Arsenic, Cadmium, Copper, Lead, Mercury and Zinc. The samples will be delivered to an ELAP-approved laboratory and analyzed in accordance with NYSDEC ASP Category B deliverables. The cleanup goal will be the Track 1 Soil Cleanup Objectives included in 6NYCRR Part 375.

The sediment in the power generation area is underlain by concrete. The sediments will be removed and the floors will be power washed with the wash water collected for proper disposal. As such, end-point samples will not be required in this area of the facility.

The coal ovens are located on the second floor of the building. Upon completion of the removal action, this floor will be demolished. Therefore, end-point samples will not be required in area of the facility as well.

3.3 Proper Off-Site Disposal of the Removed Materials

The off-site disposal of the removed materials will be transported either via truck or rail.

3.3.1 Rail - There is a railroad siding located adjacent to the site. The portion of this siding to the south has previously been used by an adjacent project for off-site disposal of demolition material. Rail transportation will require reconstruction of the portion of the siding adjacent to the site. The procedure will be to load these materials from the building by use of a conveyor system equipped with a misting device to control fugitive dust. A typical rail loading layout is illustrated on Figure 4. Air monitoring will be conducted at the off-load point to ensure adjacent properties and uses are not exposed to fugitive dust.

3.3.2 Truck - Some of the materials, such as the abandoned drums, gas cylinders, and containers, will be removed from the property by truck. A truck will access the site via the JFK marina and Warburton Avenue and park at the north east corner of the property as illustrated on Figure 5. Materials can then be transported from the property through the court yard area using a Bobcat or other similar device.

4.0 CITIZEN PARTICIPATION PLAN

This Citizen Participation (CP) Plan describes the CP activities to be conducted during the IRM planning stage. A major emphasis of the CP program is to conduct CP activities that are responsive to significant issues of community concern, and to informational needs of the community.

CA Rich will compile the CP mailing list. It will include local, state and federal officials, as well as, local businesses and homeowners in the vicinity of the former Glenwood Power Plant. This mailing list will be used to send out fact sheets and notify of upcoming meetings about the site. A NYSDEC CP representative will also arrange for a public repository for site documents.

A fact sheet about the Glenwood Power Plant site will be prepared by the NYSDEC Project Manager to inform the public about the status of the site. This fact sheet will be mailed out by NYSDEC. It will contain the planned start date for the IRM field work; the nature, goals and objectives of the IRM; major IRM activities and their schedule; and NYSDEC contacts.

5.0 REPORTING

Upon completion of the work outlined in this Plan, an IRM Report will be prepared. The Report will include:

- A description of the work performed;
- A table of the results of the end-point soil sample analyses;
- Copies of the Laboratory Reports; and
- Copies of the Waste Disposal Manifests.

6.0 IRM SCHEDULE

The following schedule has been developed for this project.

Plans	Anticipated Date
Submission of IRM Work Plan	April 2007
NYSDEC approval of Work Plan	May 2007
Citizen Participation Plan	
Fact Sheet Distribution	June 2007
Field Activities	
Development of the Anticipated Waste Streams and Selection of Disposal Facilities	June 2007
Removal of Asbestos, the Contaminated Soils in the Court Yard Area, and the Unwanted Sediment & Debris from within the Structure	June thru September 2007
Proper Off-Site Disposal of the Removed Materials	June thru September 2007
IRM Report Submission	December 2007

7.0 REFERENCES

1. CA RICH Consultants, Inc., June 2006, Phase I ESA, Former Glenwood Power Plant, Yonkers, New York 10701.
2. CA RICH Consultants, Inc., September 2006, Phase II ESA Former Glenwood Power Plant, Yonkers, New York 10701.

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TABLES

Table 1
Laboratory Analytical Results for VOC, SVOC, PCB,
Pesticides, Metals, General Chemistry, and Asbestos
For Waste Composite Soil Samples
Former Glenwood Power Plant
Yonkers, New York

Sample ID		CO-WC	CY-WC	PG-WC
Matrix		Soil	Soil	Soil
Date Sampled		8/11/2006	8/11/2006	8/11/2006
VOC - TCLP				
	Units	mg/L	mg/L	mg/L
Benzene		ND	ND	ND
2-Butanone (MEK)		ND	ND	ND
Carbon tetrachloride		ND	ND	ND
Chlorobenzene		ND	ND	ND
Chloroform		ND	ND	ND
1,4-Dichlorobenzene		ND	ND	ND
1,2-Dichloroethane		ND	ND	ND
1,1-Dichloroethene		ND	ND	ND
Tetrachloroethene		ND	ND	ND
Trichloroethene		ND	ND	ND
Vinyl chloride		ND	ND	ND
VOCs - Total				
	Units	ug/Kg	ug/Kg	ug/Kg
Acetone		15.1	ND	ND
Benzene		0.99 J	ND	ND
Bromobenzene		ND	ND	ND
Bromochloromethane		ND	ND	ND
Bromodichloromethane		ND	ND	ND
Bromoform		ND	ND	ND
Bromomethane		ND	ND	ND
2-Butanone (MEK)		ND	ND	ND
n-Butylbenzene		ND	ND	ND
sec-Butylbenzene		ND	ND	ND
tert-Butylbenzene		ND	ND	ND
Carbon tetrachloride		ND	ND	ND
Chlorobenzene		ND	ND	ND
Chloroethane		ND	ND	ND
Chloroform		ND	ND	ND
Chloromethane		ND	ND	ND
o-Chlorotoluene		ND	ND	ND
p-Chlorotoluene		ND	ND	ND
1,2-Dibromo-3-chloropropane		ND	ND	ND
Dibromochloromethane		ND	ND	ND
1,2-Dibromoethane		ND	ND	ND

Notes:
ND - Analyte not detected
J - Estimated value

Table 1 Continued
Laboratory Analytical Results for VOC, SVOC, PCB,
Pesticides, Metals, General Chemistry, and Asbestos
For Waste Composite Soil Samples
Former Glenwood Power Plant
Yonkers, New York

Sample ID		CO-WC	CY-WC	PG-WC
Matrix		Soil	Soil	Soil
Date Sampled		8/11/2006	8/11/2006	8/11/2006
VOCs - Total Continued				
	Units	ug/Kg	ug/Kg	ug/Kg
1,2-Dichlorobenzene		ND	ND	ND
1,3-Dichlorobenzene		ND	ND	ND
1,4-Dichlorobenzene		ND	ND	ND
Dichlorodifluoromethane		ND	ND	ND
1,1-Dichloroethane		ND	ND	ND
1,2-Dichloroethane		ND	ND	ND
1,1-Dichloroethene		ND	ND	ND
cis-1,2-Dichloroethene		ND	ND	ND
trans-1,2-Dichloroethene		ND	ND	ND
1,2-Dichloropropane		ND	ND	ND
1,3-Dichloropropane		ND	ND	ND
2,2-Dichloropropane		ND	ND	ND
1,1-Dichloropropene		ND	ND	ND
cis-1,3-Dichloropropene		ND	ND	ND
trans-1,3-Dichloropropene		ND	ND	ND
Ethylbenzene		2.2	ND	ND
Hexachlorobutadiene		ND	ND	ND
Isopropylbenzene		ND	ND	ND
p-Isopropyltoluene		ND	ND	ND
Methyl Tert Butyl Ether		ND	ND	ND
4-Methyl-2-pentanone(MIBK)		ND	ND	ND
Methylene bromide		ND	ND	ND
Methylene chloride		ND	ND	ND
Naphthalene		ND	ND	ND
n-Propylbenzene		ND	ND	ND
Styrene		ND	ND	ND
1,1,1,2-Tetrachloroethane		ND	ND	ND
1,1,2,2-Tetrachloroethane		ND	ND	ND
Tetrachloroethene		ND	2.4	1.8
Toluene (ug/kg)		1.3	ND	ND
1,2,3-Trichlorobenzene		ND	ND	ND
1,2,4-Trichlorobenzene		ND	ND	ND
1,1,1-Trichloroethane		ND	ND	ND
1,1,2-Trichloroethane		ND	ND	ND
Trichloroethene		ND	ND	ND
Trichlorofluoromethane		ND	ND	ND
1,2,3-Trichloropropane		ND	ND	ND
1,2,4-Trimethylbenzene		ND	ND	ND
1,3,5-Trimethylbenzene		ND	ND	ND
Vinyl chloride		ND	ND	ND
m,p-Xylene		6.5	ND	ND
o-Xylene		1.2	J	ND
Xylene (total)		7.7	ND	ND

Notes:
ND - Analyte not detected
J - Estimated value

Table 1 Continued
Laboratory Analytical Results for VOC, SVOC, PCB,
Pesticides, Metals, General Chemistry, and Asbestos
For Waste Composite Soil Samples
Former Glenwood Power Plant
Yonkers, New York

Sample ID Matrix Date Sampled	CO-WC Soil 8/11/2006	CY-WC Soil 8/11/2006	PG-WC Soil 8/11/2006
SVOC - TCLP			
Units	mg/L	mg/L	mg/L
2-Methylphenol	ND	ND	ND
3&4-Methylphenol	ND	ND	ND
Pentachlorophenol	ND	ND	ND
2,4,5-Trichlorophenol	ND	ND	ND
2,4,6-Trichlorophenol	ND	ND	ND
1,4-Dichlorobenzene	ND	ND	ND
2,4-Dinitrotoluene	ND	ND	ND
Hexachlorobenzene	ND	ND	ND
Hexachlorobutadiene	ND	ND	ND
Hexachloroethane	ND	ND	ND
Nitrobenzene	ND	ND	ND
Pyridine	ND	ND	ND
SVOC - Total			
Units	ug/Kg	ug/Kg	ug/Kg
2-Chlorophenol	ND	ND	ND
4-Chloro-3-methyl phenol	ND	ND	ND
2,4-Dichlorophenol	ND	ND	ND
2,4-Dimethylphenol	ND	ND	ND
2,4-Dinitrophenol	ND	ND	ND
4,6-Dinitro-o-cresol	ND	ND	ND
2-Methylphenol	ND	ND	ND
3&4-Methylphenol	ND	ND	ND
2-Nitrophenol	ND	ND	ND
4-Nitrophenol	ND	ND	ND
Pentachlorophenol	ND	ND	ND
Phenol	ND	ND	ND
2,4,5-Trichlorophenol	ND	ND	ND
2,4,6-Trichlorophenol	ND	ND	ND
Acenaphthene	ND	213	1,050
Acenaphthylene	41.0 J	59.3 J	260 J
Acetophenone	ND	ND	ND
Anthracene	77.1	478	2,540
Atrazine	ND	ND	ND
Benzidine	ND	ND	ND
Benzo(a)anthracene	502	1,340	7,330
Benzo(a)pyrene	458	1,200	7,170
Benzo(b)fluoranthene	544	1,100	7,180
Benzo(g,h,i)perylene	349	812	5,190
Benzo(k)fluoranthene	379	851	5,450
4-Bromophenyl phenyl ether	ND	ND	ND
Butyl benzyl phthalate	ND	ND	ND
Benzyl Alcohol	ND	ND	ND
1,1'-Biphenyl	ND	ND	ND
Benzaldehyde	ND	ND	ND
2-Chloronaphthalene	ND	ND	ND
4-Chloroaniline	ND	ND	ND
Carbazole	65.0 J	167	1,850
Caprolactam	ND	244	ND
Chrysene	605	1,500	7,370
bis(2-Chloroethoxy)methane	ND	ND	ND
bis(2-Chloroethyl)ether	ND	ND	ND
bis(2-Chloroisopropyl)ether	ND	ND	ND
4-Chlorophenyl phenyl ether	ND	ND	ND
1,2-Dichlorobenzene	ND	ND	ND

Notes:

ND - Analyte not detected

J - Estimated value

Table 1 Continued
Laboratory Analytical Results for VOC, SVOC, PCB,
Pesticides, Metals, General Chemistry, and Asbestos
For Waste Composite Soil Samples
Former Glenwood Power Plant
Yonkers, New York

Sample ID		CO-WC		CY-WC		PG-WC
Matrix		Soil		Soil		Soil
Date Sampled		8/11/2006		8/11/2006		8/11/2006
SVOC - Total						
	Units	ug/Kg		ug/Kg		ug/Kg
bis(2-Chloroethoxy)methane		ND		ND		ND
bis(2-Chloroethyl)ether		ND		ND		ND
bis(2-Chloroisopropyl)ether		ND		ND		ND
4-Chlorophenyl phenyl ether		ND		ND		ND
1,2-Dichlorobenzene		ND		ND		ND
1,3-Dichlorobenzene		ND		ND		ND
1,4-Dichlorobenzene		ND		ND		ND
2,4-Dinitrotoluene		ND		ND		ND
2,6-Dinitrotoluene		ND		ND		ND
3,3'-Dichlorobenzidine		ND		ND		ND
Dibenzo(a,h)anthracene		96.7		238		1,650
Dibenzofuran		28.7	J	91.4		255
Di-n-butyl phthalate		ND		ND		ND
Di-n-octyl phthalate		ND		ND		ND
Diethyl phthalate		ND		128		ND
Dimethyl phthalate		ND		ND		ND
bis(2-Ethylhexyl)phthalate		60.8	J	ND		824
Fluoranthene		791		2,430		16,200
Fluorene		ND		183		719
Hexachlorobenzene		ND		ND		ND
Hexachlorobutadiene		ND		ND		ND
Hexachlorocyclopentadiene		ND		ND		ND
Hexachloroethane		ND		ND		ND
Indeno(1,2,3-cd)pyrene		306		652		4,540
Isophorone		ND		ND		ND
2-Methylnaphthalene		25.9	J	53.5	J	326
2-Nitroaniline		ND		ND		ND
3-Nitroaniline		ND		ND		ND
4-Nitroaniline		ND		ND		ND
Naphthalene		48.8	J	68.8	J	1,250
Nitrobenzene		ND		ND		ND
N-Nitroso-di-n-propylamine		ND		ND		ND
N-Nitrosodiphenylamine		ND		ND		ND
Phenanthrene		396		2,120		9,670
Pyrene		940		3,410		15,500
Total TIC, Semi-Volatile		550	J	2,130	J	16,100

Notes:

ND - Analyte not detected

J - Estimated value

Table 1 Continued
Laboratory Analytical Results for VOC, SVOC, PCB,
Pesticides, Metals, General Chemistry, and Asbestos
For Waste Composite Soil Samples
Former Glenwood Power Plant
Yonkers, New York

Sample ID Matrix Date Sampled		CO-WC Soil 8/11/2006	CY-WC Soil 8/11/2006	PG-WC Soil 8/11/2006
Pesticides - TCLP				
	Units	mg/L	mg/L	mg/L
2,4-D		ND	ND	ND
2,4,5-TP (Silvex)		ND	ND	ND
gamma-BHC (Lindane)		ND	ND	ND
Chlordane		ND	ND	ND
Endrin		ND	ND	ND
Heptachlor		ND	ND	ND
Heptachlor epoxide		ND	ND	ND
Methoxychlor		ND	ND	ND
Toxaphene		ND	ND	ND
Pesticides - Total				
	Units	ug/Kg	ug/Kg	ug/Kg
Aldrin (ug/kg)		ND	ND	ND
alpha-BHC		ND	ND	ND
beta-BHC		ND	ND	ND
delta-BHC		ND	ND	ND
gamma-BHC (Lindane)		ND	ND	ND
Chlordane		ND	ND	ND
Dieldrin		ND	ND	11.5
4,4'-DDD		ND	ND	ND
4,4'-DDE		8.8	ND	7.5
4,4'-DDT		18.7	67.6	26.1
Endrin		ND	ND	ND
Endosulfan sulfate		ND	ND	ND
Endrin aldehyde		ND	ND	ND
Endosulfan-I		ND	ND	ND
Endosulfan-II		ND	ND	ND
Heptachlor		ND	ND	ND
Heptachlor epoxide		ND	ND	ND
Methoxychlor		ND	ND	ND
Toxaphene		ND	ND	ND
PCBs				
	Units	ug/Kg	ug/Kg	ug/Kg
Aroclor 1016		ND	ND	ND
Aroclor 1221		ND	ND	ND
Aroclor 1232		ND	ND	ND
Aroclor 1242		ND	ND	ND
Aroclor 1248		ND	ND	ND
Aroclor 1254		ND	ND	ND
Aroclor 1260		ND	684	86.5
TPH-DRO (C10-C28)	Units	mg/Kg	mg/Kg	mg/Kg
		77.8	882	360

Notes:
ND - Analyte not detected
J - Estimated value

Table 1 Continued
Laboratory Analytical Results for VOC, SVOC, PCB,
Pesticides, Metals, General Chemistry, and Asbestos
For Waste Composite Soil Samples
Former Glenwood Power Plant
Yonkers, New York

Sample ID Matrix Date Sampled	CO-WC Soil 8/11/2006	CY-WC Soil 8/11/2006	PG-WC Soil 8/11/2006
Metals Analysis - TCLP			
Units	mg/L	mg/L	mg/L
Arsenic	<0.50	<0.50	<0.50
Barium	<1.0	<1.0	<1.0
Cadmium	0.013	0.012	0.068
Chromium	<0.010	<0.010	<0.010
Copper	0.049	0.065	2.4
Lead	2.7	1.1	79.7
Mercury	<0.00020	<0.00020	<0.00020
Nickel	0.42	<0.040	0.27
Selenium	<0.50	<0.50	<0.50
Silver	<0.010	<0.010	<0.010
Zinc	1.9	4.2	34.2
Metals Analysis - Total			
Units	mg/Kg	mg/Kg	mg/Kg
Antimony	8.3	3.3	8.6
Arsenic	37.7	6.8	27.9
Barium	192	83.0	442
Beryllium	<0.59	<0.67	<0.78
Cadmium	1.3	2.0	2.6
Chromium	57.8	12.2	90.8
Copper	186	109	511
Lead	6,510	794	5,580
Mercury	0.42	0.28	1.4
Nickel	192	12.8	95.4
Selenium	7.2	<2.7	5.6
Silver	<2.4	<1.3	2.1
Thallium	<2.4	<1.3	<3.1
Vanadium	918	23.4	34.8
Zinc	614	784	1,630
General Chemistry			
pH	9.24	8.50	8.32
Redox Potential Vs H2 (mv)	312	379	328
Chromium, Hexavalent (mg/kg)	7.1	<1.3	7.0
Chromium, Trivalent (mg/kg)	50.7	12.2	83.8
Cyanide (mg/kg)	<0.23	0.75	0.57
Total Organic Halides (mg/kg)	<10	<10	<10
Cyanide Reactivity (mg/kg)	<5.8	<6.5	<7.9
Sulfide Reactivity (mg/kg)	<120	<130	<160
Ignitability (Flashpoint) (Deg. F)	> 200	> 200	> 200
Percent Sulfur (%)	2.2	<0.10	<0.10
Solids, Percent (%)	86.1	77.3	63.1
Corrosivity as pH ()	9.24 NC	8.50 NC	8.32 NC
Asbestos			
Units	Percent	Percent	Percent
Chrysotile	15.90%	1.20%	9.10%

Notes:

ND - Analyte not detected

J - Estimated value



HEALTH & SAFETY PLAN
AND
COMMUNITY AIR MONITORING PLAN
FOR
INTERIM REMEDIAL MEASURES
AT THE
FORMER GLENWOOD POWER PLANT
YONKERS, NY

April 2007

Prepared for:

REMI COMPANIES
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HEALTH & SAFETY PLAN
AND
COMMUNITY AIR MONITORING PLAN
FOR
INTERIM REMEDIAL MEASURES
AT THE
FORMER GLENWOOD POWER PLANT
YONKERS, NY

1.0 INTRODUCTION

This Construction Health & Safety Plan ("CHASP") is developed for utilization during planned internal demolition activities at the former Glenwood Power Plant in Yonkers, New York (the Site). **CA RICH Consultants, Inc.** will serve as the Environmental Consultant for this project and will coordinate sampling, waste profiling, regulated waste disposal, Brownfield and reporting issues. **McLearn Engineering Group** will serve as the Site Engineering Consultant for this project and will coordinate the internal demolition, structural evaluation and site redevelopment issues.

The CHASP is to be enforced jointly by CA RICH's and McLaren Engineering Group's Project Health & Safety Managers, the on-site Health & Safety Coordinators (HSC) or their assignees. The on-site HSC will interact with the Project Manager and is vested with the authority to make field decisions including the termination of on-site activities if an imminent health and safety hazard, condition or related concern arises. Information and protocol in the CHASP is applicable to all on-site personnel entering the designated work zone.

2.0 POTENTIAL HAZARDS

2.1 Chemical Hazards

The known chemicals or constituents of concern according to CA RICH's Phase II Environmental Site Assessment (ESA) consist of

- **Semi-Volatile Organic Compounds (SVOCs)** – Numerous detections including: Benzo (a) anthracene, Benzo (b) fluoranthene, Benzo (g, h, i) perylene, and Chrysene exceeded the NYSDEC TAGM limits.
- **Metals** – Numerous detections with Arsenic, Cadmium, Copper, Lead, Mercury and Zinc exceeding the NYSDEC TAGM limits. Lead -- a component of coal, coal ash and fly ash -- was the highest of the metals detected.
- **PCBs** – Aroclor 1260 was detected above the NYSDEC TAGM limits of 1,000 ug/kg.

- **Asbestos** – Many of the pipes are insulated with suspect asbestos containing materials (ACM). The Phase II Investigation determined that asbestos was present in five of the seven sampled materials. Pipe and blower insulation materials tested contained between 9% and 40% chrysotile and amosite asbestos.

Prior to any construction activities an asbestos survey followed by the abatement of asbestos from within the building is planned. The abatement will be conducted by a licensed asbestos abatement contractor. All abatement work will be performed under the provisions of a Health and Safety Plan prepared by the asbestos abatement contractor and in accordance with the Department of Labor (DOL) rules and regulations. This HASP does not address the health hazards associated with asbestos nor the proper handling procedures.

During construction activities, CA RICH will operate as if there is a potential hazard from these above-listed compounds and/or constituents in site soils. Relevant physical properties and toxicological information is included in Appendix A.

2.2 Structural Evaluation of the Building

Based on its age and years of neglect, the structural integrity of portions of this building are questionable. Prior to the initiation of the IRM activities at this property, a structural engineer from McLaren Engineering Group will inspect the building and determine which areas can safely accessed by workers and equipment. Areas that are deemed unsafe will either be shored or demolished.

2.3 Other Health & Safety Risks

Normal physical hazards associated with using excavation equipment and hand tools as well as hazards associated with adverse climatic conditions (heat & cold) or physical site-related construction and demolition debris represent a certain degree of risk to be assumed by on-site personnel.

Certain provisions in this Plan, specifically the use of personnel protective equipment, may tend to increase the risk of physical injury, as well as susceptibility to cold or heat stress. This is primarily due to restrictions in dexterity, hearing, sight, and normal body heat transfer inherent in the use of protective gear.

3.0 RISK MANAGEMENT

The Property is situated on the east side of the Hudson River and is located west of the Glenwood Railroad Station and southwest of Trevor Park & the JFK Marina. It includes four acres -- two of which are below the water level of the Hudson River -- and is improved with an inactive and vacant electric power generation plant. The three-story brick structure was initially constructed and operated by the Consolidated Edison Company (Con Ed) in the early 1900's. The facility was vacated in 1964. After Con Ed vacated the site, a contractor used the premises for the storage of construction materials.

3.1 Work / Exclusion Zones

The work scope will involve the excavation and off-site removal of contaminated soils in the courtyard area along with unwanted sediment, soil and debris from the inside of the structure. In addition, unregulated waste such as construction and demolition (C&D) material and scrap steel will be removed. Work / exclusion zone will be established for the purposes of this CHASP. Access to a designated exclusion area on-site will be limited to properly trained, properly protected, personnel directly involved with the work. Enforcement of the work / exclusion zone boundaries is the responsibility of the on-site Health & Safety Coordinator (HSC) or his/her properly trained assignee.

3.2 Personnel Protection

Health & Safety regulatory personnel have developed different levels of personnel protection to deal with differing degrees of potential risks of exposure to chemical constituents. The levels are designated as **A**, **B**, **C**, and **D** and are ranked according to the amount of personnel protection afforded by each level. Level **A** is the highest level of protection and Level **D** is the lowest level of protection.

The different levels are primarily dependent upon the degree of respiratory protection necessary, in conjunction with appropriate protective clothing. Levels of protection mandate a degree of respiratory protection. However, flexibility exists within the lower levels (B, C, and D) concerning proper protective clothing.

The four levels of protection were developed for utilization in situations which involve suspected or known atmospheric and/or environmental hazards including airborne contamination and skin-affecting substances.

It is anticipated that all of the work will be performed utilizing '**Level D**' protection (no respiratory protection necessary, but with protective clothing requirements limited to long sleeved shirts, long pants or coveralls, work gloves and steel-toe leather work boots).

Level D may be modified by the HSC to include protective clothing or equipment (Saran-coated disposable coveralls or PVC splash suits, safety glasses, hard hat with face shield, and chemically resistant boots) based upon potential for physical hazards, skin contact concerns, and/or real-time monitoring.

Real-time air monitoring for total airborne organics using either an OVA or a PID will determine if and when an upgrade from Level D to a higher level of respiratory protection is warranted. Decisions for an upgrade from Level D to higher levels of protection, mitigative actions, and/or suspension of work are the responsibility of the Project Manager and/or the designated on-site HSC.

In the event odors are detected, Level C respiratory protection will be employed.

3.3 Air Monitoring

The HSC or his/her properly trained assignee will conduct "Real Time" air monitoring for total organic vapors and total particulates. 'Real-time' monitoring refers to the utilization of instrumentation, which yields immediate measurements. The utilization of real time monitoring helps determine immediate or long-term risks to on-site personnel and the general public, the appropriate level of personnel respiratory protection necessary, and actions to mitigate the recognized hazard.

3.3.1. Particulate Monitoring

A. Instrumentation

Dust particulates in air will be monitored using a light scattering technique MINIRAM Model PDM-3 Miniature Real-time Aerosol Monitor (MINIRAM) or equivalent. The MINIRAM is capable of measuring airborne dust particles within the range of 10 to 100,000 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$). Particulate monitoring will only be necessary during excavation activities.

B. Application

Dust monitoring will occur at regular intervals during excavation activities. Monitoring will be conducted in upgradient and downgradient locations, relative to prevailing wind direction) along the perimeter of the work zone. The HSC or their assignee will perform the monitoring. As outlined in the NYSDOH Community Air Monitoring Plan, if particulate levels in the downwind location are $150 \text{ mg}/\text{m}^3$ greater than those measured in the upwind location, dust suppression techniques shall be employed.

3.3.2 Organic Vapor

A. Instrumentation

Real-time monitoring for total organic vapor (TOV) utilizes either a photo-ionization detector (PID) or flame ionization detector (FID). The appropriate PID is an intrinsically safe HNU Systems Model PI-101, MiniRae PID or equivalent, which is factory calibrated to benzene. The appropriate FID is a Foxboro model 128 Organic vapor Analyzer (OVA), which is factory calibrated to methane.

B. Application

Organic vapor monitoring is performed as outlined in the NYSDOH Community Air Monitoring Plan. Specifically, monitoring shall be conducted at the downwind perimeter of the work zone periodically during work activities. If TOV levels exceed 5 milligrams per meter cubed (mg/m^3) above established pre-work background levels, work activities will be halted and monitoring will be continued under the provision of a Vapor Emission Response Plan (outlined in Section 5).

3.4 Worker Training

Personnel overseeing the excavation of the impacted soil/fill will be properly trained. This includes the Health & Safety Coordinator and the Project Health and Safety Manager.

Prior to any work, all workers involved with the project should be aware of the potential chemical, physical and biological hazards discussed in this document, as well as the general safety practices outlined below. A 'tailgate' safety briefing by the on-site HSC and/or assistant assignee shall take place at the outset of work activities.

The HSC will be available to address environmentally-related health & safety issues a site worker (such as an equipment operator or laborer) may have regarding ongoing site conditions. Once any potential issue is brought to the HSC's attention, he or she will evaluate the issue and apply the procedures outlined in this Health & Safety Plan.

3.5 General Safety Practices

The following safety practices shall be followed by all project personnel.

1. Avoid unnecessary skin exposure to subsurface materials. Sleeved shirts tucked into long pants (or coveralls), work gloves, and steel-toe leather work boots are required unless modified gear is approved by the HSC. Remove any excess residual soil from clothes prior to leaving the site.
2. No eating, drinking, gum or tobacco chewing, or smoking allowed in designated work areas. Thoroughly wash hands prior to these activities outside the work area. Avoid sitting on the ground during breaks or while eating and drinking. Thoroughly wash all exposed body areas at the end of the workday.
3. Some symptoms of acute exposure include: dizziness, light-headedness, drowsiness, headache, and nose/eye/skin irritation. If these symptoms are experienced or strong odor is detected, leave the work area and immediately report the incident to the on-site HSC.

3.6 Enforcement

Enforcement of the Site Safety Plan will be the responsibility of the HSC or the assignee. The Coordinator should be on-site as needed, based on the work being performed and perform or directly oversee all aspects of the Health & Safety Plan including: air monitoring; environmental mitigation; personnel respiratory and skin protection; general safety practices; documentation; emergency procedures and protocol; and reporting and recordkeeping as described below.

3.7 Reporting & Recordkeeping

Incidents involving injury, symptoms of exposure, discovery of contained (potentially hazardous) materials, or unsafe work practices and/or conditions should be immediately reported to the HSC.

A logbook must be maintained on-site to document all aspects of CHASP enforcement. The log is paginated and dated with entries made on a daily basis in waterproof ink, initialed by the HSC or assignee. Log entries should include date and time of instrument monitoring, instrument type, measurement method, test results, calibration and maintenance information, as well as appropriate mitigative actions responding to detections. Miscellaneous information to be logged may include weather conditions, reported complaints or symptoms, regulatory inspections, and reasons to upgrade personnel protection above the normal specification (Level D).

4.0 EMERGENCIES

4.1 EMERGENCY RESPONSE SERVICES

(1)	HOSPITAL	Telephone
	St Joseph's Medical Hospital 127 South Broadway Yonkers, NY 10701 (between Vark Street & Herriot Street)	(914) 373-7000
(2)	AMBULANCE	911
(3)	FIRE DEPARTMENT HAZARDOUS MATERIALS	911

- | | | |
|-----|------------------------------|-----------------------|
| (4) | POLICE DEPARTMENT | 911 |
| (5) | POISON CONTROL CENTER | (800) 222-1222 |

The preceding list and associated attached map (Figure 1) illustrating the fastest route to the nearest hospital must be conspicuously posted in areas of worker congregation and adjacent to all on-site telephones (if any).

4.2 EMERGENCY PROCEDURES

4.2.1 Contact or Exposure to Suspected Hazardous Materials

In the event of a fire, chemical discharge, medical emergency, workers are instructed to immediately notify the HSC and proper emergency services (posted). Should physical contact with unknown or questionable materials occur, immediately wash the affected body areas with clean water and notify the HSC. Anyone experiencing symptoms of exposure should exit the work area, notify the HSC, and seek medical attention.

4.2.2 Ingress/egress

Clear paths of ingress/egress to work zones and site entrances/exits must be maintained at all times. Unauthorized personnel are restricted from accessing the site.

5.0 COMMUNITY AIR MONITORING PLAN

Real-time air monitoring, for volatile compounds and particulate levels at the perimeter of the work area is necessary. This plan includes the following:

- Volatile organic compounds must be monitored at the downwind perimeter of the work area on a continuous basis. If total organic vapor levels exceed 5 ppm above background, work activities must be halted and monitoring continued under the provisions of a Vapor Emission Response Plan. All readings must be recorded and be available for State (DEC & DOH) personnel to review.
- Particulates should be continuously monitored upwind, downwind and within the work area at temporary particulate monitoring stations during excavation activities. If the downwind particulate level is 150 $\mu\text{g}/\text{m}^3$ greater than the upwind particulate level, then dust suppression techniques must be employed. All readings must be recorded and be available for State (DEC & DOH) personnel to review.

Major Vapor Emission

If any organic levels greater than 5 ppm over background or particulate levels 150 $\mu\text{g}/\text{m}^3$ greater than the upwind particulate levels are identified 200 feet downwind from the work area or half the distance to the nearest residential or commercial property, whichever is less, the site soils will be misted with water and the downwind area will be monitored. If the water mist does not mitigate the elevated levels all work activities must be halted.

If, following the cessation of the work activities, or as the result of an emergency, organic levels persist above 5 ppm above background or particulate levels persist 150 µg/m³ greater than the upwind particulate levels 200 feet downwind or half the distance to the nearest residential or commercial property from the work area, then the air quality must be monitored within 20 feet of the perimeter of the nearest residential or commercial structure (20 Foot Zone).

If efforts to abate the emission source are unsuccessful and, if organic vapor levels are approaching 5 ppm above background or particulate levels persist 150 µg/m³ greater than the upwind particulate levels for more than 30 minutes in the 20 Foot Zone, then the Major Vapor Emission Response Plan shall automatically be placed into effect;

However, the Major Vapor Emission Response Plan shall be immediately placed into effect if organic vapor levels are greater than 10 ppm above background or particulate levels persist 200 µg/m³ greater than the upwind particulate levels.

Major Vapor Emission Response Plan

Upon activation, the following activities will be undertaken:

1. All Emergency Response Contacts as listed in the Health & Safety Plan of the Remedial Action Plan will go into effect.
2. The local police authorities will immediately be contacted by the Safety Officer and advised of the situation.
3. Frequent air monitoring will be conducted at 30 minute intervals within the 20 Foot Zone. If two successive readings below action levels are measured, air monitoring may be halted or modified by the Safety Officer.

6.0 HEALTH & SAFETY PLAN REFERENCES

1. American Conference Governmental Industrial Hygienists, 1989; Threshold Limit Values And Biological Exposure Indices, 111 Pp.
2. Geoenvironmental Consultants, Inc.; 1987; Safety & Operations At Hazardous Materials Sites
3. NIOSH Guide To Chemical Hazards, 2002, US Department Of Health And Human Services, Centers For Disease Control
4. US Department Of Labor Occupational Safety & Health Administration, 1989; Hazardous Waste Operations And Emergency Response Interim Final Rule, 29 CFR Part 1910
5. Sax, N. I. Dangerous Properties Of Industrial Materials; © 1984

7.0 KEY PERSONNEL

<u>Responsibility</u>	<u>Name and Phone Number</u>	<u>Task Description</u>
CA RICH Project Manager:	<u>Eric Weinstock (516) 576-8844</u>	Oversee and coordinate all environmental aspects for the project
CA RICH Site Safety Officer:	<u>Jason Cooper (516) 576-8844</u>	Coordinate and inspect all health and safety operations from the project site
CA RICH Site Safety Alternate:	<u>Deborah Shapiro (516) 576-8844</u>	
McLaren Eng. Gp. Project Manager:	<u>Steven L. Grogg (845) 353-6400</u>	Oversee and coordinate all site redevelopment aspects for the project
McLaren Eng. Gp. Site Safety Officer:	<u>Eric Bodnar (845) 353-6400</u>	Coordinate and inspect all health and safety operations from the project site
McLaren Eng. Gp. Site Safety Alternate:	<u>Victor Frazita (845) 353-6400</u>	
Client Representative:	<u>Erik Kaiser (201) 420-7142</u>	

Figure 1
Hospital Location & Directions



Start: Ravine Ave & Glenwood Ave
Yonkers, NY 10701, US

End: St Joseph's Medical Ctr:
914-378-7000
127 S Broadway, Yonkers, NY
10701, US

Notes:



Directions

Distance

Total Est. Time: 6 minutes

Total Est. Distance: 1.61 miles



1: Start out going SOUTHEAST on GLENWOOD AVE toward WOODWORTH AVE. <0.1 miles



2: Turn RIGHT onto Warburton Ave. 1.0 miles



3: Warburton Ave becomes Riverdale Ave / US-9 S / NY-9A S. 0.1 miles



4: Turn LEFT onto US-9 / NY-9A / Prospect St. <0.1 miles



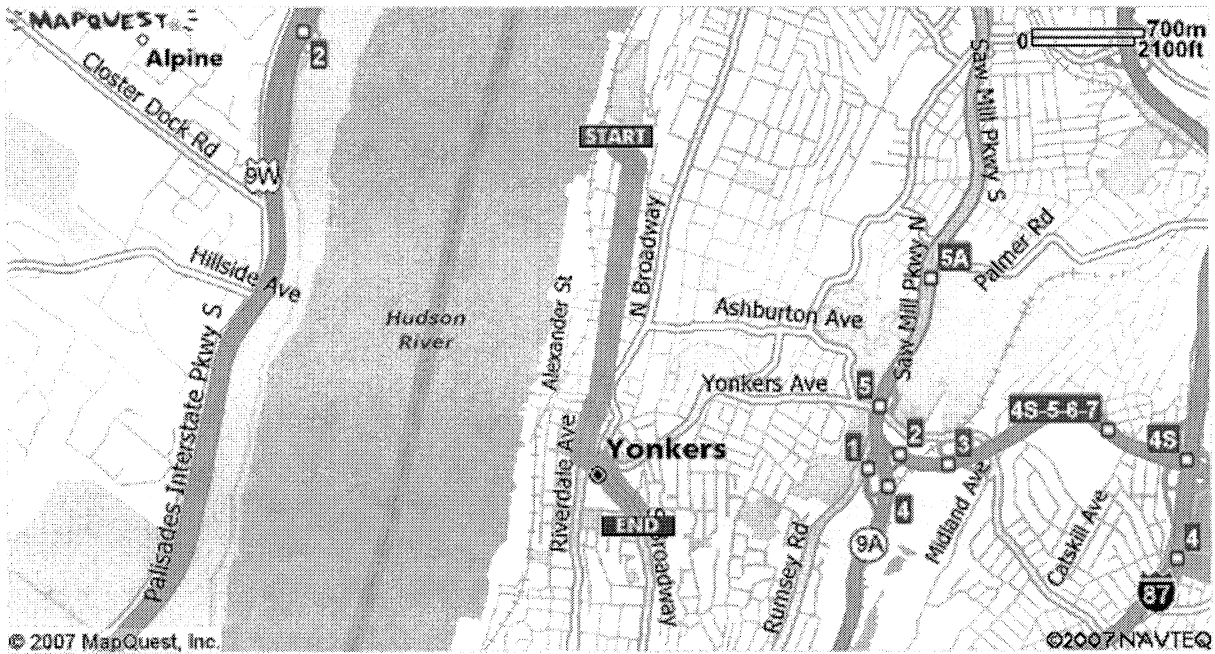
5: Turn RIGHT onto S Broadway / US-9 / NY-9A. 0.2 miles



6: End at St Joseph's Medical Ctr:
127 S Broadway, Yonkers, NY 10701, US

Total Est. Time: 6 minutes

Total Est. Distance: 1.61 miles



Start:
Ravine Ave & Glenwood Ave
Yonkers, NY 10701, US

End:
St Joseph's Medical Ctr: 914-378-7000
127 S Broadway, Yonkers, NY 10701, US



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These directions are informational only. No representation is made or warranty given as to their content, road conditions or route usability or expeditiousness. User assumes all risk of use. MapQuest and its suppliers assume no responsibility for any loss or delay resulting from such use.

APPENDIX A
Toxicological Information


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[CDC Search](#)
[CDC Health Topics A-Z](#)

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NIOSH Publication No. 2005-149:

September 2005

NIOSH Pocket Guide to Chemical Hazards

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Arsenic (inorganic compounds, as As)

CAS 7440-38-2 (metal)

As (metal)

RTECS CG0525000 (metal)

Synonyms & Trade Names

Arsenic metal: Arsenia

Other synonyms vary depending upon the specific As compound. [Note: OSHA considers "Inorganic Arsenic" to mean copper acetoarsenite & all inorganic compounds containing arsenic except ARSINE.]

DOT ID & Guide

1558 152 (metal)1562 152 (dust)

Exposure Limits

NIOSH REL: Ca C 0.002 mg/m³ [15-minute] See Appendix AOSHA PEL: [1910.1018] TWA 0.010 mg/m³IDLH Ca [5 mg/m³ (as As)] See: 7440382

Conversion

Physical Description

Metal: Silver-gray or tin-white, brittle, odorless solid.

MW: 74.9

BP: Sublimes

MLT: 1135°F (Sublimes)

Sol: Insoluble

VP: 0 mmHg (approx)

IP: NA

Sp.Gr: 5.73 (metal)

F.P: NA

UEL: NA

LEL: NA

Metal: Noncombustible Solid in bulk form, but a slight explosion hazard in the form of dust when exposed to flame.

Incompatibilities & Reactivities

Strong oxidizers, bromine azide [Note: Hydrogen gas can react with inorganic arsenic to form the highly toxic gas arsine.]

Measurement Methods

NIOSH 7300, 7301, 7303, 7900, 9102; OSHA ID105

See: [NMAM](#) or [OSHA Methods](#)

Personal Protection & Sanitation (See protection)

Skin: Prevent skin contact

Eyes: Prevent eye contact

Wash skin: When contaminated/Daily

Remove: When wet or contaminated

Change: Daily

Provide: Eyewash, Quick drench

First Aid (See procedures)

Eye: Irrigate immediately

Skin: Soap wash immediately

Breathing: Respiratory support

Swallow: Medical attention immediately

Respirator Recommendations (See Appendix E) NIOSH

At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:

(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted acid gas canister having an N100, R100, or P100 filter. [Click here](#) for information on selection of N, R, or P filters./Any appropriate escape-type, self-contained breathing apparatus[Important additional information about respirator selection](#)

Exposure Routes inhalation, skin absorption, skin and/or eye contact ingestion

Symptoms Ulceration of nasal septum, dermatitis, gastrointestinal disturbances, peripheral neuropathy, respiratory irritation, hyperpigmentation of skin, [potential occupational carcinogen]

Target Organs Liver, kidneys, skin, lungs, lymphatic system

Cancer Site [lung & lymphatic cancer]

See also: [INTRODUCTION](#) See ICSC CARD: [0013](#) See MEDICAL TESTS: [0017](#)

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NIOSH Publication No. 2005-149:

September 2005

NIOSH Pocket Guide to Chemical Hazards

[NPG Home](#) | [Introduction](#) | [Synonyms & Trade Names](#) | [Chemical Names](#) | [CAS Numbers](#) | [RTECS Numbers](#) | [Appendices](#) | [Search](#)

Cadmium dust (as Cd)

CAS 7440-43-9 (metal)

Cd (metal)

RTECS EU9800000 (metal)

Synonyms & Trade Names

Cadmium metal: Cadmium

Other synonyms vary depending upon the specific cadmium compound.

DOT ID & Guide

2570 154 (cadmium compound)

Exposure Limits

NIOSH REL*: Ca See Appendix A [*Note: The REL applies to all Cadmium compounds (as Cd).]

OSHA PEL*: [1910.1027] TWA 0.005 mg/m³ [*Note: The PEL applies to all Cadmium compounds (as Cd).]IDLH Ca [9 mg/m³ (as Cd)] See: [IDLH INDEX](#)

Conversion

Physical Description

Metal: Silver-white, blue-tinged lustrous, odorless solid.

MW: 112.4

BP: 1409°F

MLT: 610°F

Sol: Insoluble

VP: 0 mmHg (approx)

IP: NA

Sp.Gr: 8.65 (metal)

F.P: NA

UEL: NA

LEL: NA

Metal: Noncombustible Solid in bulk form, but will burn in powder form.

Incompatibilities & Reactivities

Strong oxidizers; elemental sulfur, selenium & tellurium

Measurement Methods

NIOSH 7048, 7300, 7301, 7303, 9102; OSHA ID121, ID125G, ID189, ID206

See: [NMAM](#) or [OSHA Methods](#)

Personal Protection & Sanitation (See protection)

Skin: No recommendation

Eyes: No recommendation

Wash skin: Daily

Remove: No recommendation

Change: Daily

First Aid (See procedures)

Eye: Irrigate immediately

Skin: Soap wash

Breathing: Respiratory support

Swallow: Medical attention immediately

Respirator Recommendations (See Appendix E) NIOSH

At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:

(APF = 50) Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter. [Click here](#) for information on selection of N, R, or P filters./Any appropriate escape-type, self-contained breathing apparatus[Important additional information about respirator selection](#)

Exposure Routes inhalation, ingestion

Symptoms Pulmonary edema, dyspnea (breathing difficulty), cough, chest tightness, substernal (occurring beneath the sternum) pain; headache; chills, muscle aches; nausea, vomiting, diarrhea; anosmia (loss of the sense of smell), emphysema, proteinuria, mild

anemia; [potential occupational carcinogen]

Target Organs respiratory system, kidneys, prostate, blood

Cancer Site [prostatic & lung cancer]

See also: [INTRODUCTION](#) See ICSC CARD: [0020](#) See MEDICAL TESTS: [0035](#)

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Chromium metal

CAS 7440-47-3

Cr

RTECS GB4200000

Synonyms & Trade Names

Chrome, Chromium

DOT ID & Guide

Exposure Limits

NIOSH REL: TWA 0.5 mg/m³ [See Appendix C](#)OSHA PEL*: TWA 1 mg/m³ [See Appendix C](#) [*Note: The PEL also applies to insoluble chromium salts.]IDLH 250 mg/m³ (as Cr) [See: 7440473](#)

Conversion

Physical Description

Blue-white to steel-gray, lustrous, brittle, hard, odorless solid.

MW: 52.0

BP: 4788°F

MLT: 3452°F

Sol: Insoluble

VP: 0 mmHg (approx)

IP: NA

Sp.Gr: 7.14

F.I.P: NA

UEL: NA

LEL: NA

Noncombustible Solid in bulk form, but finely divided dust burns rapidly if heated in a flame.

Incompatibilities & Reactivities

Strong oxidizers (such as hydrogen peroxide), alkalis

Measurement Methods

NIOSH 7024, 7300, 7301, 7303, 9102; OSHA ID121, ID125G

[See: NMAM](#) or [OSHA Methods](#)

Personal Protection & Sanitation [\(See protection\)](#)

Skin: No recommendation

Eyes: No recommendation

Wash skin: No recommendation

Remove: No recommendation

Change: No recommendation

First Aid [\(See procedures\)](#)

Eye: Irrigate immediately

Skin: Soap wash

Breathing: Respiratory support

Swallow: Medical attention immediately

Respirator Recommendations NIOSH

Up to 2.5 mg/m³:

(APF = 5) Any quarter-mask respirator. [Click here](#) for information on selection of N, R, or P filters.*

Up to 5 mg/m³:

(APF = 10) Any particulate respirator equipped with an N95, R95, or P95 filter (including N95, R95, and P95 filtering facepieces) except quarter-mask respirators. The following filters may also be used: N99, R99, P99, N100, R100, P100. [Click here](#) for information on selection of N, R, or P filters.*

(APF = 10) Any supplied-air respirator*

Up to 12.5 mg/m³:

(APF = 25) Any supplied-air respirator operated in a continuous-flow mode*

(APF = 25) Any powered air-purifying respirator with a high-efficiency particulate filter.*

Up to 25 mg/m³:

(APF = 50) Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter. [Click here](#) for information on selection of N, R, or P filters.

(APF = 50) Any powered, air-purifying respirator with a tight-fitting facepiece and a high-efficiency particulate filter*

(APF = 50) Any self-contained breathing apparatus with a full facepiece

(APF = 50) Any supplied-air respirator with a full facepiece

Up to 250 mg/m³:

(APF = 2000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

Emergency or planned entry into unknown concentrations or IDLH conditions:

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:

(APF = 50) Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter. [Click here](#) for information on selection of N, R, or P filters./Any appropriate escape-type, self-contained breathing apparatus

[Important additional information about respirator selection](#)

Exposure Routes inhalation, ingestion, skin and/or eye contact

Symptoms Irritation eyes, skin; lung fibrosis (histologic)

Target Organs Eyes, skin, respiratory system

See also: [INTRODUCTION](#) See ICSC CARD: [0029](#) See MEDICAL TESTS: [0052](#)

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Copper fume (as Cu)

CAS 1317-38-0 (CuO)

CuO/Cu

RTECS [GL7900000](#) (CuO)

Synonyms & Trade Names

DOT ID & Guide

CuO: Black copper oxide fume, Copper monoxide fume, Copper(II) oxide fume, Cupric oxide fume
 Cu: Copper fume [Note: Also see specific listing for Copper (dusts and mists).]

Exposure Limits

NIOSH REL: TWA 0.1 mg/m³OSHA PEL: TWA 0.1 mg/m³IDLH 100 mg/m³ (as Cu) See: [IDLH INDEX](#)

Conversion

Physical Description

Finely divided black particulate dispersed in air. [Note: Exposure may occur in copper & brass plants and during the welding of copper alloys.]

MW: 79.5

BP: Decomposes

MLT: 1879°F (Decomposes)

Sol: Insoluble

VP: 0 mmHg (approx)

IP: NA

Sp.Gr: 6.4 (CuO)

F.I.P: NA

UEL: NA

LEL: NA

CuO: Noncombustible Solid

Incompatibilities & Reactivities

CuO: Acetylene, zirconium [Note: See Copper (dusts and mists) for properties of Copper metal.]

Measurement Methods

NIOSH [7029](#), [7300](#), [7301](#), [7303](#); OSHA [ID121](#), [ID125G](#), [ID206](#)See: [NMAM](#) or [OSHA Methods](#)

Personal Protection & Sanitation (See protection)

First Aid (See procedures)

Skin: No recommendation

Eyes: No recommendation

Wash skin: No recommendation

Remove: No recommendation

Change: No recommendation

Breathing: Respiratory support

Respirator Recommendations NIOSH/OSHA

Up to 1 mg/m³:

(APF = 10) Any particulate respirator equipped with an N95, R95, or P95 filter (including N95, R95, and P95 filtering facepieces) except quarter-mask respirators. The following filters may also be used: N99, R99, P99, N100, R100, P100. [Click here](#) for information on selection of N, R, or P filters.

(APF = 10) Any supplied-air respirator

Up to 2.5 mg/m³:

(APF = 25) Any supplied-air respirator operated in a continuous-flow mode

(APF = 25) Any powered air-purifying respirator with a high-efficiency particulate filter.

Up to 5 mg/m³:

(APF = 50) Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter. [Click here](#) for information on selection of N, R, or P filters.

(APF = 50) Any supplied-air respirator that has a tight-fitting facepiece and is operated in a continuous-flow mode

(APF = 50) Any powered, air-purifying respirator with a tight-fitting facepiece and a high-efficiency particulate filter

(APF = 50) Any self-contained breathing apparatus with a full facepiece
 (APF = 50) Any supplied-air respirator with a full facepiece

Up to 100 mg/m³:

(APF = 2000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

Emergency or planned entry into unknown concentrations or IDLH conditions:

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:

(APF = 50) Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter. [Click here](#) for information on selection of N, R, or P filters./Any appropriate escape-type, self-contained breathing apparatus

[Important additional information about respirator selection](#)

Exposure Routes inhalation, skin and/or eye contact

Symptoms Irritation eyes, upper respiratory system; metal fume fever: chills, muscle ache, nausea, fever, dry throat, cough, lassitude (weakness, exhaustion); metallic or sweet taste; discoloration skin, hair

Target Organs Eyes, skin, respiratory system (increase(d) risk with Wilson's disease)

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Lead

CAS 7439-92-1

Pb

RTECS OF7525000

Synonyms & Trade Names

Lead metal, Plumbum

DOT ID & Guide

Exposure Limits

NIOSH REL*: TWA 0.050 mg/m³ See Appendix C [*Note: The REL also applies to other lead compounds (as Pb) -- see Appendix C.]OSHA PEL*: [1910.1025] TWA 0.050 mg/m³ See Appendix C [*Note: The PEL also applies to other lead compounds (as Pb) -- see Appendix C.]IDLH 100 mg/m³ (as Pb) See: 7439921

Conversion

Physical Description

A heavy, ductile, soft, gray solid.

MW: 207.2

BP: 3164°F

MLT: 621°F

Sol: Insoluble

VP: 0 mmHg (approx)

IP: NA

Sp.Gr: 11.34

F.I.P: NA

UEL: NA

LEL: NA

Noncombustible Solid in bulk form.

Incompatibilities & Reactivities

Strong oxidizers, hydrogen peroxide, acids

Measurement Methods

NIOSH 7082, 7105, 7300, 7301, 7303, 7700, 7701, 7702, 9100, 9102, 9105; OSHA ID121, ID125G, ID206

See: NMAM or OSHA Methods

Personal Protection & Sanitation (See protection)

Skin: Prevent skin contact

Eyes: Prevent eye contact

Wash skin: Daily

Remove: When wet or contaminated

Change: Daily

First Aid (See procedures)

Eye: Irrigate immediately

Skin: Soap flush promptly

Breathing: Respiratory support

Swallow: Medical attention immediately

Respirator Recommendations (See Appendix E) NIOSH/OSHA

Up to 0.5 mg/m³:

(APF = 10) Any air-purifying respirator with an N100, R100, or P100 filter (including N100, R100, and P100 filtering facepieces) except quarter-mask respirators. [Click here](#) for information on selection of N, R, or P filters.

(APF = 10) Any supplied-air respirator

Up to 1.25 mg/m³:

(APF = 25) Any supplied-air respirator operated in a continuous-flow mode

(APF = 25) Any powered, air-purifying respirator with a high-efficiency particulate filter

Up to 2.5 mg/m³:

(APF = 50) Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter. [Click here](#) for information on selection of N, R, or P filters.

(APF = 50) Any supplied-air respirator that has a tight-fitting facepiece and is operated in a continuous-flow mode

(APF = 50) Any powered, air-purifying respirator with a tight-fitting facepiece and a high-efficiency particulate filter

(APF = 50) Any self-contained breathing apparatus with a full facepiece

(APF = 50) Any supplied-air respirator with a full facepiece

Up to 50 mg/m³:

(APF = 1000) Any supplied-air respirator operated in a pressure-demand or other positive-pressure mode

Up to 100 mg/m³:

(APF = 2000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

Emergency or planned entry into unknown concentrations or IDLH conditions:

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:

(APF = 50) Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter. [Click here](#) for information on selection of N, R, or P filters./Any appropriate escape-type, self-contained breathing apparatus

[Important additional information about respirator selection](#)

Exposure Routes inhalation, ingestion, skin and/or eye contact

Symptoms Lassitude (weakness, exhaustion), insomnia; facial pallor; anorexia, weight loss, malnutrition; constipation, abdominal pain, colic; anemia; gingival lead line; tremor; paralysis wrist, ankles; encephalopathy; kidney disease; irritation eyes; hypotension

Target Organs Eyes, gastrointestinal tract, central nervous system, kidneys, blood, gingival tissue

See also: [INTRODUCTION](#) See ICSC CARD: [0052](#) See MEDICAL TESTS: [0127](#)

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Mercury compounds [except (organo) alkyls] (as Hg)

CAS 7439-97-6 (metal)

Hg (metal)

RTECS OV4550000 (metal)

Synonyms & Trade Names

Mercury metal: Colloidal mercury, Metallic mercury, Quicksilver

Synonyms of "other" Hg compounds vary depending upon the specific compound.

DOT ID & Guide

2809 172 (metal)

Exposure Limits

NIOSH REL: Hg Vapor: TWA 0.05 mg/m³ [skin]Other: C 0.1 mg/m³ [skin]OSHA PEL†: C 0.1 mg/m³IDLH 10 mg/m³ (as Hg) See: [7439976](#)

Conversion

Physical Description

Metal: Silver-white, heavy, odorless liquid. [Note: "Other" Hg compounds include all inorganic & aryl Hg compounds except (organo) alkyls.]

MW: 200.6

BP: 674°F

FRZ: -38°F

Sol: Insoluble

VP: 0.0012 mmHg

IP: ?

Sp.Gr: 13.6 (metal)

F.I.P: NA

UEL: NA

LEL: NA

Metal: Noncombustible Liquid

Incompatibilities & Reactivities

Acetylene, ammonia, chlorine dioxide, azides, calcium (amalgam formation), sodium carbide, lithium, rubidium, copper

Measurement Methods

NIOSH [6009](#); OSHA [ID140](#)See: [NMAM](#) or [OSHA Methods](#)

Personal Protection & Sanitation (See [protection](#))

Skin: Prevent skin contact

Eyes: No recommendation

Wash skin: When contaminated

Remove: When wet or contaminated

Change: Daily

First Aid (See [procedures](#))

Eye: Irrigate immediately

Skin: Soap wash promptly

Breathing: Respiratory support

Swallow: Medical attention immediately

Respirator Recommendations

Mercury vapor: NIOSH

Up to 0.5 mg/m³:

(APF = 10) Any chemical cartridge respirator with cartridge(s) providing protection against the compound of concern†

(APF = 10) Any supplied-air respirator

Up to 1.25 mg/m³:

(APF = 25) Any supplied-air respirator operated in a continuous-flow mode

(APF = 25) Any powered, air-purifying respirator with cartridge(s) providing protection against the compound of concern†(canister)

Up to 2.5 mg/m³:

(APF = 50) Any chemical cartridge respirator with a full facepiece and cartridge(s) providing protection against the compound of concern†

(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against the compound of concern†

(APF = 50) Any supplied-air respirator that has a tight-fitting facepiece and is operated in a continuous-flow mode/PAPRTS(canister)
 (APF = 50) Any self-contained breathing apparatus with a full facepiece
 (APF = 50) Any supplied-air respirator with a full facepiece

Up to 10 mg/m³:

(APF = 1000) Any supplied-air respirator operated in a pressure-demand or other positive-pressure mode

Emergency or planned entry into unknown concentrations or IDLH conditions:

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:

(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against the compound of concern/Any appropriate escape-type, self-contained breathing apparatus

Other mercury compounds: NIOSH/OSHA

Up to 1 mg/m³:

(APF = 10) Any chemical cartridge respirator with cartridge(s) providing protection against the compound of concern†

(APF = 10) Any supplied-air respirator

Up to 2.5 mg/m³:

(APF = 25) Any supplied-air respirator operated in a continuous-flow mode

(APF = 25) Any powered, air-purifying respirator with cartridge(s) providing protection against the compound of concern†(canister)

Up to 5 mg/m³:

(APF = 50) Any chemical cartridge respirator with a full facepiece and cartridge(s) providing protection against the compound of concern†

(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against the compound of concern†

(APF = 50) Any supplied-air respirator that has a tight-fitting facepiece and is operated in a continuous-flow mode/PAPRTS(canister)

(APF = 50) Any self-contained breathing apparatus with a full facepiece

(APF = 50) Any supplied-air respirator with a full facepiece

Up to 10 mg/m³:

(APF = 1000) Any supplied-air respirator operated in a pressure-demand or other positive-pressure mode

Emergency or planned entry into unknown concentrations or IDLH conditions:

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:

(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted canister providing protection against the compound of concern/Any appropriate escape-type, self-contained breathing apparatus

Important additional information about respirator selection

Exposure Routes inhalation, skin absorption, ingestion, skin and/or eye contact

Symptoms Irritation eyes, skin; cough, chest pain, dyspnea (breathing difficulty), bronchitis, pneumonitis; tremor, insomnia, irritability, indecision, headache, lassitude (weakness, exhaustion); stomatitis, salivation; gastrointestinal disturbance, anorexia, weight loss; proteinuria

Target Organs Eyes, skin, respiratory system, central nervous system, kidneys

See also: [INTRODUCTION](#) See ICSC CARD: [0056](#) See MEDICAL TESTS: [0136](#)

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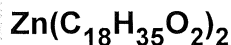
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Zinc stearate

CAS 557-05-1

RTECS [ZH5200000](#)

Synonyms & Trade Names

Dibasic zinc stearate, Zinc salt of stearic acid, Zinc distearate

DOT ID & Guide

Exposure Limits

NIOSH REL: TWA 10 mg/m³ (total) TWA 5 mg/m³ (resp)OSHA PEL†: TWA 15 mg/m³ (total) TWA 5 mg/m³ (resp)IDLH N.D. See: [IDLH INDEX](#)

Conversion

Physical Description

Soft, white powder with a slight, characteristic odor.

MW: 632.4

BP: ?

MLT: 266°F

Sol: Insoluble

VP: 0 mmHg (approx)

IP: NA

Sp.Gr: 1.10

Fl.P(oc): 530°F

UEL: ?

LEL: ?

MEC: 20 g/m³

Combustible Solid

Incompatibilities & Reactivities

Oxidizers, dilute acids [Note: Hydrophobic (i.e., repels water).]

Measurement Methods

NIOSH 0500, 0600

See: [NMAM](#) or [OSHA Methods](#)

Personal Protection & Sanitation (See [protection](#))

Skin: No recommendation

Eyes: No recommendation

Wash skin: No recommendation

Remove: No recommendation

Change: No recommendation

First Aid (See [procedures](#))

Eye: Irrigate immediately

Skin: Soap wash

Breathing: Fresh air

Swallow: Medical attention immediately

Respirator Recommendations Not available.

[Important additional information about respirator selection](#)

Exposure Routes inhalation, ingestion, skin and/or eye contact

Symptoms Irritation eyes, skin, upper respiratory system; cough

Target Organs Eyes, skin, respiratory system

See also: [INTRODUCTION](#) See ICSC CARD: [0987](#)
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Zinc chloride fume

CAS 7646-85-7

RTECS [ZH1400000](#)

Synonyms & Trade Names

Zinc dichloride fume

DOT ID & Guide

2331 [154](#)

Exposure Limits

NIOSH REL: TWA 1 mg/m³ ST 2 mg/m³OSHA PEL†: TWA 1 mg/m³IDLH 50 mg/m³ See: [7646857](#)

Conversion

Physical Description

White particulate dispersed in air.

MW: 136.3

BP: 1350°F

MLT: 554°F

Sol(70°F): 435%

VP: 0 mmHg (approx)

IP: NA

Sp.Gr(77°F): 2.91

FI.P: NA

UEL: NA

LEL: NA

Noncombustible Solid

Incompatibilities & Reactivities

Potassium

Measurement Methods

OSHA [ID121](#)See: [NMAM](#) or [OSHA Methods](#)

Personal Protection & Sanitation (See [protection](#))

Skin: No recommendation

Eyes: No recommendation

Wash skin: No recommendation

Remove: No recommendation

Change: No recommendation

First Aid (See [procedures](#))

Breathing: Respiratory support

Respirator Recommendations NIOSH/OSHA

Up to 10 mg/m³:(APF = 10) Any particulate respirator equipped with an N95, R95, or P95 filter (including N95, R95, and P95 filtering facepieces) except quarter-mask respirators. The following filters may also be used: N99, R99, P99, N100, R100, P100. [Click here](#) for information on selection of N, R, or P filters.*

(APF = 10) Any supplied-air respirator*

Up to 25 mg/m³:

(APF = 25) Any supplied-air respirator operated in a continuous-flow mode*

(APF = 25) Any powered air-purifying respirator with a high-efficiency particulate filter.*

Up to 50 mg/m³:(APF = 50) Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter. [Click here](#) for information on selection of N, R, or P filters.

(APF = 50) Any powered, air-purifying respirator with a tight-fitting facepiece and a high-efficiency particulate filter*

(APF = 50) Any self-contained breathing apparatus with a full facepiece

(APF = 50) Any supplied-air respirator with a full facepiece

Emergency or planned entry into unknown concentrations or IDLH conditions:

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:

(APF = 50) Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter. [Click here](#) for information on selection of N, R, or P filters./Any appropriate escape-type, self-contained breathing apparatus

Important additional information about respirator selection

Exposure Routes inhalation, skin and/or eye contact

Symptoms Irritation eyes, skin, nose, throat; conjunctivitis; cough, copious sputum; dyspnea (breathing difficulty), chest pain, pulmonary edema, pneumonitis; pulmonary fibrosis, cor pulmonale; fever; cyanosis; tachypnea; skin burns

Target Organs Eyes, skin, respiratory system, cardiovascular system

See also: [INTRODUCTION](#) See ICSC CARD: [1064](#) See MEDICAL TESTS: [0245](#)

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Zinc oxide

CAS 1314-13-2

ZnO

RTECS [ZH4810000](#)

Synonyms & Trade Names

Zinc peroxide

DOT ID & Guide

1516 [143](#)

Exposure Limits

 NIOSH REL: Dust: TWA 5 mg/m³ C 15 mg/m³
 Fume: TWA 5 mg/m³ ST 10 mg/m³

 OSHA PEL†: TWA 5 mg/m³ (fume) TWA 15 mg/m³ (total dust) TWA 5 mg/m³ (resp dust)
IDLH 500 mg/m³ See: [1314132](#)

Conversion

Physical Description

White, odorless solid.

MW: 81.4

BP: ?

MLT: 3587°F

Sol(64°F): 0.0004%

VP: 0 mmHg (approx)

IP: NA

Sp.Gr: 5.61

F.I.P: NA

UEL: NA

LEL: NA

Noncombustible Solid

Incompatibilities & Reactivities

Chlorinated rubber (at 419°F), water [Note: Slowly decomposed by water.]

Measurement Methods

NIOSH 7303, 7502; OSHA ID121, ID143

See: [NMAM](#) or [OSHA Methods](#)

Personal Protection & Sanitation (See [protection](#))

 Skin: No recommendation
 Eyes: No recommendation
 Wash skin: No recommendation
 Remove: No recommendation
 Change: No recommendation

First Aid (See [procedures](#))

Breathing: Respiratory support

Respirator Recommendations NIOSH/OSHA

Up to 50 mg/m³:
 (APF = 10) Any particulate respirator equipped with an N95, R95, or P95 filter (including N95, R95, and P95 filtering facepieces) except quarter-mask respirators. The following filters may also be used: N99, R99, P99, N100, R100, P100. [Click here](#) for information on selection of N, R, or P filters.

(APF = 10) Any supplied-air respirator

Up to 125 mg/m³:

(APF = 25) Any supplied-air respirator operated in a continuous-flow mode

(APF = 25) Any powered air-purifying respirator with a high-efficiency particulate filter.

Up to 250 mg/m³:
 (APF = 50) Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter. [Click here](#) for information on selection of N, R, or P filters.

(APF = 50) Any supplied-air respirator that has a tight-fitting facepiece and is operated in a continuous-flow mode

(APF = 50) Any powered, air-purifying respirator with a tight-fitting facepiece and a high-efficiency particulate filter

(APF = 50) Any self-contained breathing apparatus with a full facepiece

(APF = 50) Any supplied-air respirator with a full facepiece

Up to 500 mg/m³:

(APF = 1000) Any supplied-air respirator operated in a pressure-demand or other positive-pressure mode

Emergency or planned entry into unknown concentrations or IDLH conditions:

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:

(APF = 50) Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter. [Click here](#) for information on selection of N, R, or P filters./Any appropriate escape-type, self-contained breathing apparatus

Important additional information about respirator selection

Exposure Routes inhalation

Symptoms Metal fume fever: chills, muscle ache, nausea, fever, dry throat, cough; lassitude (weakness, exhaustion); metallic taste; headache; blurred vision; low back pain; vomiting; malaise (vague feeling of discomfort); chest tightness; dyspnea (breathing difficulty), rales, decreased pulmonary function

Target Organs respiratory system

See also: [INTRODUCTION](#) See ICSC CARD: [0208](#) See MEDICAL TESTS: [0246](#)

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Coal tar pitch volatiles

CAS 65996-93-2

RTECS GF8655000

DOT ID & Guide
2713 153 (acridine)

Synonyms & Trade Names

Synonyms vary depending upon the specific compound (e.g., pyrene, phenanthrene, acridine, chrysene, anthracene & benzo(a)pyrene). [Note: NIOSH considers coal tar, coal tar pitch, and creosote to be coal tar products.]

Exposure Limits

NIOSH REL: Ca TWA 0.1 mg/m³ (cyclohexane-extractable fraction) [See Appendix A](#) [See Appendix C](#)OSHA PEL: TWA 0.2 mg/m³ (benzene-soluble fraction) [1910.1002] [See Appendix C](#)IDLH Ca [80 mg/m³] See: [65996932](#)

Conversion

Physical Description

Black or dark-brown amorphous residue.

Properties vary depending upon
the specific compound.

Combustible Solids

Incompatibilities & Reactivities

Strong oxidizers

Measurement Methods

OSHA 58

See: [NMAM](#) or [OSHA Methods](#)

Personal Protection & Sanitation (See [protection](#))

Skin: Prevent skin contact

Eyes: Prevent eye contact

Wash skin: Daily

Remove: No recommendation

Change: Daily

First Aid (See [procedures](#))

Eye: Irrigate immediately

Skin: Soap wash immediately

Breathing: Respiratory support

Swallow: Medical attention immediately

Respirator Recommendations NIOSH

At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:

(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter. [Click here](#) for information on selection of N, R, or P filters./Any appropriate escape-type, self-contained breathing apparatus[Important additional information about respirator selection](#)

Exposure Routes inhalation, skin and/or eye contact

Symptoms Dermatitis, bronchitis, [potential occupational carcinogen]

Target Organs respiratory system, skin, bladder, kidneys

Cancer Site [lung, kidney & skin cancer]

See also: [INTRODUCTION](#) [See ICSC CARD: 1415](#) [See MEDICAL TESTS: 0054](#)

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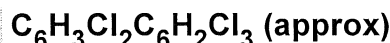
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Chlorodiphenyl (54% chlorine)

CAS 11097-69-1

RTECS [TQ1360000](#)

Synonyms & Trade Names

Aroclor® 1254, PCB, Polychlorinated biphenyl

DOT ID & Guide

2315 [171](#)

Exposure Limits

NIOSH REL*: Ca TWA 0.001 mg/m³ See [Appendix A](#) [*Note: The REL also applies to other PCBs.]OSHA PEL: TWA 0.5 mg/m³ [skin]IDLH Ca [5 mg/m³] See: [IDLH INDEX](#)

Conversion

Physical Description

Colorless to pale-yellow, viscous liquid or solid (below 50°F) with a mild, hydrocarbon odor.

MW: 326 (approx)

BP: 689-734°F

FRZ: 50°F

Sol: Insoluble

VP: 0.00006 mmHg

IP: ?

Sp.Gr(77°F): 1.38

F.I.P: NA

UEL: NA

LEL: NA

Nonflammable Liquid, but exposure in a fire results in the formation of a black soot containing PCBs, polychlorinated dibenzofurans, and chlorinated dibenzo-p-dioxins.

Incompatibilities & Reactivities

Strong oxidizers

Measurement Methods

NIOSH 5503; OSHA [PV2088](#)See: [NMAM](#) or [OSHA Methods](#)

Personal Protection & Sanitation (See [protection](#))

Skin: Prevent skin contact

Eyes: Prevent eye contact

Wash skin: When contaminated

Remove: When wet or contaminated

Change: Daily

Provide: Eyewash, Quick drench

First Aid (See [procedures](#))

Eye: Irrigate immediately

Skin: Soap wash immediately

Breathing: Respiratory support

Swallow: Medical attention immediately

Respirator Recommendations NIOSH

At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:

(APF = 50) Any air-purifying, full-facepiece respirator (gas mask) with a chin-style, front- or back-mounted organic vapor canister having an N100, R100, or P100 filter. [Click here](#) for information on selection of N, R, or P filters./Any appropriate escape-type, self-contained breathing apparatus[Important additional information about respirator selection](#)**Exposure Routes** inhalation, skin absorption, ingestion, skin and/or eye contact**Symptoms** Irritation eyes, chloracne; liver damage; reproductive effects; [potential occupational carcinogen]

Target Organs Skin, eyes, liver, reproductive system

Cancer Site [in animals: tumors of the pituitary gland & liver, leukemia]

See also: [INTRODUCTION](#) See ICSC CARD: [0939](#) See MEDICAL TESTS: [0176](#)

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Asbestos

CAS 1332-21-4

Hydrated mineral silicates

RTECS [CI6475000](#)

Synonyms & Trade Names

Actinolite, Actinolite asbestos, Amosite (cummingtonite-grunerite), Anthophyllite, Anthophyllite asbestos, Chrysotile, Crocidolite (Riebeckite), Tremolite, Tremolite asbestos

DOT ID & Guide

 2212 [171](#) (blue, brown)
2590 [171](#) (white)

Exposure Limits

NIOSH REL: Ca [See Appendix A](#) [See Appendix C](#)OSHA PEL: [1910.1001] [1926.1101] [See Appendix C](#)IDLH Ca [N.D.] See: [IDLH INDEX](#)

Conversion

Physical Description

White or greenish (chrysotile), blue (crocidolite), or gray-green (amosite) fibrous, odorless solids.

MW: Varies

BP: Decomposes

MLT: 1112°F (Decomposes)

Sol: Insoluble

VP: 0 mmHg (approx)

IP: NA

Sp.Gr: ?

F.I.P: NA

UEL: NA

LEL: NA

Noncombustible Solids

Incompatibilities & Reactivities

None reported

Measurement Methods

NIOSH 7400, 7402; OSHA ID160, ID191

See: [NMAM](#) or [OSHA Methods](#)

Personal Protection & Sanitation (See [protection](#))

Skin: Prevent skin contact

Eyes: Prevent eye contact

Wash skin: Daily

Remove: No recommendation

Change: Daily

First Aid (See [procedures](#))

Eye: Irrigate immediately

Breathing: Fresh air

Respirator Recommendations (See [Appendix E](#)) NIOSH

At concentrations above the NIOSH REL, or where there is no REL, at any detectable concentration:

(APF = 10,000) Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode

(APF = 10,000) Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus

Escape:

(APF = 50) Any air-purifying, full-facepiece respirator with an N100, R100, or P100 filter. [Click here](#) for information on selection of N, R, or P filters./Any appropriate escape-type, self-contained breathing apparatus[Important additional information about respirator selection](#)

Exposure Routes inhalation, ingestion, skin and/or eye contact

Symptoms Asbestosis (chronic exposure): dyspnea (breathing difficulty), interstitial fibrosis, restricted pulmonary function, finger clubbing; irritation eyes; [potential occupational carcinogen]

Target Organs respiratory system, eyes

Cancer Site [lung cancer]

See also: [INTRODUCTION](#) See [MEDICAL TESTS: 0019](#)

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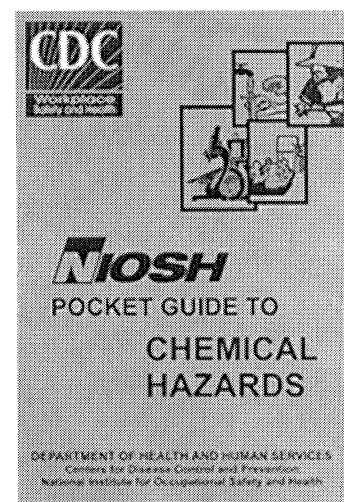
APPENDIX A - NIOSH Potential Occupational Carcinogens

New Policy

For the past 20 plus years, NIOSH has subscribed to a carcinogen policy that was published in 1976 by Edward J. Fairchild, II, Associate Director for Cincinnati Operations, which called for "no detectable exposure levels for proven carcinogenic substances" (Annals of the New York Academy of Sciences, 271:200-207, 1976). This was in response to a generic OSHA rulemaking on carcinogens. Because of advances in science and in approaches to risk assessment and risk management, NIOSH has adopted a more inclusive policy. NIOSH recommended exposure limits (RELs) will be based on risk evaluations using human or animal health effects data, and on an assessment of what levels can be feasibly achieved by engineering controls and measured by analytical techniques. To the extent feasible, NIOSH will project not only a no-effect exposure, but also exposure levels at which there may be residual risks. This policy applies to all workplace hazards, including carcinogens, and is responsive to Section 20(a)(3) of the Occupational Safety and Health Act of 1970, which charges NIOSH to "...describe exposure levels that are safe for various periods of employment, including but not limited to the exposure levels at which no employee will suffer impaired health or functional capacities or diminished life expectancy as a result of his work experience."

The effect of this new policy will be the development, whenever possible, of quantitative RELs that are based on human and/or animal data, as well as on the consideration of technological feasibility for controlling workplace exposures to the REL. Under the old policy, RELs for most carcinogens were non-quantitative values labeled "lowest feasible concentration (LFC)." [Note: There are a few exceptions to LFC RELs for carcinogens (e.g., RELs for asbestos, formaldehyde, benzene, and ethylene oxide are quantitative values based primarily on analytical limits of detection or technological feasibility). Also, in 1989, NIOSH adopted several quantitative RELs for carcinogens from OSHA's permissible exposure limit (PEL) update.]

Under the new policy, NIOSH will also recommend the complete range of respirators (as determined by the NIOSH Respirator Decision Logic) for carcinogens with quantitative RELs. In this way, respirators will be consistently recommended regardless of whether a substance is a carcinogen or a non-carcinogen.

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Old Policy

In the past, NIOSH identified numerous substances that should be treated as potential occupational carcinogens even though OSHA might not have identified them as such. In determining their carcinogenicity, NIOSH used the OSHA classification outlined in 29 CFR 1990.103, which states in part:

Potential occupational carcinogen means any substance, or combination or mixture of substances, which causes an increased incidence of benign and/or malignant neoplasms, or a substantial decrease in the latency period between exposure and onset of neoplasms in humans or in one or more experimental mammalian species as the result of any oral, respiratory or dermal exposure, or any other exposure which results in the induction of tumors at a site other than the site of administration. This definition also includes any substance which is metabolized into one or more potential occupational carcinogens by mammals.

When thresholds for carcinogens that would protect 100% of the population had not been identified, NIOSH usually recommended that occupational exposures to carcinogens be limited to the lowest feasible concentration. To ensure maximum protection from carcinogens through the use of respiratory protection, NIOSH also recommended that only the most reliable and protective respirators be used. These respirators include (1) a self-contained breathing apparatus (SCBA) that has a full facepiece and is operated in a positive-pressure mode, or (2) a supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary SCBA operated in a pressure-demand or other positive-pressure mode.

Recommendations to be Revised

The RELs and respirator recommendations for carcinogens listed in this edition of the *Pocket Guide* still reflect the old policy. Changes in the RELs and respirator recommendations that reflect the new policy will be included in future editions.

APPENDIX B - Thirteen OSHA-Regulated Carcinogens

Without establishing PELs, OSHA promulgated standards in 1974 to regulate the industrial use of 13 chemicals identified as potential occupational carcinogens.

- 2-Acetylaminofluorene
- 4-Aminodiphenyl
- Benzidine
- bis-Chloromethyl ether
- 3,3'-Dichlorobenzidine
- 4-Dimethylaminoazobenzene
- Ethyleneimine
- Methyl chloromethyl ether
- alpha-Naphthylamine
- beta-Naphthylamine
- 4-Nitrobiphenyl
- N-Nitrosodimethylamine
- beta-Propiolactone

Exposures of workers to these 13 chemicals are to be controlled through the required use of engineering controls, work practices, and personal protective equipment, including respirators. See 29 CFR 1910.1003-1910.1016 for specific details of these requirements.

Respirator selections in the Pocket Guide are based on NIOSH policy, which considers the 13 chemicals to be potential occupational carcinogens.

APPENDIX C

Supplementary Exposure Limits

Aldehydes (Low-Molecular-Weight)

Exposure to acetaldehyde has produced nasal tumors in rats and laryngeal tumors in hamsters, and exposure to malonaldehyde has produced thyroid gland and pancreatic islet cell tumors in rats. NIOSH therefore recommends that acetaldehyde and malonaldehyde be considered potential occupational carcinogens in conformance with the OSHA carcinogen policy.

Testing has not been completed to determine the carcinogenicity of acrolein, butyraldehyde (CAS#: 123-72-8), crotonaldehyde, glutaraldehyde, glyoxal (CAS#: 107-22-2), paraformaldehyde (CAS#: 30525-89-4), propionaldehyde (CAS#: 624-67-9), propionaldehyde (CAS#: 123-38-6), and n-valeraldehyde, nine related low-molecular-weight-aldehydes.

However, the limited studies to date indicate that these substances have chemical reactivity and mutagenicity similar to acetaldehyde and malonaldehyde. Therefore, NIOSH recommends that careful consideration should be given to reducing exposures to these nine related aldehydes.

Further information can be found in the "NIOSH Current Intelligence Bulletin 55: Carcinogenicity of Acetaldehyde and Malonaldehyde, and Mutagenicity of Related Low-Molecular-Weight Aldehydes" [DHHS (NIOSH) Publication No. 91-112.]

Asbestos

NIOSH considers asbestos to be a potential occupational carcinogen and recommends that exposures be reduced to the lowest feasible concentration. For asbestos fibers >5 micrometers in length, NIOSH recommends a REL of 100,000 fibers per cubic meter of air (100,000 fibers/m³), which is equal to 0.1 fiber per cubic centimeter of air (0.1 fiber/cm³), as determined by a 400-liter air sample collected over 100 minutes in accordance with NIOSH Analytical Method #7400. Airborne asbestos fibers are defined as those particles having (1) an aspect ratio of 3 to 1 or greater and (2) the mineralogic characteristics (that is, the crystal structure and elemental composition) of the asbestos minerals and their nonasbestiform analogs. The asbestos minerals are defined as chrysotile, crocidolite, amosite (cummingtonite-grunerite), anthophyllite, tremolite, and actinolite. In addition, airborne cleavage fragments from the nonasbestiform habits of the serpentine minerals antigorite and lizardite, and the amphibole minerals contained in the series cummingtonite-grunerite, tremolite-ferroactinolite, and glaucophane-riebeckite should also be counted as fibers provided they meet the criteria for a fiber when viewed microscopically.

As found in 29 CFR 1910.1001, the OSHA PEL for asbestos fibers (i.e., actinolite asbestos, amosite, anthophyllite asbestos, chrysotile, crocidolite, and tremolite asbestos) is an 8-hour TWA airborne concentration of 0.1 fiber (longer than 5 micrometers and having a length-to-diameter ratio of at least 3 to 1) per cubic centimeter of air (0.1 fiber/cm³), as determined by the membrane filter method at approximately 400X magnification with phase contrast illumination. No worker should be exposed in excess of 1 fiber/cm³ (excursion limit) as averaged over a sampling period of 30 minutes.

Benzidine-, o-Tolidine, and o-Dianisidine-based Dyes

In December 1980, OSHA and NIOSH jointly published the Health Hazard Alert: Benzidine-, o-Tolidine-, and o-Dianisidine-based Dyes.

In this Alert, OSHA and NIOSH concluded that benzidine and benzidine-based dyes were potential occupational carcinogens and recommended that worker exposure be reduced to the lowest feasible level.

OSHA and NIOSH further concluded that o-tolidine and o-dianisidine (and dyes based on them) may present a cancer risk to workers and should be handled with caution and exposure minimized.

Carbon Black

NIOSH considers "Carbon Black" to be the material consisting of more than 80% elemental carbon, in the form of near-spherical colloidal particles and coalesced particle aggregates of colloidal size, that is obtained by the partial combustion or thermal decomposition of hydrocarbons. The NIOSH REL (10-hour TWA) for carbon black is 3.5 mg/m³. Polycyclic aromatic hydrocarbons (PAHs), particulate polycyclic organic material (PPOM), and polynuclear aromatic hydrocarbons (PNAs) are terms frequently used to describe various petroleum-based substances that NIOSH considers to be potential occupational carcinogens. Since some of these aromatic hydrocarbons may be formed during the manufacture of carbon black (and become adsorbed on the carbon black), the NIOSH REL (10-hour TWA) for carbon black in the presence of PAHs is 0.1 mg PAHs/m³ (measured as the cyclohexane-extractable fraction). The OSHA PEL (8-hour TWA) for carbon black is 3.5 mg/m³.

Chloroethanes

NIOSH considers ethylene dichloride; hexachloroethane; 1,1,2,2-tetrachloroethane; and 1,1,2-trichloroethane; to be potential occupational carcinogens.

Additionally, NIOSH recommends that the other five chloroethane compounds:

- 1,1-Dichloroethane
- Ethyl chloride
- Methyl chloroform
- Pentachloroethane
- 1,1,1,2-Tetrachloroethane

be treated in the workplace with caution because of their structural similarity to the four chloroethanes shown to be carcinogenic in animals.

Chromic Acid and Chromates (as CrO₃), Chromium(II) and Chromium(III) Compounds (as Cr), and Chromium Metal (as Cr)

The NIOSH REL (10-hour TWA) is 0.001 mg Cr(VI)/m³ for all hexavalent chromium [Cr(VI)] compounds. NIOSH considers all Cr(VI) compounds (including chromic acid, tert-butyl chromate, zinc chromate, and chromyl chloride) to be potential occupational carcinogens.

The NIOSH REL (8-hour TWA) is 0.5 mg Cr/m³ for chromium metal and chromium(II) and chromium(III) compounds.

The OSHA PEL is 0.1 mg CrO₃/m³ (ceiling) for chromic acid and chromates (including tert-butyl chromate with a "skin" designation and zinc chromate); 0.5 mg Cr/m³ (8-hour TWA) for chromium(II) and chromium(III) compounds; and 1 mg Cr/m³ (8-hour TWA) for chromium metal and insoluble salts.

Coal Tar Pitch Volatiles

NIOSH considers coal tar products (i.e., coal tar, coal tar pitch, or creosote) to be potential occupational carcinogens; the NIOSH REL (10-hour TWA) for coal tar products is 0.1 mg/m³ (cyclohexane-extractable fraction).

The OSHA PEL (8-hour TWA) for coal tar pitch volatiles is 0.2 mg/m³ (benzene-soluble fraction). OSHA defines "coal tar pitch volatiles" in 29 CFR 1910.1002 as the fused polycyclic hydrocarbons that volatilize from the distillation residues of coal, petroleum (excluding asphalt), wood, and other organic matter and includes substances such as anthracene, benzo(a)pyrene (BaP), phenanthrene, acridine, chrysene, pyrene, etc.

Coke Oven Emissions

The production of coke by the carbonization of bituminous coal leads to the release of chemically-complex emissions from coke ovens that include both gases and particulate matter of varying chemical composition.

The emissions include coal tar pitch volatiles (e.g., particulate polycyclic organic matter [PPOM], polycyclic aromatic hydrocarbons [PAHs], and polynuclear aromatic hydrocarbons [PNAs]), aromatic compounds (e.g., benzene and beta-naphthylamine), trace metals (e.g., arsenic, beryllium, cadmium, chromium, lead, and nickel), and gases (e.g., nitric oxides and sulfur dioxide).

Cotton Dust (raw)

NIOSH recommends reducing exposures to cotton dust to the lowest feasible concentration to reduce the prevalence and severity of byssinosis; the REL is <0.200 mg/m³ (as lint-free cotton dust).

As found in OSHA Table Z-1 (29 CFR 1910.1000), the PEL for cotton dust (raw) is 1 mg/m³ for the cotton waste processing operations of waste recycling (sorting, blending, cleaning, and willowing) and garnetting.

PELs for other sectors (as found in 29 CFR 1910.1043) are 0.200 mg/m³ for yarn manufacturing and cotton washing operations, 0.500 mg/m³ for textile mill waste house operations or for dust from "lower grade washed cotton" used during yarn manufacturing, and 0.750 mg/m³ for textile slashing and weaving operations.

The OSHA standard in 29 CFR 1910.1043 does not apply to cotton harvesting, ginning, or the handling and processing of woven or knitted materials and washed cotton.

All PELs for cotton dust are mean concentrations of lint-free, respirable cotton dust collected by the vertical elutriator or an equivalent method and averaged over an 8-hour period.

Lead

NIOSH considers "Lead" to mean metallic lead, lead oxides, and lead salts (including organic salts such as lead soaps but excluding lead arsenate).

The NIOSH REL for lead (8-hour TWA) is 0.050 mg/m³; air concentrations should be maintained so that worker blood lead remains less than 0.060 mg Pb/100 g of whole blood.

OSHA considers "Lead" to mean metallic lead, all inorganic lead compounds (lead oxides and lead salts), and a class of organic compounds called soaps; all other lead compounds are excluded from this definition.

The OSHA PEL (8-hour TWA) is 0.050 mg/m³; other OSHA requirements can be found in 29 CFR 1910.1025. The OSHA PEL (8-hour TWA) for lead in "non-ferrous foundries with less than 20 employees" is 0.075 mg/m³.

Mineral Dusts

The OSHA PELs for "mineral dusts" listed below are from Table Z-3 of 29 CFR 1910.1000. The OSHA PEL (8-hour TWA) for crystalline silica (as respirable quartz) is either 250 mppcf divided by the value "%SiO₂ + 5" or 10 mg/m³ divided by the value "%SiO₂ + 2." The OSHA PEL (8-hour TWA) for crystalline silica (as total quartz) is 30 mg/m³ divided by the value "%SiO₂ + 2." The OSHA PELs (8-hour TWAs) for cristobalite and tridymite are ½ the values calculated above using the count or mass formulae for quartz.

The OSHA PEL (8-hour TWA) for amorphous silica (including diatomaceous earth) is either 80 mg/m³ divided by the value "%SiO₂," or 20 mppcf.

The OSHA PELs (8-hour TWAs) for talc (not containing asbestos), mica, and soapstone are 20 mppcf. The OSHA PEL (8-hour TWA) for portland cement is 50 mppcf. The OSHA PEL (8-hour TWA) for graphite (natural) is 15 mppcf. The PELs for talc (not containing asbestos), mica, soapstone, and portland cement are applicable if the material contains less than 1% crystalline silica.

The OSHA PEL (8-hour TWA) for coal dust (as the respirable fraction) containing less than 5% SiO₂ is 2.4 mg/m³ divided by the value "%SiO₂ + 2." The OSHA PEL (8-hour TWA) for coal dust (as the respirable fraction) containing greater than or equal to 5% SiO₂ is 10 mg/m³ divided by the value "%SiO₂ + 2."

NIAX® Catalyst ESN

In May 1978, OSHA and NIOSH jointly published the Current Intelligence Bulletin (CIB) 26: NIAX® Catalyst ESN.

In this CIB, OSHA and NIOSH recommended that occupational exposure to NIAX® Catalyst ESN, its components, dimethylaminopropionitrile and bis(2-(dimethylamino)ethyl)ether, as well as formulations containing either component, be minimized.

Exposures should be limited to as few workers as possible, while minimizing workplace exposure concentrations with effective work practices and engineering controls.

Exposed workers should be carefully monitored for potential disorders of the nervous and genitourinary system. Although substitution is a possible control measure, alternatives to NIAX® Catalyst ESN or its components should be carefully evaluated with regard to possible adverse health effects.

Trichloroethylene

NIOSH considers trichloroethylene (TCE) to be a potential occupational carcinogen and recommends a REL of 2 ppm (as a 60-minute ceiling) during the usage of TCE as an anesthetic agent and 25 ppm (as a 10-hour TWA) during all other exposures.

Tungsten Carbide (Cemented)

"Cemented tungsten carbide" or "hard metal" refers to a mixture of tungsten carbide, cobalt, and sometimes metal oxides or carbides and other metals (including nickel).

When the cobalt (Co) content exceeds 2%, its contribution to the potential hazard is judged to exceed that of tungsten carbide.

Therefore, the NIOSH REL (10-hour TWA) for cemented tungsten carbide containing >2% Co is 0.05 mg Co/m³; the applicable OSHA PEL is 0.1 mg Co/m³ (8-hour TWA). Nickel (Ni) may sometimes be used as a binder rather than cobalt.

NIOSH considers cemented tungsten carbide containing nickel to be a potential occupational carcinogen and recommends a REL of 0.015 mg Ni/m³ (10-hour TWA).

The OSHA PEL for Insoluble Nickel (i.e., a 1 mg Ni/m³ 8-hour TWA) applies to mixtures of tungsten carbide and nickel.

APPENDIX D - Substances with No Established RELs

After reviewing available published literature, NIOSH provided comments to OSHA on August 1, 1988, regarding the "Proposed Rule on Air Contaminants" (29 CFR 1910, Docket No. H-020).

In these comments, NIOSH questioned whether the PELs proposed (and listed below) for the following substances included in the Pocket Guide were adequate to protect workers from recognized health hazards:

- Acetylene tetrabromide [TWA 1 ppm]
- Chlorobenzene [TWA 75 ppm]
- Coal dust (<5%SiO₂) [TWA 2 mg/m³ (as the respirable dust fraction)]
- Coal dust (> or = 5% SiO₂) [TWA 0.1 mg/m³ (as the respirable quartz fraction)]
- Ethyl bromide [TWA 200 ppm; STEL 250 ppm]
- Ethylene glycol [Ceiling 50 ppm]
- Ethyl ether [TWA 400 ppm; STEL 500 ppm]
- Fenthion [TWA 0.2 mg/m³ (skin)]
- Furfural [TWA 2 ppm (skin)]
- 2-Isopropoxyethanol [TWA 25 ppm]
- Isopropyl acetate [TWA 250 ppm; STEL 310 ppm]
- Isopropylamine [TWA 5 ppm; STEL 10 ppm]
- Manganese tetroxide (as Mn) [TWA 1 mg/m³]
- Molybdenum (soluble compounds as Mo) [TWA 5 mg/m³]
- Nitromethane [TWA 100 ppm]
- m-Toluidine [TWA 2 ppm (skin)]
- Triethylamine [TWA 10 ppm; STEL 15 ppm]

At that time, NIOSH also conducted a limited evaluation of the literature and concluded that the documentation cited by OSHA was inadequate to support the proposed PEL (as an 8-hour TWA) of 10 mg/m³ for alpha-alumina, benomyl, emery, glycerine (mist), graphite (synthetic), magnesium oxide fume, molybdenum (insoluble compounds as Mo), particulates not otherwise regulated, picloram, and rouge.

APPENDIX E - OSHA Respirator Requirements for Selected Chemicals

Revisions to the OSHA Respiratory Protection Standard (29 CFR 1910.134) became effective on April 8, 1998. Incorporated within the preamble of this ruling were changes to OSHA regulations for several chemicals or substances, which are listed as subheadings in blue text throughout this appendix. These subheadings, which are also the titles of the affected standards within 29 CFR 1910 and 29 CFR 1926, are followed by the standard number(s) in parentheses and the OSHA respirator requirements. Fit testing is required by OSHA for all tight-fitting air-purifying respirators. *Please consult 29 CFR 1910.134 for the full content of the changes that apply.* For all of the chemicals listed in this appendix, any respirators that are permitted at higher environmental concentrations can be used at lower concentrations.

13 Carcinogens (4-Nitrobiphenyl, etc.) (1910.1003)

Employees engaged in handling operations involving the carcinogens listed below must be provided with, and required to wear and use, a *half-mask* filter-type respirator for dusts, mists, and fumes. A respirator affording higher levels of protection than this respirator may be substituted.

2-Acetylaminofluorene	4-Dimethylaminoazobenzene	beta-Naphthylamine
4-Aminodiphenyl	Ethyleneimine	4-Nitrobiphenyl
Benzidine	Methyl chloromethyl ether	N-Nitrosodimethylamine
bis-Chloromethyl ether	alpha-Naphthylamine	beta-Propiolactone
3,3'-Dichlorobenzidine (and its salts)		

Acrylonitrile (1910.1045)

Airborne Concentration or Condition of Use	Respirator Type
< or = 20 ppm (parts per million)	(1) Chemical cartridge respirator with organic vapor cartridge(s) and half-mask facepiece; or (2) Supplied-air respirator with half-mask facepiece.
< or = 100 ppm or maximum use concentration of	(1) Full-facepiece respirator with (A) organic vapor cartridges,
cartridges or canisters, whichever is lower	(B) organic vapor gas mask, chin-style, or (C) organic vapor gas mask canister, front- or back-mounted; (2) Supplied-air respirator with full facepiece; or (3) Self-contained breathing apparatus with full facepiece.
< or = 4,000 ppm	Supplied-air respirator operated in positive-pressure mode with full facepiece, helmet, suit, or hood.
> 4,000 ppm or unknown concentration	(1) Supplied-air and auxiliary self-contained breathing apparatus with full facepiece in positive-pressure mode; or (2) Self-contained breathing apparatus with full facepiece in positive-pressure mode.
Firefighting	Self-contained breathing apparatus with full facepiece in positive-pressure mode.
Escape	(1) Any organic vapor respirator; or
	(2) Any self-contained breathing apparatus.

Arsenic, inorganic (1910.1018)**Requirements for Respiratory Protection for Inorganic Arsenic Particulate*****Except for Those With Significant Vapor Pressure***

Airborne Concentration (as As) or Condition of Use	Required Respirator
< or = 100 µg/m ³ (micrograms per cubic meter)	(1) Half-mask air-purifying respirator equipped with high-efficiency filter*; or (2) Any half-mask supplied air respirator.
< or = 500 µg/m ³	(1) Full facepiece air-purifying respirator equipped with high-efficiency filter*; (2) Any full-facepiece supplied-air respirator; or

(3) Any full-facepiece self-contained breathing apparatus.**< or = 10,000 µg/m³****(1) Powered air-purifying respirators in all inlet face coverings with high-efficiency filters*; or (2) Half-mask supplied-air respirators operated in positive-pressure mode.****< or = 20,000 µg/m³****Supplied-air respirator with full facepiece, hood, or helmet or suit, operated in positive-pressure mode.****> 20,000 µg/m³, unknown concentrations, or firefighting****Any full-facepiece self-contained breathing apparatus operated in positive-pressure mode.***** A high-efficiency filter means a filter that is at least 99.97% efficient against mono-dispersed particles of 0.3 µm (micrometers) in diameter or higher.****Requirements for Respiratory Protection for Inorganic Arsenicals With Significant Vapor Pressure****Airborne Concentration (as As) or Condition of Use****Required Respirator****< or = 100 µg/m³ (micrograms****(1) Half-mask* air-purifying respirator equipped with high-efficiency filter** and acid gas cartridge; or (2) Any half-mask* supplied-air respirator.****per cubic meter)****< or = 500 µg/m³****(1) Front- or back-mounted gas mask equipped with high-efficiency filter** and acid gas canister; (2) Any full-facepiece supplied-air respirator; or (3) Any full-facepiece self-contained breathing apparatus.****< or = 10,000 µg/m³****Half-mask* supplied-air respirator operated in positive-pressure mode.****< or = 20,000 µg/m³****Supplied-air respirator with full facepiece, hood, or helmet or suit, operated in positive-pressure mode.****> 20,000 µg/m³, unknown concentrations, or firefighting****Any full-facepiece self-contained breathing apparatus operated in positive-pressure mode.***** Half-mask respirators shall not be used for protection against arsenic trichloride, as it is rapidly absorbed through the skin.****** A high-efficiency filter means a filter that is at least 99.97% efficient against mono-dispersed particles of 0.3 µm (micrometers) in diameter or higher.****Asbestos (1910.1001 & 1926.1101)****Airborne Concentration or Condition of Use****Required Respirator****< or = 1 f/cm³ (fibers per cubic centimeter) (10 X PEL)****Half-mask air-purifying respirator other than a disposable respirator, equipped with high-efficiency filters*.****< or = 5 f/cm³ (50 X PEL)****Full-facepiece air-purifying respirator equipped with high-efficiency filters*.****< or = 10 f/cm³ (100 X PEL)****Any powered air-purifying respirator equipped with high-efficiency filters* or any supplied-air respirator operated in continuous-flow mode.****< or = 100 f/cm³ (1,000 X PEL)****Full-facepiece supplied air respirator operated in pressure-demand mode.****> 100 f/cm³ (1,000 X PEL),****Full-facepiece supplied-air respirator operated in pressure-demand mode, equipped with an auxiliary positive-pressure self-contained breathing apparatus.**

or unknown concentrations

* A high-efficiency filter means a filter that is at least 99.97% efficient against mono-dispersed particles of 0.3 μm (micrometers) in diameter or higher.

Benzene (1910.1028)

Airborne Concentration or Condition of Use	Required Respirator
< or = 10 ppm (parts per million)	Half-mask air-purifying respirator with organic vapor cartridge.
< or = 50 ppm	(1) Full-facepiece respirator with organic vapor cartridges; or (2) Full-facepiece gas mask with chin-style canisters*.
< or = 100 ppm	Full-facepiece powered air-purifying respirator with organic vapor canister*.
< or = 1,000 ppm	Supplied-air respirator with full facepiece in positive-pressure mode.
> 1,000 ppm or unknown concentration	(1) Self-contained breathing apparatus with full facepiece in positive-pressure mode; or (2) Full-facepiece positive-pressure supplied-air respirator with auxiliary self-contained air supply.
Escape	(1) Any organic vapor gas mask; or (2) Any self-contained breathing apparatus with full facepiece.
Firefighting	Full-facepiece self-contained breathing apparatus in positive-pressure mode.

* Canisters must have a minimum service life of four (4) hours when tested at 150 ppm benzene, at a flow rate of 64 liters per minute (LPM), 25°C, and 85% relative humidity for non-powered air-purifying respirators. The flow rate shall be 115 LPM and 170 LPM, respectively, for tight-fitting and loose-fitting powered air-purifying respirators.

1,3-Butadiene (1910.1051)

Airborne Concentration or Condition of Use	Required Respirator
< or = 5 ppm (parts per million)	Air-purifying half-mask or full-facepiece respirator equipped with approved butadiene or organic vapor cartridges or canisters. Cartridges or canisters shall be replaced every 4 hours.
< or = 10 ppm	Air-purifying half-mask or full-facepiece respirator equipped with approved butadiene or organic vapor cartridges or canisters. Cartridges or canisters shall be replaced every 3 hours.
< or = 25 ppm	(1) Air-purifying half-mask or full-facepiece respirator equipped with approved butadiene or organic vapor cartridges or canisters. Cartridges or canisters shall be replaced every 2 hours; (2) Any powered air-purifying respirator equipped with approved butadiene or organic vapor cartridges or canisters. Cartridges or canisters shall be replaced every [1] hour; or (3) Continuous-flow supplied-air respirator equipped with a hood or helmet.
< or = 50 ppm	(1) Air-purifying full-facepiece respirator equipped with approved butadiene or organic vapor cartridges or canisters. Cartridges or canisters shall be replaced every [1] hour; or (2) Powered air-purifying respirator (PAPR) equipped with a tight-fitting facepiece and approved butadiene or organic vapor cartridges. PAPR cartridges shall be replaced every [1] hour.

< or = 1,000 ppm	Supplied-air respirator equipped with a half-mask or full facepiece and operated in a pressure-demand or other positive-pressure mode.
> 1,000 ppm, unknown concentration, or firefighting	(1) Self-contained breathing apparatus equipped with a full facepiece and operated in a pressure-demand or other positive-pressure mode; or (2) Any supplied-air respirator equipped 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.
Escape from IDLH conditions (IDLH is 2,000 ppm)	(1) Any positive-pressure self-contained breathing apparatus with an appropriate service life; or (2) Any air-purifying full-facepiece respirator equipped with a front- or back-mounted butadiene or organic vapor canister.

Cadmium (1910.1027 & 1926.1127)

Airborne Concentration or Condition of Use	Required Respirator
< or = 50 µg/m ³ (micrograms per cubic meter)	Half-mask, air-purifying respirator equipped with a high-efficiency filter*.
< or = 125 µg/m ³	(1) Powered air-purifying respirator with a loose-fitting hood or helmet equipped with a high-efficiency filter*; or (2) Supplied-air respirator with a loose-fitting hood or helmet facepiece operated in continuous-flow mode.
< or = 250 µg/m ³	(1) Full-facepiece air-purifying respirator equipped with a high-efficiency filter*; (2) Powered air-purifying respirator with a tight-fitting half-mask equipped with a high-efficiency filter*; or (3) Supplied-air respirator with a tight-fitting half-mask operated in continuous-flow mode.
< or = 1,250 µg/m ³	(1) Powered air-purifying respirator with a tight-fitting full facepiece equipped with a high-efficiency filter*; or (2) Supplied-air respirator with a tight-fitting full facepiece operated in continuous-flow mode.
< or = 5,000 µg/m ³	Supplied-air respirator with half-mask or full facepiece operated in pressure-demand or other positive-pressure mode.
> 5,000 µg/m ³ or unknown concentration	(1) Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode; or (2) Supplied-air respirator with a full facepiece operated in pressure-demand or other positive-pressure mode and equipped with an auxiliary escape-type self-contained breathing apparatus operated in pressure-demand mode.
Firefighting	Self-contained breathing apparatus with full facepiece operated in pressure-demand or other positive-pressure mode.

Note: Quantitative fit testing is required for all tight-fitting air-purifying respirators where airborne concentration of cadmium exceeds 10 times the TWA PEL (10 X 5 µg/m³ = 50 µg/m³). A full-facepiece respirator is required when eye irritation is expected.

* A high-efficiency filter means a filter that is at least 99.97% efficient against mono-dispersed particles of 0.3 µm (micrometers) in diameter or higher.

Coke oven emissions (1910.1029)

Airborne Concentration	Required Respirator
	(1) Any particulate filter respirator for dust and mist except single-use

< or = 1500 µg/m ³ (micrograms per cubic meter)	respirator; or (2) Any particulate filter respirator or combination chemical cartridge and particulate filter respirator for coke oven emissions.
Any concentrations	(1) Type C supplied-air <u>respirator</u> operated in pressure-demand or continuous-flow mode; (2) Powered air-purifying particulate filter respirator for dust and mist; or (3) Powered air-purifying particulate filter respirator or combination chemical cartridge and particulate filter respirator for coke oven emissions.

Cotton dust (1910.1043)

Airborne Concentration	Required Respirator
< or = 5 X PEL	Disposable respirator* with a particulate filter.
< or = 10 X PEL	Quarter- or half-mask respirator, other than a disposable respirator, equipped with particulate filters.
< or = 100 X PEL	Full-facepiece respirator equipped with high-efficiency particulate filters**.
> 100 X PEL	Powered air-purifying respirator equipped with high-efficiency particulate filters.

* A disposable respirator means the filter element is an inseparable part of the respirator. ** A high-efficiency filter means a filter that is at least 99.97% efficient against mono-dispersed particles of 0.3 µm (micrometers) in diameter or higher.

Notes: Self-contained breathing apparatus are not required but are permitted respirators.

Supplied-air respirators are not required but are permitted under the following conditions:

Cotton dust concentration not greater than 10X the PEL: Any supplied air respirator; not greater than 100X the PEL: Any supplied-air respirator with full facepiece, helmet, or hood; greater than 100X the PEL: Supplied-air respirator operated in positive-pressure mode.

1,2-Dibromo-3-chloropropane (1910.1044)

Airborne Concentration	Required Respirator
or Condition of Use	
< or = 10 ppb (parts per billion)	(1) Any supplied-air respirator; or (2) any self-contained breathing apparatus.
< or = 50 ppb	(1) Any supplied-air respirator with full facepiece, helmet, or hood; or (2) any self-contained breathing apparatus with full facepiece.
< or = 1,000 ppb	Type C supplied-air <u>respirator</u> operated in pressure-demand or other positive-pressure or continuous-flow mode.
< or = 2,000 ppb	Type C supplied-air <u>respirator</u> with full facepiece operated in pressure-demand or other positive-pressure mode, or with full facepiece, helmet, or hood operated in continuous-flow mode.
> 2,000 ppb or entry and escape from unknown concentrations	(1) A combination respirator which includes a Type C supplied-air <u>respirator</u> with 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 positive-pressure mode; or (2) Self-contained breathing apparatus with full facepiece operated in pressure-demand or other positive-pressure mode.

Firefighting	Self-contained breathing apparatus with full facepiece operated in pressure-demand or other positive-pressure mode.
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Ethylene oxide (1910.1047)

Airborne Concentration or Condition of Use	Required Respirator
< or = 50 ppm (parts per million)	Full-facepiece respirator with ethylene oxide approved canister, front- or back-mounted.
< or = 2,000 ppm	(1) Positive-pressure supplied-air respirator equipped with full facepiece, hood, or helmet; or (2) Continuous-flow supplied-air respirator (positive-pressure) equipped with hood, helmet, or suit.
> 2,000 ppm or unknown concentrations	(1) Positive-pressure self-contained breathing apparatus equipped with full facepiece; or (2) Positive-pressure full-facepiece supplied-air respirator equipped with an auxiliary positive-pressure self-contained breathing apparatus.
Firefighting	Positive-pressure self-contained breathing apparatus equipped with full facepiece.
Escape	Any respirator described above.

Formaldehyde (1910.1048)

Airborne Concentration or Condition of Use	Required Respirator
< or = 7.5 ppm (parts per million) (10 X PEL)	Full-facepiece respirator with cartridges or canisters specifically approved for protection against formaldehyde*.
< or = 75 ppm (100 X PEL)	(1) Full-face mask respirator with chin style or chest- or back-mounted type with industrial size canister specifically approved for protection against formaldehyde; or (2) Type C supplied-air respirator, demand type or continuous flow type, with full facepiece, hood, or helmet.
> 75 ppm (100 X PEL) or unknown concentrations (emergencies)	(1) Self-contained breathing apparatus with positive-pressure full-facepiece; or (2) Combination supplied-air, full-facepiece positive-pressure respirator with auxiliary self-contained air supply.
Firefighting	Self-contained breathing apparatus with positive-pressure in full facepiece.
Escape	(1) Self-contained breathing apparatus in demand or pressure-demand mode; or (2) Full-face mask respirator with chin-style or front- or back-mounted type industrial size canister specifically approved for protection against formaldehyde.

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

Lead (1910.1025 & 1926.62)**Respirator Requirements of 1910.1025 (General Industry Lead Standard)**

Airborne Concentration or Condition of Use	Required Respirator
< or = 0.5 mg/m ³ (milligrams per cubic meter) (10 X PEL)	Half-mask* air-purifying respirator equipped with high-efficiency filters**.

< or = 2.5 mg/m ³ (50 X PEL)	Full-facepiece air-purifying respirator with high-efficiency filters**.
< or = 50 mg/m ³ (1000 X PEL)	(1) Any powered air-purifying respirator with high-efficiency filters**; or (2) Half-mask* supplied-air respirator operated in positive-pressure mode.
< or = 100 mg/m ³ (2000 X PEL)	Supplied-air respirators with full facepiece, hood, helmet, or suit, operated in positive-pressure mode.
> 100 mg/m ³ , unknown concentration, or firefighting	Full-facepiece, self-contained breathing apparatus operated in positive-pressure mode.

* Full facepiece is required if the lead aerosols cause eye or skin irritation at the use concentrations.

** A high-efficiency filter means a filter that is at least 99.97% efficient against mono-dispersed particles of 0.3 µm (micrometers) in diameter or higher.

Respirator Requirements of 1926.62 (Construction Lead Standard)

Airborne Concentration or Condition of Use	Required Respirator
< or = 0.5 mg/m ³ (milligrams per cubic meter)	(1) Half-mask* air-purifying respirator with high-efficiency filters**; or (2) Half-mask* supplied-air respirator operated in demand (negative pressure) mode.
< or = 1.25 mg/m ³	(1) Loose-fitting hood or helmet powered air-purifying respirator with high-efficiency filters**; or (2) Hood or helmet supplied-air respirator operated in a continuous-flow mode (e.g., Type CE abrasive blasting <u>respirators</u> operated in a continuous-flow mode).
< or = 2.5 mg/m ³	(1) Full-facepiece air-purifying respirator with high-efficiency filters**; (2) Tight-fitting powered air-purifying respirator with high-efficiency filters**; (3) Full-facepiece supplied-air respirator operated in demand mode; (4) Half-mask* or full-facepiece supplied-air respirator operated in a continuous-flow mode; or (5) Full-facepiece self-contained breathing apparatus operated in demand mode.
< or = 50 mg/m ³	Half-mask* supplied-air respirator operated in pressure-demand or other positive-pressure mode.
< or = 100 mg/m ³	Full-facepiece supplied-air respirator operated in pressure-demand or other positive-pressure mode (e.g., Type CE abrasive blasting <u>respirators</u> operated in a continuous-flow mode).
> 100 mg/m ³ , unknown concentration, or firefighting	Full-facepiece self-contained breathing apparatus in pressure-demand or other positive-pressure mode.

* Full facepiece is required if the lead aerosols cause eye or skin irritation at the use concentrations.

** A high-efficiency filter means a filter that is at least 99.97% efficient against mono-dispersed particles of 0.3 µm (micrometers) in diameter or higher.

Methylene chloride (1910.1052)

Airborne Concentration Required Respirator

or Condition of Use	
< or = 625 ppm (parts per million) (25 X PEL)	Continuous-flow supplied-air respirator, hood or helmet.
< or = 1250 ppm (50 X PEL)	(1) Full-facepiece supplied-air respirator operated in negative-pressure (demand) mode; or (2) Full-facepiece self-contained breathing apparatus operated in negative-pressure (demand) mode.
< or = 5,000 ppm (200 X PEL)	(1) Continuous-flow supplied-air respirator, full-facepiece; (2) Pressure-demand supplied-air respirator, full-facepiece; or (3) Positive-pressure full-facepiece self-contained breathing apparatus.
> 5,000 ppm or unknown concentration	(1) Positive-pressure full-facepiece self-contained breathing apparatus; or (2) Full-facepiece pressure-demand supplied-air respirator with an auxiliary self-contained air supply.
Firefighting	Positive-pressure full-facepiece self-contained breathing apparatus.
Emergency escape	(1) Any continuous-flow or pressure-demand self-contained breathing apparatus; or (2) Gas mask with organic vapor canister.

4,4'-Methylenedianiline (1910.1050 & 1926.60)

Airborne Concentration or Condition of Use	Required Respirator
< or = 10 X PEL	Half-mask respirator with high-efficiency* cartridge**.
< or = 50 X PEL	Full-facepiece respirator with high-efficiency* cartridge or canister**.
< or = 1,000 X PEL	Full-facepiece powered air-purifying respirator with high-efficiency* cartridge**.
> 1,000 X PEL or unknown concentration	(1) Self-contained breathing apparatus with full facepiece in positive-pressure mode; or (2) Full-facepiece positive-pressure demand supplied-air respirator with auxiliary self-contained air supply.
Escape	(1) Any full-facepiece air-purifying respirator with high-efficiency* cartridges**; or (2) Any positive-pressure or continuous-flow self-contained breathing apparatus with full facepiece or hood.
Firefighting	Full-facepiece self-contained breathing apparatus in positive-pressure demand mode.

* A high-efficiency filter means a filter that is at least 99.97% efficient against mono-dispersed particles of 0.3 µm (micrometers) in diameter or higher.

** Combination High-Efficiency/Organic Vapor Cartridges shall be used whenever Methylenedianiline is in liquid form or a process requiring heat is used.

Vinyl Chloride (1910.1017)

Airborne Concentration or Condition of Use	Required Respirator
< or = 10 ppm (parts per million)	(1) Combination Type C supplied-air respirator, demand type, with half facepiece, and auxiliary self-contained air supply; (2) Type C supplied-air respirator, demand type, with half facepiece; or (3) Any chemical cartridge respirator with an organic vapor cartridge which provides a service life of at least 1 hour for concentrations of vinyl chloride up to 10 ppm.

< or = 25 ppm	(1) Powered air-purifying respirator with hood, helmet, full or half facepiece, and a canister which provides a service life of at least 4 hours for concentrations of vinyl chloride up to 25 ppm; or (2) Gas mask with front- or back-mounted canister which provides a service life of at least 4 hours for concentrations of vinyl chloride up to 25 ppm.
< or = 100 ppm	(1) Combination Type C supplied-air <u>respirator</u> , demand type, with full facepiece, and auxiliary self-contained air supply; or (2) Open-circuit self-contained breathing apparatus with full facepiece, in demand mode; or (3) Type C supplied-air <u>respirator</u> , demand type, with full facepiece.
< or = 1,000 ppm	Type C supplied-air <u>respirator</u> , continuous-flow type, with full or half facepiece, helmet, or hood.
< or = 3,600 ppm	(1) Combination Type C supplied-air <u>respirator</u> , pressure demand type, with full or half facepiece, and auxiliary self-contained air supply; or (2) Combination type continuous-flow supplied-air respirator with full or half facepiece and auxiliary self-contained air supply.
> 3,600 ppm or unknown concentration	Open-circuit self-contained breathing apparatus, pressure-demand type, with full facepiece.

APPENDIX F: Miscellaneous Notes

Benzene

The final OSHA Benzene standard in 1910.1028 applies to all occupational exposures to benzene except some subsegments of industry where exposures are consistently under the action level (i.e., distribution and sales of fuels, sealed containers and pipelines, coke production, oil and gas drilling and production, natural gas processing, and the percentage exclusion for liquid mixtures); for the excepted subsegments, the benzene limits in Table Z-2 apply (i.e., an 8-hour TWA of 10 ppm, an acceptable ceiling of 25 ppm, and 50 ppm for a maximum duration of 10 minutes as an acceptable maximum peak above the acceptable ceiling).

OctachloronaphthalenePentachloronaphthaleneTetrachloronaphthalene

Trichloronaphthalene

IDLH values for these four chloronaphthalene compounds are unknown. The *Documentation for Immediately Dangerous to Life or Health Concentrations* identified "Effective" IDLH values, based on analogy with other chloronaphthalenes and the then-effective *NIOSH Respirator Decision Logic* (DHHS [NIOSH] Publication No. 87-108; <http://www.cdc.gov/niosh/docs/87-108>). These values for respirator recommendations were determined by multiplying the NIOSH REL or OSHA PEL by an assigned protection factor of 10. This assigned protection factor was used during the Standards Completion Program for deciding when the "most protective" respirators should be used for these four chemicals. Listed below are the "Effective" IDLH values that were determined using 10 times the REL or PEL for each chemical. For more information please consult the *IDLH Documentation*.

Chemical	NIOSH REL/OSHA PEL	"Effective" IDLH (10 X REL/PEL)
Octachloronaphthalene	TWA 0.1 mg/m ³ *	1 mg/m ³
Pentachloronaphthalene	TWA 0.5 mg/m ³	5 mg/m ³
Tetrachloronaphthalene	TWA 5 mg/m ³	50 mg/m ³
Trichloronaphthalene	TWA 2 mg/m ³	20 mg/m ³

* NIOSH also recommends a STEL of 0.3 mg/m³ for octachloronaphthalene; the TWA of 0.1 mg/m³

was used to calculate the "Effective" IDLH of 1 mg/m³.

APPENDIX G: 1989 Air Contaminants Update Project - Exposure Limits NOT in Effect

Acetaldehyde	TWA 100 ppm (180 mg/m ³) ST 150 ppm (270 mg/m ³)
Acetic anhydride	C 5 ppm (20 mg/m ³)
Acetone	TWA 750 ppm (1800 mg/m ³) ST 1000 ppm (2400 mg/m ³)
Acetonitrile	TWA 40 ppm (70 mg/m ³) ST 60 ppm (105 mg/m ³)
Acetylsalicylic acid	TWA 5 mg/m ³
Acrolein	TWA 0.1 ppm (0.25 mg/m ³) ST 0.3 ppm (0.8 mg/m ³)
Acrylamide	TWA 0.03 mg/m ³ [skin]
Acrylic acid	TWA 10 ppm (30 mg/m ³) [skin]
Allyl alcohol	TWA 2 ppm (5 mg/m ³) ST 4 ppm (10 mg/m ³) [skin]
Allyl chloride	TWA 1 ppm (3 mg/m ³) ST 2 ppm (6 mg/m ³)
Allyl glycidyl ether	TWA 5 ppm (22 mg/m ³) ST 10 ppm (44 mg/m ³)
Allyl propyl disulfide	TWA 2 ppm (12 mg/m ³) ST 3 ppm (18 mg/m ³)
alpha-Alumina	TWA 10 mg/m ³ (total) TWA 5 mg/m ³ (resp)
Aluminum (pyro powders & welding fumes, as Al)	TWA 5 mg/m ³
Aluminum (soluble salts & alkyls, as Al)	TWA 2 mg/m ³
Amitrole	TWA 0.2 mg/m ³
Ammonia	ST 35 ppm (27 mg/m ³)
Ammonium chloride fume	TWA 10 mg/m ³ ST 20 mg/m ³
Ammonium sulfamate	TWA 10 mg/m ³ (total) TWA 5 mg/m ³ (resp)
Aniline (and homologs)	TWA 2 ppm (8 mg/m ³) [skin]
Atrazine	TWA 5 mg/m ³
Barium sulfate	TWA 10 mg/m ³ (total) TWA 5 mg/m ³ (resp)
Benomyl	TWA 10 mg/m ³ (total) TWA 5 mg/m ³ (resp)

Benzenethiol	TWA 0.5 ppm (2 mg/m ³)
Bismuth telluride (doped with selenium sulfide, as Bi ₂ Te ₃)	TWA 5 mg/m ³
Borates, tetra, sodium salts (Anhydrous)	TWA 10 mg/m ³
Borates, tetra, sodium salts (Decahydrate)	TWA 10 mg/m ³
Borates, tetra, sodium salts (Pentahydrate)	TWA 10 mg/m ³
Boron oxide	TWA 10 mg/m ³
Boron tribromide	C 1 ppm (10 mg/m ³)
Bromacil	TWA 1 ppm (10 mg/m ³)
Bromine	TWA 0.1 ppm (0.7 mg/m ³) ST 0.3 ppm (2 mg/m ³)
Bromine pentafluoride	TWA 0.1 ppm (0.7 mg/m ³)
n-Butane	TWA 800 ppm (1900 mg/m ³)
2-Butanone	TWA 200 ppm (590 mg/m ³) ST 300 ppm (885 mg/m ³)
2-Butoxyethanol	TWA 25 ppm (120 mg/m ³) [skin]
n-Butyl acetate	TWA 150 ppm (710 mg/m ³) ST 200 ppm (950 mg/m ³)
Butyl acrylate	TWA 10 ppm (55 mg/m ³)
n-Butyl alcohol	C 50 ppm (150 mg/m ³) [skin]
sec-Butyl alcohol	TWA 100 ppm (305 mg/m ³)
tert-Butyl alcohol	TWA 100 ppm (300 mg/m ³) ST 150 ppm (450 mg/m ³)
n-Butyl glycidyl ether	TWA 25 ppm (135 mg/m ³)
n-Butyl lactate	TWA 5 ppm (25 mg/m ³)
n-Butyl mercaptan	TWA 0.5 ppm (1.5 mg/m ³)
o-sec-Butylphenol	TWA 5 ppm (30 mg/m ³) [skin]
p-tert-Butyltoluene	TWA 10 ppm (60 mg/m ³) ST 20 ppm (120 mg/m ³)
Calcium cyanamide	TWA 0.5 mg/m ³
Caprolactam	Dust: TWA 1 mg/m ³ ST 3 mg/m ³ Vapor: TWA 5 ppm (20 mg/m ³) ST 10 ppm (40 mg/m ³)
Captafol	TWA 0.1 mg/m ³
Captan	TWA 5 mg/m ³
Carbofuran	TWA 0.1 mg/m ³

Carbon dioxide	TWA 10,000 ppm (18,000 mg/m ³) ST 30,000 ppm (54,000 mg/m ³)
Carbon disulfide	TWA 4 ppm (12 mg/m ³) ST 12 ppm (36 mg/m ³) [skin]
Carbon monoxide	TWA 35 ppm (40 mg/m ³) C 200 ppm (229 mg/m ³)
Carbon tetrabromide	TWA 0.1 ppm (1.4 mg/m ³) ST 0.3 ppm (4 mg/m ³)
Carbon tetrachloride	TWA 2 ppm (12.6 mg/m ³)
Carbonyl fluoride	TWA 2 ppm (5 mg/m ³) ST 5 ppm (15 mg/m ³)
Catechol	TWA 5 ppm (20 mg/m ³) [skin]
Cesium hydroxide	TWA 2 mg/m ³
Chlorinated camphene	TWA 0.5 mg/m ³ ST 1 mg/m ³ [skin]
Chlorine	TWA 0.5 ppm (1.5 mg/m ³) ST 1 ppm (3 mg/m ³)
Chlorine dioxide	TWA 0.1 ppm (0.3 mg/m ³) ST 0.3 ppm (0.9 mg/m ³)
Chloroacetyl chloride	TWA 0.05 ppm (0.2 mg/m ³)
o-Chlorobenzylidene malononitrile	C 0.05 ppm (0.4 mg/m ³) [skin]
Chlorodifluoromethane	TWA 1000 ppm (3500 mg/m ³)
Chloroform	TWA 2 ppm (9.78 mg/m ³)
1-Chloro-1-nitropropane	TWA 2 ppm (10 mg/m ³)
Chloropentafluoroethane	TWA 1000 ppm (6320 mg/m ³)
beta-Chloroprene	TWA 10 ppm (35 mg/m ³) [skin]
o-Chlorostyrene	TWA 50 ppm (285 mg/m ³) ST 75 ppm (428 mg/m ³)
o-Chlorotoluene	TWA 50 ppm (250 mg/m ³)
Chlorpyrifos	TWA 0.2 mg/m ³ [skin]
Coal dust	TWA 2 mg/m ³ (<5% SiO ₂)(resp dust) TWA 0.1 mg/m ³ (> or = 5% SiO ₂) (resp quartz)
Cobalt metal dust & fume, as Co	TWA 0.05 mg/m ³
Cobalt carbonyl (as Co)	TWA 0.1 mg/m ³
Cobalt hydrocarbonyl (as Co)	TWA 0.1 mg/m ³
Crag® herbicide	TWA 10 mg/m ³ (total) TWA 5 mg/m ³ (resp)
Cruformate	TWA 5 mg/m ³

Cyanamide	TWA 2 mg/m ³
Cyanogen	TWA 10 ppm (20 mg/m ³)
Cyanogen chloride	C 0.3 ppm (0.6 mg/m ³)
Cyclohexanol	TWA 50 ppm (200 mg/m ³) [skin]
Cyclohexanone	TWA 25 ppm (100 mg/m ³) [skin]
Cyclohexylamine	TWA 10 ppm (40 mg/m ³)
Cyclonite	TWA 1.5 mg/m ³ [skin]
Cyclopentane	TWA 600 ppm (1720 mg/m ³)
Cyhexatin	TWA 5 mg/m ³
Decaborane	TWA 0.3 mg/m ³ (0.05 ppm) ST 0.9 mg/m ³ (0.15 ppm) [skin]
Diazinon	TWA 0.1 mg/m ³ [skin]
2-N-Dibutylaminoethanol	TWA 2 ppm (14 mg/m ³)
Dibutyl phosphate	TWA 1 ppm (5 mg/m ³) ST 2 ppm (10 mg/m ³)
Dichloroacetylene	C 0.1 ppm (0.4 mg/m ³)
p-Dichlorobenzene	TWA 75 ppm (450 mg/m ³) ST 110 ppm (675 mg/m ³)
1,3-Dichloro-5,5-dimethylhydantoin	TWA 0.2 mg/m ³ ST 0.4 mg/m ³
Dichloroethyl ether	TWA 5 ppm (30 mg/m ³) ST 10 ppm (60 mg/m ³) [skin]
Dichloromonofluoromethane	TWA 10 ppm (40 mg/m ³)
1,1-Dichloro-1-nitroethane	TWA 2 ppm (10 mg/m ³)
1,3-Dichloropropene	TWA 1 ppm (5 mg/m ³) [skin]
2,2-Dichloropropionic acid	TWA 1 ppm (6 mg/m ³)
Dicrotophos	TWA 0.25 mg/m ³ [skin]
Dicyclopentadiene	TWA 5 ppm (30 mg/m ³)
Dicyclopentadienyl iron	TWA 10 mg/m ³ (total) TWA 5 mg/m ³ (resp)
Diethanolamine	TWA 3 ppm (15 mg/m ³)
Diethylamine	TWA 10 ppm (30 mg/m ³) ST 25 ppm (75 mg/m ³)
Diethylenetriamine	TWA 1 ppm (4 mg/m ³)
Diethyl ketone	TWA 200 ppm (705 mg/m ³)
Diethyl phthalate	TWA 5 mg/m ³
Diglycidyl ether	TWA 0.1 ppm (0.5 mg/m ³)
Diisobutyl ketone	TWA 25 ppm (150 mg/m ³)

N,N-Dimethylaniline	TWA 5 ppm (25 mg/m ³) ST 10 ppm (50 mg/m ³) [skin]
Dimethyl-1,2-dibromo-2,2-dichlorethyl phosphate	TWA 3 mg/m ³ [skin]
Dimethyl sulfate	TWA 0.1 ppm (0.5 mg/m ³) [skin]
Dinitolmide	TWA 5 mg/m ³
Di-sec octyl phthalate	TWA 5 mg/m ³ ST 10 mg/m ³
Dioxane	TWA 25 ppm (90 mg/m ³) [skin]
Dioxathion	TWA 0.2 mg/m ³ [skin]
Diphenylamine	TWA 10 mg/m ³
Dipropylene glycol methyl ether	TWA 100 ppm (600 mg/m ³) ST 150 ppm (900 mg/m ³) [skin]
Dipropyl ketone	TWA 50 ppm (235 mg/m ³)
Diquat (Diquat dibromide)	TWA 0.5 mg/m ³
Disulfiram	TWA 2 mg/m ³
Disulfoton	TWA 0.1 mg/m ³ [skin]
2,6-Di-tert-butyl-p-cresol	TWA 10 mg/m ³
Diuron	TWA 10 mg/m ³
Divinyl benzene	TWA 10 ppm (50 mg/m ³)
Emery	TWA 10 mg/m ³ (total) TWA 5 mg/m ³ (resp)
Endosulfan	TWA 0.1 mg/m ³ [skin]
Epichlorohydrin	TWA 2 ppm (8 mg/m ³) [skin]
Ethanolamine	TWA 3 ppm (8 mg/m ³) ST 6 ppm (15 mg/m ³)
Ethion	TWA 0.4 mg/m ³ [skin]
Ethyl acrylate	TWA 5 ppm (20 mg/m ³) ST 25 ppm (100 mg/m ³) [skin]
Ethyl benzene	TWA 100 ppm (435 mg/m ³) ST 125 ppm (545 mg/m ³)
Ethyl bromide	TWA 200 ppm (890 mg/m ³) ST 250 ppm (1110 mg/m ³)
Ethylene chlorohydrin	C 1 ppm (3 mg/m ³) [skin]
Ethylene dichloride	TWA 1 ppm (4 mg/m ³) ST 2 ppm (8 mg/m ³)
Ethylene glycol	C 50 ppm (125 mg/m ³)
Ethylene glycol dinitrate	ST 0.1 mg/m ³ [skin]
Ethyl ether	TWA 400 ppm (1200 mg/m ³) ST 500 ppm (1500 mg/m ³)

Ethylidene norbornene	C 5 ppm (25 mg/m ³)
Ethyl mercaptan	TWA 0.5 ppm (1 mg/m ³)
N-Ethylmorpholine	TWA 5 ppm (23 mg/m ³) [skin]
Ethyl silicate	TWA 10 ppm (85 mg/m ³)
Fenamiphos	TWA 0.1 mg/m ³ [skin]
Fensulfothion	TWA 0.1 mg/m ³
Fenthion	TWA 0.2 mg/m ³ [skin]
Ferbam	TWA 10 mg/m ³
Ferrovandium dust	TWA 1 mg/m ³ ST 3 mg/m ³
Fluorotrichloromethane	C 1000 ppm (5600 mg/m ³)
Fonofos	TWA 0.1 mg/m ³ [skin]
Formamide	TWA 20 ppm (30 mg/m ³) ST 30 ppm (45 mg/m ³)
Furfural	TWA 2 ppm (8 mg/m ³) [skin]
Furfuryl alcohol	TWA 10 ppm (40 mg/m ³) ST 15 ppm (60 mg/m ³) [skin]
Gasoline	TWA 300 ppm (900 mg/m ³) ST 500 ppm (1500 mg/m ³)
Germanium tetrahydride	TWA 0.2 ppm (0.6 mg/m ³)
Glutaraldehyde	C 0.2 ppm (0.8 mg/m ³)
Glycerin (mist)	TWA 10 mg/m ³ (total) TWA 5 mg/m ³ (resp)
Glycidol	TWA 25 ppm (75 mg/m ³)
Graphite (natural)	TWA 2.5 mg/m ³ (resp)
Graphite (synthetic)	TWA 10 mg/m ³ (total) TWA 5 mg/m ³ (resp)
n-Heptane	TWA 400 ppm (1600 mg/m ³) ST 500 ppm (2000 mg/m ³)
Hexachlorobutadiene	TWA 0.02 ppm (0.24 mg/m ³)
Hexachlorocyclopentadiene	TWA 0.01 ppm (0.1 mg/m ³)
Hexafluoroacetone	TWA 0.1 ppm (0.7 mg/m ³) [skin]
n-Hexane	TWA 50 ppm (180 mg/m ³)
Hexane isomers (except n-Hexane)	TWA 500 ppm (1800 mg/m ³) ST 1000 ppm (3600 mg/m ³)
2-Hexanone	TWA 5 ppm (20 mg/m ³)
Hexone	TWA 50 ppm (205 mg/m ³) ST 75 ppm (300 mg/m ³)
Hexylene glycol	

C 25 ppm (125 mg/m³)**Hydrazine**TWA 0.1 ppm (0.1 mg/m³) [skin]**Hydrogenated terphenyls**TWA 0.5 ppm (5 mg/m³)**Hydrogen bromide**C 3 ppm (10 mg/m³)**Hydrogen cyanide**ST 4.7 ppm (5 mg/m³) [skin]**Hydrogen fluoride (as F)**TWA 3 ppm
ST 6 ppm**Hydrogen sulfide**TWA 10 ppm (14 mg/m³)
ST 15 ppm (21 mg/m³)**2-Hydroxypropyl acrylate**TWA 0.5 ppm (3 mg/m³) [skin]**Indene**TWA 10 ppm (45 mg/m³)**Indium**TWA 0.1 mg/m³**Iodoform**TWA 0.6 ppm (10 mg/m³)**Iron pentacarbonyl (as Fe)**TWA 0.1 ppm (0.8 mg/m³)
ST 0.2 ppm (1.6 mg/m³)**Iron salts (soluble, as Fe)**TWA 1 mg/m³**Isoamyl alcohol (primary & secondary)**TWA 100 ppm (360 mg/m³)
ST 125 ppm (450 mg/m³)**Isobutane**TWA 800 ppm (1900 mg/m³)**Isobutyl alcohol**TWA 50 ppm (150 mg/m³)**Isooctyl alcohol**TWA 50 ppm (270 mg/m³) [skin]**Isophorone**TWA 4 ppm (23 mg/m³)**Isophorone diisocyanate**TWA 0.005 ppm
ST 0.02 ppm [skin]**2-Isopropoxyethanol**TWA 25 ppm (105 mg/m³)**Isopropyl acetate**TWA 250 ppm (950 mg/m³)
ST 310 ppm (1185 mg/m³)**Isopropyl alcohol**TWA 400 ppm (980 mg/m³)
ST 500 ppm (1225 mg/m³)**Isopropylamine**TWA 5 ppm (12 mg/m³)
ST 10 ppm (24 mg/m³)**N-Isopropylaniline**TWA 2 ppm (10 mg/m³) [skin]**Isopropyl glycidyl ether**TWA 50 ppm (240 mg/m³)
ST 75 ppm (360 mg/m³)**Kaolin**TWA 10 mg/m³ (total)
TWA 5 mg/m³ (resp)**Ketene**TWA 0.5 ppm (0.9 mg/m³)
ST 1.5 ppm (3 mg/m³)**Magnesium oxide fume**TWA 10 mg/m³**Malathion**TWA 10 mg/m³ [skin]

Manganese compounds and fume (as Mn)	Compounds: C 5 mg/m ³
	Fume: TWA 1 mg/m ³ ST 3 mg/m ³
Manganese cyclopentadienyl tricarbonyl (as Mn)	TWA 0.1 mg/m ³ [skin]
Manganese tetroxide (as Mn)	TWA 1 mg/m ³
Mercury compounds, as Hg [except(organo) alkyls]	
Hg Vapor	TWA 0.05 mg/m ³ [skin]
Non-alkyl compounds	C 0.1 mg/m ³ [skin]
Mercury (organo) alkyl compounds (as Hg)	TWA 0.01 mg/m ³ ST 0.03 mg/m ³ [skin]
Mesityl oxide	TWA 15 ppm (60 mg/m ³) ST 25 ppm (100 mg/m ³)
Methacrylic acid	TWA 20 ppm (70 mg/m ³) [skin]
Methomyl	TWA 2.5 mg/m ³
Methoxychlor	TWA 10 mg/m ³
4-Methoxyphenol	TWA 5 mg/m ³
Methyl acetate	TWA 200 ppm (610 mg/m ³) ST 250 ppm (760 mg/m ³)
Methyl acetylene-propadiene mixture	TWA 1000 ppm (1800 mg/m ³) ST 1250 ppm (2250 mg/m ³)
Methylacrylonitrile	TWA 1 ppm (3 mg/m ³) [skin]
Methyl alcohol	TWA 200 ppm (260 mg/m ³) ST 250 ppm (325 mg/m ³) [skin]
Methyl bromide	TWA 5 ppm (20 mg/m ³) [skin]
Methyl chloride	TWA 50 ppm (105 mg/m ³) ST 100 ppm (210 mg/m ³)
Methyl chloroform	TWA 350 ppm (1900 mg/m ³) ST 450 ppm (2450 mg/m ³)
Methyl-2-cyanoacrylate	TWA 2 ppm (8 mg/m ³) ST 4 ppm (16 mg/m ³)
Methylcyclohexane	TWA 400 ppm (1600 mg/m ³)
Methylcyclohexanol	TWA 50 ppm (235 mg/m ³)
o-Methylcyclohexanone	TWA 50 ppm (230 mg/m ³) ST 75 ppm (345 mg/m ³) [skin]
Methyl cyclopentadienyl manganese tricarbonyl (as Mn)	TWA 0.2 mg/m ³ [skin]
Methyl demeton	TWA 0.5 mg/m ³ [skin]
4,4'-Methylenebis(2-chloroaniline)	TWA 0.02 ppm (0.22 mg/m ³) [skin]

Methylene bis(4-cyclo-hexylisocyanate)	C 0.01 ppm (0.11 mg/m ³) [skin]
Methyl ethyl ketone peroxide	C 0.7 ppm (5 mg/m ³)
Methyl formate	TWA 100 ppm (250 mg/m ³) ST 150 ppm (375 mg/m ³)
Methyl iodide	TWA 2 ppm (10 mg/m ³) [skin]
Methyl isoamyl ketone	TWA 50 ppm (240 mg/m ³)
Methyl isobutyl carbinol	TWA 25 ppm (100 mg/m ³) ST 40 ppm (165 mg/m ³) [skin]
Methyl isopropyl ketone	TWA 200 ppm (705 mg/m ³)
Methyl mercaptan	TWA 0.5 ppm (1 mg/m ³)
Methyl parathion	TWA 0.2 mg/m ³ [skin]
Methyl silicate	TWA 1 ppm (6 mg/m ³)
alpha-Methyl styrene	TWA 50 ppm (240 mg/m ³) ST 100 ppm (485 mg/m ³)
Metribuzin	TWA 5 mg/m ³
Mica	TWA 3 mg/m ³ (resp)
Molybdenum (insoluble compounds, as Mo)	TWA 10 mg/m ³
Monocrotophos	TWA 0.25 mg/m ³
Monomethyl aniline	TWA 0.5 ppm (2 mg/m ³) [skin]
Morpholine	TWA 20 ppm (70 mg/m ³) ST 30 ppm (105 mg/m ³) [skin]
Naphthalene	TWA 10 ppm (50 mg/m ³) ST 15 ppm (75 mg/m ³)
Nickel metal & other compounds (as Ni)	
Metal & insoluble compounds	TWA 1 mg/m ³
Soluble compounds	TWA 0.1 mg/m ³
Nitric acid	TWA 2 ppm (5 mg/m ³) ST 4 ppm (10 mg/m ³)
p-Nitroaniline	TWA 3 mg/m ³ [skin]
Nitrogen dioxide	ST 1 ppm (1.8 mg/m ³)
Nitroglycerine	ST 0.1 mg/m ³ [skin]
2-Nitropropane	TWA 10 ppm (35 mg/m ³)
Nitrotoluene (o-, m-, p-isomers)	TWA 2 ppm (11 mg/m ³) [skin]
Nonane	TWA 200 ppm (1050 mg/m ³)
Octachloronaphthalene	TWA 0.1 mg/m ³ ST 0.3 mg/m ³ [skin]
Octane	TWA 300 ppm (1450 mg/m ³) ST 375 ppm (1800 mg/m ³)

Osmium tetroxide (as Os)	TWA 0.002 mg/m ³ (0.0002 ppm) ST 0.006 mg/m ³ (0.0006 ppm)
Oxalic acid	TWA 1 mg/m ³ ST 2 mg/m ³
Oxygen difluoride	C 0.05 ppm (0.1 mg/m ³)
Ozone	TWA 0.1 ppm (0.2 mg/m ³) ST 0.3 ppm (0.6 mg/m ³)
Paraffin wax fume	TWA 2 mg/m ³
Paraquat	TWA 0.1 mg/m ³ (resp) [skin]
Pentaborane	TWA 0.005 ppm (0.01 mg/m ³) ST 0.015 ppm (0.03 mg/m ³)
Pentaerythritol	TWA 10 mg/m ³ (total) TWA 5 mg/m ³ (resp)
n-Pentane	TWA 600 ppm (1800 mg/m ³) ST 750 ppm (2250 mg/m ³)
2-Pentanone	TWA 200 ppm (700 mg/m ³) ST 250 ppm (875 mg/m ³)
Perchloryl fluoride	TWA 3 ppm (14 mg/m ³) ST 6 ppm (28 mg/m ³)
Petroleum distillates (naphtha)	TWA 400 ppm (1600 mg/m ³)
Phenothiazine	TWA 5 mg/m ³ [skin]
Phenyl glycidyl ether	TWA 1 ppm (6 mg/m ³)
Phenylhydrazine	TWA 5 ppm (20 mg/m ³) ST 10 ppm (45 mg/m ³) [skin]
Phenylphosphine	C 0.05 ppm (0.25 mg/m ³)
Phorate	TWA 0.05 mg/m ³ ST 0.2 mg/m ³ [skin]
Phosdrin	TWA 0.01 ppm (0.1 mg/m ³) ST 0.03 ppm (0.3 mg/m ³) [skin]
Phosphine	TWA 0.3 ppm (0.4 mg/m ³) ST 1 ppm (1 mg/m ³)
Phosphoric acid	TWA 1 mg/m ³ ST 3 mg/m ³
Phosphorus oxychloride	TWA 0.1 ppm (0.6 mg/m ³)
Phosphorus pentasulfide	TWA 1 mg/m ³ ST 3 mg/m ³
Phosphorus trichloride	TWA 0.2 ppm (1.5 mg/m ³) ST 0.5 ppm (3 mg/m ³)
Phthalic anhydride	TWA 6 mg/m ³ (1 ppm)
m-Phthalodinitrile	TWA 5 mg/m ³
Picloram	TWA 10 mg/m ³ (total)

TWA 5 mg/m³ (resp)

Piperazine dihydrochloride

TWA 5 mg/m³

Platinum metal (as Pt)

TWA 1 mg/m³

Portland cement

TWA 10 mg/m³ (total)TWA 5 mg/m³ (resp)

Potassium hydroxide

TWA 2 mg/m³

Propargyl alcohol

TWA 1 ppm (2 mg/m³) [skin]

Propionic acid

TWA 10 ppm (30 mg/m³)

Propoxur

TWA 0.5 mg/m³

n-Propyl acetate

TWA 200 ppm (840 mg/m³)ST 250 ppm (1050 mg/m³)

n-Propyl alcohol

TWA 200 ppm (500 mg/m³)ST 250 ppm (625 mg/m³)

Propylene dichloride

TWA 75 ppm (350 mg/m³)ST 110 ppm (510 mg/m³)

Propylene glycol dinitrate

TWA 0.05 ppm (0.3 mg/m³)

Propylene glycol monomethyl ether

TWA 100 ppm (360 mg/m³)ST 150 ppm (540 mg/m³)

Propylene oxide

TWA 20 ppm (50 mg/m³)

n-Propyl nitrate

TWA 25 ppm (105 mg/m³)ST 40 ppm (170 mg/m³)

Resorcinol

TWA 10 ppm (45 mg/m³)ST 20 ppm (90 mg/m³)

Ronnel

TWA 10 mg/m³

Rosin core solder, pyrolysis products (as formaldehyde)

TWA 0.1 mg/m³

Rouge

TWA 10 mg/m³ (total)TWA 5 mg/m³ (resp)

Silica, amorphous

TWA 6 mg/m³TWA 0.1 mg/m³ (fused)

Silica, crystalline (as respirable dust)

TWA 0.05 mg/m³ (cristobalite)TWA 0.05 mg/m³ (tridymite)TWA 0.1 mg/m³ (quartz)TWA 0.1 mg/m³ (tripoli)

Silicon

TWA 10 mg/m³ (total)TWA 5 mg/m³ (resp)

Silicon carbide

TWA 10 mg/m³ (total)TWA 5 mg/m³ (resp)

Silicon tetrahydride

TWA 5 ppm (7 mg/m³)

Soapstone

TWA 6 mg/m³ (total)TWA 3 mg/m³ (resp)

Sodium azide	C 0.1 ppm (as HN_3) [skin] C 0.3 mg/m^3 (as NaN_3) [skin]
Sodium bisulfite	TWA 5 mg/m^3
Sodium fluoroacetate	TWA 0.05 mg/m^3 ST 0.15 mg/m^3 [skin]
Sodium hydroxide	C 2 mg/m^3
Sodium metabisulfite	TWA 5 mg/m^3
Stoddard solvent	TWA 525 mg/m^3 (100 ppm)
Styrene	TWA 50 ppm (215 mg/m^3) ST 100 ppm (425 mg/m^3)
Subtilisins	ST 0.00006 mg/m^3 [60-minute]
Sulfur dioxide	TWA 2 ppm (5 mg/m^3) ST 5 ppm (13 mg/m^3)
Sulfur monochloride	C 1 ppm (6 mg/m^3)
Sulfur pentafluoride	C 0.01 ppm (0.1 mg/m^3)
Sulfur tetrafluoride	C 0.1 ppm (0.4 mg/m^3)
Sulfuryl fluoride	TWA 5 ppm (20 mg/m^3) ST 10 ppm (40 mg/m^3)
Sulprofos	TWA 1 mg/m^3
Talc	TWA 2 mg/m^3 (resp)
Temephos	TWA 10 mg/m^3 (total) TWA 5 mg/m^3 (resp)
Terphenyl (o-, m-, p-isomers)	C 5 mg/m^3 (0.5 ppm)
1,1,2,2-Tetrachloroethane	TWA 1 ppm (7 mg/m^3) [skin]
Tetrachloroethylene	TWA 25 ppm (170 mg/m^3)
Tetrahydrofuran	TWA 200 ppm (590 mg/m^3) ST 250 ppm (735 mg/m^3)
Tetrasodium pyrophosphate	TWA 5 mg/m^3
4,4'-Thiobis(6-tert-butyl-m-cresol)	TWA 10 mg/m^3 (total) TWA 5 mg/m^3 (resp)
Thioglycolic acid	TWA 1 ppm (4 mg/m^3) [skin]
Thionyl chloride	C 1 ppm (5 mg/m^3)
Tin (organic compounds, as Sn)	TWA 0.1 mg/m^3 [skin]
Tin(II) oxide (as Sn)	TWA 2 mg/m^3
Tin(IV) oxide (as Sn)	TWA 2 mg/m^3
Titanium dioxide	TWA 10 mg/m^3
Toluene	TWA 100 ppm (375 mg/m^3) ST 150 ppm (560 mg/m^3)

Toluene-2,4-diisocyanate	TWA 0.005 ppm (0.04 mg/m ³) ST 0.02 ppm (0.15 mg/m ³)
m-Toluidine	TWA 2 ppm (9 mg/m ³) [skin]
p-Toluidine	TWA 2 ppm (9 mg/m ³) [skin]
Tributyl phosphate	TWA 0.2 ppm (2.5 mg/m ³)
Trichloroacetic acid	TWA 1 ppm (7 mg/m ³)
1,2,4-Trichlorobenzene	C 5 ppm (40 mg/m ³)
Trichloroethylene	TWA 50 ppm (270 mg/m ³) ST 200 ppm (1080 mg/m ³)
1,2,3-Trichloropropane	TWA 10 ppm (60 mg/m ³)
1,1,2-Trichloro-1,2,2-trifluoroethane	TWA 1000 ppm (7600 mg/m ³) ST 1250 ppm (9500 mg/m ³)
Triethylamine	TWA 10 ppm (40 mg/m ³) ST 15 ppm (60 mg/m ³)
Trimellitic anhydride	TWA 0.005 ppm (0.04 mg/m ³)
Trimethylamine	TWA 10 ppm (24 mg/m ³) ST 15 ppm (36 mg/m ³)
1,2,3-Trimethylbenzene	TWA 25 ppm (125 mg/m ³)
1,2,4-Trimethylbenzene	TWA 25 ppm (125 mg/m ³)
1,3,5-Trimethylbenzene	TWA 25 ppm (125 mg/m ³)
Trimethyl phosphite	TWA 2 ppm (10 mg/m ³)
2,4,6-Trinitrotoluene	TWA 0.5 mg/m ³ [skin]
Triorthocresyl phosphate	TWA 0.1 mg/m ³ [skin]
Triphenylamine	TWA 5 mg/m ³
Tungsten (insoluble compounds, as W)	TWA 5 mg/m ³ ST 10 mg/m ³
Tungsten (soluble compounds, as W)	TWA 1 mg/m ³ ST 3 mg/m ³
Tungsten carbide (cemented)	TWA 5 mg/m ³ (as W) ST 10 mg/m ³ (as W) TWA 0.05 mg/m ³ (as Co) TWA 1 mg/m ³ (as Ni)
Uranium (insoluble compounds, as U)	TWA 0.2 mg/m ³ ST 0.6 mg/m ³
n-Valeraldehyde	TWA 50 ppm (175 mg/m ³)
Vanadium dust	TWA 0.05 mg V ₂ O ₅ /m ³ (resp)
Vanadium fume	C 0.05 mg V ₂ O ₅ /m ³
Vinyl acetate	TWA 10 ppm (30 mg/m ³) ST 20 ppm (60 mg/m ³)

Vinyl bromide	TWA 5 ppm (20 mg/m ³)
Vinyl cyclohexene dioxide	TWA 10 ppm (60 mg/m ³) [skin]
Vinylidene chloride	TWA 1 ppm (4 mg/m ³)
VM & P Naptha	TWA 1350 mg/m ³ (300 ppm) ST 1800 mg/m ³ (400 ppm)
Welding fumes	TWA 5 mg/m ³
Wood dust (all wood dusts except Western red cedar)	TWA 5 mg/m ³ ST 10 mg/m ³
Wood dust (Western red cedar)	TWA 2.5 mg/m ³
Xylene (o-, m-, p-isomers)	TWA 100 ppm (435 mg/m ³) ST 150 ppm (655 mg/m ³)
m-Xylene alpha, alpha'-diamine	C 0.1 mg/m ³ [skin]
Xylidine	TWA 2 ppm (10 mg/m ³) [skin]
Zinc chloride fume	TWA 1 mg/m ³ ST 2 mg/m ³
Zinc oxide	TWA 5 mg/m ³ (fume) ST 10 mg/m ³ (fume) TWA 10 mg/m ³ (total dust) TWA 5 mg/m ³ (resp dust)
Zinc stearate	TWA 10 mg/m ³ (total) TWA 5 mg/m ³ (resp)
Zirconium compounds (as Zr)	TWA 5 mg/m ³ ST 10 mg/m ³

Definitions for Type C and Type CE Respirators

The definitions below were obtained from the NIOSH Certified Equipment List, which is available on the NIOSH Web site (<http://www.cdc.gov/niosh/npptl/topics/respirators/cel>).

Type C Respirator: An airline respirator, for entry into and escape from atmospheres not immediately dangerous to life or health, which consists of a source of respirable breathing air, a hose, a detachable coupling, a control valve, orifice, a demand valve or pressure demand valve, and arrangement for attaching the hose to the wearer and a facepiece, hood, or helmet.

Type CE Respirator: A Type C supplied-air respirator equipped with additional devices designed to protect the wearer's head and neck against impact and abrasion from rebounding abrasive material, and with shielding material such as plastic, glass, woven wire, sheet metal, or other suitable material to protect the window(s) of facepieces, hoods, and helmets which do not unduly interfere with the wearer's vision and permit easy access to the external surface of such window(s) for cleaning.