CENTERS FOR DISEASE CONTROL

October 7, 1983/Vol. 32/No. 1S

MMWR

Supplement

MORBIDITY AND MORTALITY WEEKLY REPORT

NIOSH Recommendations for Occupational Health Standards

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Public Health Service
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INTRODUCTION

The National Institute for Occupational Safety and Health (NIOSH) develops and periodically revises recommendations for limits of exposure to potentially hazardous substances or conditions in the workplace. It also recommends appropriate preventive measures designed to reduce or eliminate adverse health effects of these hazards. To formulate these recommendations, NIOSH evaluates all known and available medical, biological, engineering, chemical, trade, and other information relevant to the potential hazard. These recommendations, published as Criteria Documents, are then transmitted to the Department of Labor, Occupational Safety and Health Administration (OSHA), for use in promulgating legal standards.

In the past, NIOSH also produced Special Hazard Reviews, which supported and complemented the other standards-recommending activities of the Institute. The purpose of these publications was to assess, from the standpoint of health, specific problems associated with a given agent or hazard, such as its potential for carcinogenic, mutagenic, or teratogenic effects, and to recommend appropriate methods for control and surveillance. While they were not intended to supplant the more comprehensive Criteria Documents, they were prepared to assist OSHA with the formulation of regulations.

The *NIOSH Recommendations for Occupational Health Standards* contains a summary of each of the major recommendations found in the Criteria Documents and Special Hazard Reviews published by NIOSH and transmitted to OSHA. (Unless otherwise noted in the table, the recommendations are published in Criteria Documents.) The intent of the table is to provide, in rapid-reference form, the recommendations as well as the current OSHA standard for each potential hazard. In addition, the significant health effect or effects that were considered by staff of NIOSH in developing the recommendations are presented. Other information that was considered to be pertinent to the substance or condition is included in the column labeled "COMMENTS." The comments reflect the state of knowledge at the time the document was submitted to OSHA.

Note to Readers:

Copies of NIOSH publications are generally available from the U.S. Government Printing Office and the National Technical Information Service. Single copies of Criteria Documents may be obtained (while the supply lasts) from:

Publications Dissemination, DSDTT
National Institute for Occupational Safety and Health
4676 Columbia Parkway
Cincinnati, Ohio 45226

Please enclose a self-addressed mailing label with your request.

Definitions of abbreviations and terms used in this publication:

Action level	the level of exposure at which certain provisions of the proposed standards must be initiated, such as periodic measurements of employee exposure, training of employees, and medical surveillance (if appropriate for the particular substance)
CFR	Code of Federal Regulations
CNS	central nervous system
dbA	decibel, weighted according to the A scale, which approximates the response of the human ear
ECG	electrocardiogram
mppcf	millions of particles per cubic foot
NIOSH	National Institute for Occupational Safety and Health
OSHA	Occupational Safety and Health Administration
PEL	permissible exposure limit
ppb	parts per billion
ppm	parts per million
TWA	time-weighted average
WBGT	wet bulb globe temperature

NIOSH RECOMMENDATIONS COMPARED WITH OSHA REGULATIONS FOR OCCUPATIONAL HEALTH STANDARDS, 1982

Potential Hazard	OSHA Standard	NIOSH Recommended Exposure Limit*	Health Effect Considered	Comments
Acetylene (July 1976)†	2,500 ppm (10% of lower explosive limit)	No exposure > 2,500 ppm (2,662 mg/m^3)	Indirect asphyxia	Employers to check for and inform employees of contaminants such as arsine and phosphine
Acrylamide (October 1976)	0.3 mg/m^3, 8-hr TWA (skin)	0.3 mg/m^3 TWA	Skin, eye, nervous system effects	Skin and eye contact to be prevented
Acrylonitrile (September 1977)	2 ppm, 8-hr TWA; 10 ppm ceiling (15 min) (skin) (Standard promulgated October 3, 1978)	4 ppm (4 hr) as measured by recommended method (8.7 mg/m^3)	Lung and bowel cancer	Chest X-ray required; first aid and medical kits to be available during use; hazardous liquid, skin.
Aldrin/dieldrin (Special Hazard Review) (September 1978)	0.25 mg/m^3, 8-hr TWA (skin)	Lowest reliably detectable level; 0.15 mg/m^3 TWA by NIOSH-validated method; skin contact to be prevented	Cancer	No longer produced in United States
Alkanes (C5-C8) (March 1977)	pentane: 1,000 ppm, 8-hr TWA; n-hexane, n-heptane, octane: 500 ppm, 8-hr TWA	350 mg/m^3 TWA (pentane: approx. 120 ppm; hexane: 100 ppm; heptane: 85 ppm; octane: 75 ppm); mixtures not to exceed 350 mg/m^3 TWA; 1,800 mg/m^3 ceiling singly or mixtures (15 min)	Skin and nervous system effects	Action level defined as 200 mg/m^3 for these substances
Allyl chloride (September 1976)	1 ppm, 8-hr TWA	1 ppm TWA (3.1 mg/m^3); 3 ppm ceiling (9.3 mg/m^3) (15 min)	Liver, kidney, lung effects	Urine, blood, and pulmonary function testing required
Ammonia (July 1974)	50 ppm, 8-hr TWA	50 ppm ceiling (34.8 mg/m^3) (5 min)	Respiratory irritation	Hazardous liquid, eye damage

Anesthetic gases and vapors, waste (March 1977)	None for substances when used as anesthetic agents	Halogenated anesthetic agents: 2 ppm ceiling (1 hr); nitrous oxide: 25 ppm TWA during periods of use	Reproductive effects and audiovisual performance decrements	Employees to be advised of potential effects; abnormal outcome of pregnancies of employees and spouses to be documented
Antimony (September 1978)	0.5 mg/m^3, 8-hr TWA	0.5 mg/m^3 TWA	Irritation; heart and lung effects	Chest X-ray, pulmonary function testing, and electrocardiogram required
Arsenic, inorganic (September 1974; revised June 1975)	10 μg/m^3, 8-hr TWA (Standard promulgated May 5, 1978)	2 μg As/m^3 ceiling (15-min)	Dermatitis; lung and lymphatic cancer	Chest X-ray required.
Asbestos (January 1972; revised September 1976)	2 million fibers/m^3, 8-hr TWA; 10 million fibers/m^3 ceiling (Standard promulgated July 7, 1972; TWA lowered July 1, 1976)	100,000 fibers/m^3 over 5 μm in length, 8-hr TWA; 500,000 fibers/m^3 over 5 μm in length ceiling (15 min)	Asbestosis, lung cancer, mesothelioma	
Asphalt fumes (September 1977)	See coal tar products	5 mg/m^3 ceiling measured as total particulate (15 min)	Eye & respiratory irritation	Hazardous substance, skin
Benzene (July 1974; revised August 1976; revised July 1977 as part of NIOSH testimony at OSHA hearing)	10 ppm, 8-hr TWA; 25 ppm acceptable ceiling; 50 ppm maximum ceiling; (10 min) (Standard promulgated February 10, 1978)	1 ppm ceiling (3.2 mg/m^3) (60 min)	Blood changes including leukemia	Blood testing required
Benzidine-based dyes (Special Hazard Review) (November 1979)	Not controlled as such	Stringent work practices and controls; replacement with less toxic materials	Cancer	Urine monitoring suggested

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Potential Hazard	OSHA Standard	NIOSH Recommended Exposure Limit*	Health Effect Considered	Comments
Benzoyl peroxide (June 1977)†	5 mg/m^3, 8-hr TWA	5 mg/m^3 TWA	Respiratory and eye irritation; skin effects	
Benzyl chloride (August 1978)	1 ppm (5 mg/m^3), 8-hr TWA	5 mg/m^3 ceiling (15 min)	Irritation; skin and eye effects	Chest X-ray and pulmonary function testing required
Beryllium (June 1972; revised August 1977 as part of NIOSH testimony at OSHA hearing)	2 μg/m^3, 8-hr TWA; 5 μg/m^3 acceptable ceiling; 25 μg/m^3 maximum ceiling (30 min)	Not to exceed 0.5 μg/m^3	Lung cancer	Pulmonary function testing, chest X-ray, and sputum cytology required
Boron trifluoride (December 1976)	1 ppm ceiling	None recommended	Respiratory effects	Adequate procedures for sampling and analysis not available; pulmonary function testing required
Cadmium (August 1976)	Fume: 0.1 mg/m^3, 8-hr TWA; 0.3 mg/m^3 ceiling (erroneously published as 3 mg/m^3); dust: 0.2 mg/m^3, 8-hr TWA; 0.6 mg/m^3 ceiling	40 μg/Cd/m^3 TWA; 200 μg/Cd/m^3 ceiling (15 min)	Lung and kidney effects	Urine and pulmonary function testing required
Carbaryl (September 1976)	5 mg/m^3, 8-hr TWA	5 mg/m^3 TWA	CNS and reproductive system effects	Workers to be warned of possible effects on reproductive system and to have only minimum exposure during pregnancy; skin and eye contact to be prevented
Carbon black (September 1978)	3.5 mg/m^3, 8-hr TWA	3.5 mg/m^3 TWA; 0.1 mg/m^3 TWA in presence of polycyclic aromatic hydrocarbons	Lung, heart, and skin effects; cancer	Chest X-rays, pulmonary function testing, ECG, and sputum cytology required

Carbon dioxide (August 1976)	5,000 ppm, 8-hr TWA	10,000 ppm TWA (18,000 mg/m^3); 30,000 ppm ceiling(54,000 mg/m^3) (10 min)	Respiratory effects	
Carbon disulfide (May 1977)	20 ppm, 8-hr TWA; 30 ppm acceptable ceiling; 100 ppm maximum ceiling	1 ppm TWA (3 mg/m^3); 10 ppm ceiling (30 mg/m^3) (15 min)	Heart, CNS, and reproductive system effects	Employees to be advised of potential effects on reproductive system
Carbon monoxide (August 1972)	50 ppm, 8-hr TWA	35 ppm TWA (40 mg/m^3); 200 ppm ceiling (229 mg/m^3) (No minimum time)	Heart effects	
Carbon tetrachloride (December 1975; revised June 1976)	10 ppm, 8-hr TWA; 25 ppm acceptable ceiling; 200 ppm maximum ceiling (5 min in 4 hr)	2 ppm ceiling (12.6 mg/m^3) (60 min)	Liver cancer	Recommended standard based on lower limit of detection
Chlorine (May 1976)	1 ppm ceiling	0.5 ppm ceiling (1.45 mg/m^3) (15 min)	Eye and respiratory irritation	Chest X-rays required
Chloroform (September 1976; revised June 1976)	50 ppm ceiling	2 ppm ceiling (9.78 mg/m^3) (60 min)	Liver or kidney tumors and central nervous system effects	Current federal standard should be TWA; published as "C" in error
Chloroprene (August 1977)	25 ppm, 8-hr TWA	1 ppm ceiling (3.6 mg/m^3) (15 min)	Reproductive effects; potential for cancer	Chest X-ray and pulmonary function testing required; workers to be warned about reproductive effects in animals; pregnant workers to be counseled about continuing work with chloroprene
Chromic acid (July 1973)	1 mg/10 m^3 ceiling	0.05 mg CrO_3/m^3 TWA; 0.1 mg CrO_3/m^3 ceiling (15 min)	Nasal ulceration	
Chromium (VI) (December 1975)	100 μg/m^3 ceiling	Carcinogenic Cr (VI): 1 μg/m^3; other Cr (VI): 25 μg/m^3 TWA; 50 μg/m^3 ceiling (15 min)	Lung cancer, skin ulcers, and lung irritation	Employer must demonstrate absence of carcinogenic Cr(VI); X-ray required

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Potential Hazard	OSHA Standard	NIOSH Recommended Exposure Limit*	Health Effect Considered	Comments
Chrysene (Special Hazard Review) (June 1978)†	None	To be controlled as an occupational carcinogen	Cancer	Control recommendations also included for polycyclic aromatic hydrocarbons
Coal gasification (September 1978)	OSHA permissible exposure limits or NIOSH-recommended limits for specific hazards are applicable		Various effects depending on substances present; carcinogenic potential	Extensive work-practice and control procedures recommended
Coal liquefaction, volumes I and II (Occupational Hazard Assessment) (June 1981)	OSHA permissible exposure limits or NIOSH recommendations are applicable		Various effects depending on substances present; carcinogenic potential	Extensive work-practice and control procedures recommended
Coal-tar products (September 1977)	0.2 mg/m^3, 8-hr TWA (benzene-soluble fraction)	0.1 mg/m^3 TWA (cyclohexane-extractable fraction)	Lung and skin cancer	Includes coal tar, creosote, and coal-tar pitch. Pulmonary function testing, chest X-rays, and sputum cytology required
Cobalt (Occupational Hazard Assessment) (November 1981)	0.1 mg/m^3, 8-hr TWA	NIOSH has concluded that there is insufficient evidence to warrant recommending a new permissible exposure limit	Dermatitis, potential for pulmonary fibrosis	Includes recommendations for engineering controls, work practices, protective equipment, worker education, monitoring, and medical surveillance
Coke oven emissions (February 1973; revised November 1975 as part of NIOSH testimony at OSHA hearing)	150 μg/m^3, 8-hr TWA (Standard promulgated October 22, 1976)	0.5-0.7 mg/m^3 (total particulates) as screening level; work practices to minimize exposure to emissions	Lung cancer	Sputum cytology and chest X-ray required.

Confined spaces, working in (January 1980)	Covered under numerous OSHA regulations for General Industry (29 CFR 1910)	Various recommendations including a permit system to prevent worker injury and death	Injury and death	
Cotton dust (September 1974)	Yarn manufacturing: 200 $\mu g/m^3$; 8-hr TWA, slashing and weaving operations: 750 $\mu g/m^3$, 8-hr TWA; all other operations: 500 $\mu g/m^3$, 8-hr TWA (Standard promulgated June 23, 1978)	200 $\mu g/m^3$ lint-free cotton dust	Pulmonary disease (byssinosis)	Pulmonary function testing required.
Cresol (February 1978)	22 mg/m^3, 8-hr TWA (skin)	10 mg/m^3 TWA	Skin, liver, kidney, and pancreas effects	Applies to mixtures of cresols and cresylic acid; hazardous substance, skin and eyes; possible delayed effects
Cyanide, hydrogen and cyanide salts (October 1976)	Alkali cyanides: 10 ppm, 8-hr TWA; cyanide: 5 mg CN/m^3 (skin)	5 mg CN/m^3 ceiling (4.7 ppm) (10 min)	Thyroid, blood, respiratory system effects	Concurrent measurement required for HCN when measuring for cyanide salt; trained first-aid personnel and first-aid kits to be available during use; hazardous liquid, skin and eye
DDT (Special Hazard Review) (September 1978)	1 mg/m^3, 8-hr TWA (skin)	Lowest reliably detectable level; 0.5 mg/m^3 TWA by NIOSH validated method; skin contact to be avoided	Cancer	
Dibromochloro-propane (September 1977)	1 ppb, 8-hr TWA; eye and skin contact to be avoided (Standard promulgated March 17, 1978)	10 ppb ceiling (0.1 mg/m^3)	Sterility; renal and liver effects	Workers to be warned of reproductive system abnormalities, including sterility, and cancer in animals following direct gastric application.

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Potential Hazard	OSHA Standard	NIOSH Recommended Exposure Limit*	Health Effect Considered	Comments
Diisocyanates (September 1978) †	Toluene diisocyanate (TDI): 0.02 ppm (0.14 mg/m^3) ceiling; diphenylmethane diisocyanate (MDI): 0.02 ppm (0.2 mg/m^3) ceiling	All values in μg/m^3 and all ceiling values for 10 min: TDI: 35 TWA, 140 ceiling; MDI: 50 TWA, 200 ceiling; hexamethylene diisocyanate (HDI): 35 TWA, 140 ceiling; naphthalene diisocyanate (NDI): 40 TWA, 170 ceiling; isophorene diisocyanate (IPDI): 45 TWA, 180 ceiling; dicyclohexylmethane 4,4'-diisocyanate (hydrogenated MDI): 55 TWA, 210 ceiling; other diisocyanates to be controlled to 20 ppb ceiling and 5 ppb TWA	Respiratory effects and sensitization; irritation	Chest X-ray and pulmonary function testing required
Dinitro-orthocresol (February 1978)	0.1 mg/m^3, 8-hr TWA (skin)	0.2 mg/m^3 TWA	CNS and metabolic effects	Blood and urine monitoring required; hazardous substance, skin and eyes; possible delayed effects
Dioxane (September 1977)	100 ppm, 8-hr TWA (skin)	1 ppm ceiling (3.6 mg/m^3) (30 min)	Liver and kidney effects; cancer	Blood and urine testing required; hazardous liquid, skin
Elevated workstations, emergency egress from (December 1975)	Sections under Subpart E, General Industry Standards, and Subpart R, 29 CFR 1910.261	Various recommendations concerning means and availability of egress	Trauma and injury	
Epichlorohydrin (September 1976)	5 ppm, 8-hr TWA (20 mg/m^3)	2 mg/m^3 TWA; 19 mg/m^3 ceiling (15 min)	Skin, kidney, liver, and respiratory-system effects	Workers to be warned about infertility; hazardous liquid, skin

Ethylene dibromide (August 1977)	20 ppm, 8-hr TWA; 30 ppm acceptable ceiling; 50 ppm maximum peak (5 min)	1 mg/m^3 ceiling (0.13 ppm) (15 min)	Damage to skin, eyes, heart, liver, spleen, respiratory and central nervous systems; potential for cancer and mutagenesis	Workers to be warned of potential reproductive abnormalities and cancer following direct administration in animals; hazardous liquid; contact to be prevented
Ethylene dichloride (Special Hazard Review) (March 1976; revised September 1978)	50 ppm, 8-hr TWA; 100 ppm acceptable ceiling; 200 ppm maximum ceiling (5 min in 3 hr)	1 ppm TWA (4 mg/m^3); 2 ppm ceiling (8 mg/m^3) (15 min)	Cancer; nervous system, respiratory, heart, and liver effects	Nursing infants of exposed mothers at risk
Ethylene oxide (Special Hazard Review) (September 1977)	90 mg/m^3 (50 ppm), 8-hr TWA	90 mg/m^3 (50 ppm) TWA; 135 mg/m^3 (75 ppm) ceiling (15 min)	Mutagenesis; cancer	Blood monitoring and medical counseling concerning mutations found in animal tests recommended.
Ethylene thiourea (Special Hazard Review) (October 1978)	None	Used in encapsulated form in industry; worker exposure to be minimized	Carcinogenesis and teratogenesis	Workers to be informed of carcinogenic and teratogenic hazards; special attention to be given to thyroid function tests
Fibrous glass (April 1977)	15 mg/m^3 total dust; 5 mg/m^3 respirable fraction (nuisance dust)	3 million fibers/m^3 TWA (fibers $\leq$ 3.5 μm diameter and $\geq$ 10 μm length); 5 mg/m^3 TWA (total fibrous glass)	Eye, skin, and respiratory effects	NIOSH recommends this limit also apply to other man-made fibers
Fluorides, inorganic (June 1975)	2.5 mg/m^3, 8-hr TWA	2.5 mg F/m^3 TWA	Kidney and bone effects	Urine monitoring required
Fluorocarbon polymers, decomposition products (September 1977)	None	None recommended	Lung effects, polymer fume fever	Workroom air to be monitored for inorganic fluorides and hydrogen fluoride

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†Date recommendation transmitted to OSHA.

Potential Hazard	OSHA Standard	NIOSH Recommended Exposure Limit*	Health Effect Considered	Comments
Formaldehyde (December 1976)†	3 ppm, 8-hr TWA; 5 ppm acceptable ceiling; 10 ppm maximum ceiling (30 min)	1.2 mg/m^3 ceiling (1 ppm) (30 min)	Irritation, lung effects	Hazardous liquid, skin
Furfuryl alcohol (March 1979)	50 ppm, 8-hr TWA	50 ppm (200 mg/m^3) TWA	Respiratory system effects	
Glycidyl ethers (June 1978)	All values in mg/m^3: allylglycidyl ether (AGE): 45, ceiling; n-butyl glycidyl ether (BGE): 270, 8-hr TWA; di-2,3-epoxypropyl ether (DGE): 2.8, 8-hr TWA; isopropyl glycidyl ether (IGE): 240, 8-hr TWA; phenyl glycidyl ether (PGE): 60, 8-hr TWA	All ceiling values (15 min) in mg/m^3: AGE: 45 BGE: 30 DGE: 1 IGE: 240 PGE: 5	Skin, mucous membrane effects, sensitization potential; tumorigenesis and mutagenesis	Possible additive effects with mixtures
Hot environments (June 1972)	None	Action levels: 79°F WBGT (men) 76°F WBGT (women); sliding-scale limits for unimpaired mental function	Heat illnesses	Factors recommended include acclimatization, strict work practices, and protective equipment
Hydrazines (June 1978)	All values in mg/m^3; hydrazine: 1.3, 8-hr TWA; 1,1-dimethyl-hydrazine: 1.0, 8-hr TWA; phenyl-hydrazine: 22, 8-hr TWA; methyl-hydrazine: 0.35, ceiling	All ceiling values (120 min) in mg/m^3: hydrazine: 0.4; 1,1-dimethyl-hydrazine: 0.15; phenyl-hydrazine: 0.6; methyl-hydrazine: 0.08	Liver, blood, eye, skin effects; cancer	Blood and urine monitoring and chest X-ray required, bowel examination for some workers
Hydrogen fluoride (March 1976)	3 ppm, 8-hr TWA	2.5 mg F/m^3 TWA (approx. 3 ppm); 5.0 mg F/m^3 ceiling (approx. 6 ppm) (15 min)	Skin, eye, respiratory irritation; bone effects	Pelvic X-ray (male) and urine testing required

Hydrogen sulfide (May 1977)	20 ppm acceptable ceiling; 50 ppm maximum ceiling (10 min)	15 mg/m^3 ceiling (approx. 10 ppm) (10 min)	Irritation; severe acute effects involving nervous and respiratory systems	Continuous monitoring required if potential exists for exposure to $\geqslant$ 70 mg/m^3; evacuation required at this level
Hydroquinone (April 1978)	2 mg/m^3, 8-hr TWA	2 mg/m^3 ceiling (15 min)	Eye and skin effects	Special provisions for darkroom use
Identification System for Occupationally Hazardous Materials (December 1974)	Not applicable	Complete designation system for occupationally hazardous materials		Includes definition, safety data sheets, alert symbols, and label statements
Isopropyl alcohol (March 1976)	400 ppm, 8-hr TWA	400 ppm TWA (984 mg/m^3); 800 ppm ceiling (1,968 mg/m^3) (15 min)	Mucous membrane irritation; possible cancer threat in manufacturing process	More stringent work practices and medical surveillance for manufacturing workers required
Kepone (January 1976)	None	1 μg/m^3 ceiling (15 min)	Nervous system effects; liver cancer	Liver function testing required
Ketones (June 1978)	All values, 8-hr TWA, in mg/m^3:	All values TWA in mg/m^3:	Irritation; liver, kidney and nervous system effects	Urinalysis required; workers exposed to methyl n-butyl ketone to be warned of nervous system effects.
	acetone: 2,400;	590		
	methyl ethyl ketone: 590;	590		
	methyl n-propyl ketone: 700;	530		
	methyl n-butyl ketone: 410;	4		
	methyl n-amyl ketone: 465;	465		
	methyl isobutyl ketone: 410;	200		
	methyl isoamyl ketone: none;	230		
	diisobutyl ketone: 290;	140		
	cyclohexanone: 200;	100		
	mesityl oxide: 100;	40		
	diacetone alcohol: 240;	240		
	isophorone: 140	23		

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Potential Hazard	OSHA Standard	NIOSH Recommended Exposure Limit*	Health Effect Considered	Comments
Lead, inorganic (January 1973; revised March 1977 as part of NIOSH testimony at OSHA hearing, March 1978)†	50 $\mu g/m^3$, 8-hr TWA; over 8-hr exposure to be determined by formula (Standard promulgated November 14, 1978)	< 100 $\mu g/m^3$	Kidney, blood, and nervous system effects	Air level to be maintained so that worker blood lead remains ≤ 0.060 mg/100 g; blood monitoring required.
Logging from felling to first haul (July 1976)	None	Extensive work-practice and personal-protection recommendations	Primarily trauma and falls	Immunization and first-aid programs to be instituted
Malathion (July 1976)	15 mg/m^3, 8-hr TWA	15 mg/m^3 TWA	Nervous system effects	Skin contact to be prevented; blood monitoring required
Mercury, inorganic (January 1973)	0.1 mg/m^3, ceiling	0.05 mg/m^3 TWA	Central nervous system and mental effects	Work practices, sanitation, monitoring, and medical surveillance emphasized
Methyl alcohol (March 1976)	200 ppm, 8-hr TWA	200 ppm TWA (262 mg/m^3); 800 ppm ceiling (1048 mg/m^3) (15 min)	Blindness; metabolic acidosis	
Methyl parathion (September 1976)	None	0.2 mg/m^3 TWA	Nervous system effects	Skin contact to be prevented; blood monitoring required
4,4'-Methylenebis (2-chloroaniline) (Special Hazard Review) (September 1978)	Original standard vacated by decision. Standard formally revoked by OSHA, August 1975. (41 CFR 35 184)	3 $\mu g/m^3$, 8-hr TWA (lowest detectable level); skin contact to be avoided	Cancer	Chest X-ray, blood and urine testing required

Methylene chloride (March 1976)	500 ppm, 8-hr TWA; 1,000 ppm acceptable ceiling; 2,000 ppm maximum ceiling (5 min in 2 hr)	75 ppm TWA (261 mg/m^3); 500 ppm ceiling (1,740 mg/m^3) (15 min) to be lowered in presence of carbon monoxide	Central nervous system effects; carbon monoxide toxicity	Blood monitoring required
Nickel carbonyl (Special Hazard Review) (May 1977)	7 μg/m^3 (1 ppb), 8-hr TWA	7 μg/m^3 (1 ppb) TWA (least detectable level)	Cancer	Chest X-ray, pulmonary function testing, and urine monitoring recommended
Nickel, inorganic and compounds (May 1977)	1 mg/m^3, 8-hr TWA	15 μg Ni/m^3 TWA	Skin effects; lung and nasal cancer	Chest X-ray and pulmonary function testing required
Nitric acid (March 1976)	2 ppm, 8-hr TWA	2 ppm TWA (5 mg/m^3)	Dental erosion, nasal/lung irritation	Hazardous liquid, eyes and skin; chest X-ray required
Nitriles (September 1978)	Acetonitrile: 70 mg/m^3 (40 ppm), 8-hr TWA; tetramethyl-succinonitrile: 3 mg/m^3 (0.5 ppm), 8-hr TWA (skin)	All values TWA in mg/m^3 (ppm): acetonitrile: 34 (20); n-butyronitrile: 22 (8); isobutyronitrile: 22 (8); propionitrile: 14 (6); malononitrile: 8 (3); adiponitrile: 18 (4); succinonitrile: 20 (6). All ceiling values (15 min) in mg/m^3 (ppm): acetone cyanohydrin: 4 (1); glycolonitrile: 5 (2); tetramethyl succinonitrile: 6 (1). When present as mixtures or with other sources of cyanide, exposure to be considered additive and environmental limit to be calculated	Hepatic, renal, respiratory, cardiovascular, gastrointestinal, and nervous system effects	Chest X-ray and pulmonary function testing required. Trained personnel and first-aid kits to be available during use, hazardous substances, skin and eyes
Nitrogen, oxides (March 1976)	NO_2: 5 ppm, 8-hr TWA NO: 25 ppm, 8-hr TWA	NO_2: 1 ppm (1.8 mg/m^3) ceiling (15 min) NO: 25 ppm TWA (30 mg/m^3)	Respiratory effects Blood effects	Pulmonary function testing required

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Potential Hazard	OSHA Standard	NIOSH Recommended Exposure Limit*	Health Effect Considered	Comments
Nitroglycerin: ethylene glycol dinitrate (EGDN) (June 1978)†	Nitroglycerin: 2 mg/m^3 (skin) 8-hr TWA; EGDN: 1 mg/m^3 (skin) ceiling	0.1 mg/m^3 ceiling (20 min)	Circulatory system effects	Skin contact to be prevented; recommended limit for either substance alone or mixtures
Noise (August 1972)	90 dBA, 8-hr TWA	85 dBA TWA; 115 dBA ceiling	Hearing damage	
Organotin compounds (November 1976)	0.1 mg tin/m^3, 8-hr TWA	0.1 mg tin/m^3 TWA	Eye, skin, liver, nervous system, heart effects	Chest X-ray, blood and urine monitoring, eye tests, heart examination, and nervous system testing required; hazardous liquid, skin and eyes
Parathion (June 1976)	0.1 mg/m^3, 8-hr TWA (skin)	0.05 mg/m^3 TWA	Nervous system effects	Skin contact to be prevented; blood monitoring required
Pesticide manufacturing and formulation (July 1978)	Current OSHA or previously recommended NIOSH levels to be followed; stringent work-practice and medical-surveillance requirements to be instituted; pesticides considered in three groups based on toxicity; skin contact to be prevented		Wide range of toxicities considered; nervous and reproductive system effects; cancer	Blood monitoring required for some groups; workers to be warned of possible reproductive system effects by some compounds
Phenol (June 1976)	5 ppm, 8-hr TWA (skin)	20 mg/m^3 TWA (5.2 ppm); 60 mg/m^3 ceiling (15.6 ppm) (15 min)	Skin, eye, CNS, liver, and kidney effects	Hazardous substance,skin and eyes
Phosgene (February 1976)	0.1 ppm, 8-hr TWA	0.1 ppm TWA (0.4 mg/m^3); 0.2 ppm ceiling (0.8 mg/m^3) (15 min)	Respiratory effects	Pulmonary function testing and X-ray required
Polychlorinated biphenyls (September 1977)	42% chlorine: 1 mg/m^3, 8-hr TWA; 54% chlorine: 0.5 mg/m^3, 8-hr TWA	1 μg/m^3 TWA	Cancer; skin, liver, and reproductive effects	Blood testing required; women workers of child-bearing age and nursing mothers to be warned of potential adverse effects.

Refined petroleum solvent (July 1977)	500 ppm, 8-hr TWA (2,950 mg/m^3) (Stoddard solvents)	All solvents except kerosene: 350 mg/m^3 TWA; 1,800 mg/m^3 ceiling (15 min) kerosene: 100 mg/m^3 TWA	Skin, lung, and nerve irritation	Blood and urine monitoring required; action level for petroleum ether, rubber solvent, naptha: 200 mg/m^3 TWA; action level for mineral spirits and Stoddard solvent: 350 mg/m^3 TWA; action level for kerosene: 100 mg/m^3 TWA; hazardous substance, skin
Rendering processes (Occupational Hazard Assessment) (March 1981)	Existing OSHA permissible exposure limits or NIOSH recommendations for specific hazards are applicable		Mechanical injury, burns, heat stress, infections from biological agents, chemical hazards	Guidelines for engineering controls and work practices to reduce injury and illness presented
Silica, crystalline (November 1974)	250/%SiO+5 in mppcf, or 10 mg/m^3/%SiO+2 (respirable quartz)	50 μg/m^3 TWA, respirable free silica	Chronic lung disease (Silicosis)	X-ray, pulmonary function testing required
Sodium hydroxide (September 1975)	2 mg/m^3, 8-hr TWA	2 mg/m^3 ceiling (15 min)	Respiratory irritation	Hazardous liquid, eyes and skin
Sulfur dioxide (February 1974; revised May 1977 as part of NIOSH testimony at OSHA hearing)	5 ppm, 8-hr TWA	0.5 ppm TWA(1.3 mg/m^3)	Respiratory effects	Pulmonary function testing required
Sulfuric acid (June 1974)	1 mg/m^3, 8-hr TWA	1 mg/m^3 TWA	Pulmonary irritation	Hazardous liquid, eye and skin

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Potential Hazard	OSHA Standard	NIOSH Recommended Exposure Limit*	Health Effect Considered	Comments
1,1,2,2-Tetrachloroethane (December 1976) †	5 ppm, 8-hr TWA (skin)	1 ppm TWA (6.87 mg/m^3)	Liver, gastrointestinal, and nervous system effects	Skin contact to be prevented; blood monitoring required
Tetrachloroethylene (July 1976)	100 ppm, 8-hr TWA; 200 ppm acceptable maximum ceiling; 300 ppm maximum ceiling (5 min in 3 hr)	50 ppm TWA (339 mg/m^3); 100 ppm ceiling (678 mg/m^3) (15 min, twice daily)	Nervous system, heart, respiratory, liver effects	Medical warning of possible congenital abnormalities required
Thiols: n-alkane mono, cyclohexane, and benzene (September 1978)	Butylmercaptan: 10 ppm, 8-hr TWA; methyl and ethyl mercaptan: 10 ppm ceiling	All values in mg/m^3 (ppm): Ceilings 15 min: benzenethiol: 0.5 (0.1); 1-methanethiol: 1.0 (0.5); 1-ethanethiol: 1.3 (0.5); 1-propanethiol: 1.6 (0.5); 1-butanethiol: 1.8 (0.5); 1-pentanethiol: 2.1 (0.5); 1-hexanethiol: 2.4 (0.5); 1-heptanethiol: 2.7 (0.5); 1-octanethiol: 3.0 (0.5); 1-nonanethiol: 3.3 (0.5); 1-decanethiol: 3.6 (0.5); 1-undecanethiol: 3.9 (0.5); 1-dodecanethiol: 4.1 (0.5); 1-hexadecanethiol: 5.3 (0.5); 1-octadecanethiol: 5.9 (0.5); cyclohexanethiol: 2.4 (0.5); mixtures of thiols to be controlled by calculation of equivalent concentrations	Irritation, eye, skin, blood, and nervous system effects	Blood and urine monitoring required; hazardous substance, skin
o-Tolidine (August 1978)	None	20 μg/m^3 ceiling; (60 min); skin contact to be prevented	Nasal irritation; cancer	Urine testing required; quarterly urine monitoring recommended
Toluene (July 1973)	200 ppm, 8-hr TWA; 300 ppm acceptable ceiling; 500 ppm maximum ceiling (10 min)	100 ppm TWA (375 mg/m^3); 200 ppm ceiling (750 mg/m^3) (10 min)	Central nervous system depressant	

Toluene diisocyanate (July 1973; revised—See Diisocyanates—September 1978)	0.02 ppm ceiling	0.005 ppm TWA (0.036 mg/m^3); 0.02 ppm ceiling (0.14 mg/m^3) (20 min)	Respiratory effects	Chest X-rays, blood tests, pulmonary function testing required.
1,1,1,-Trichloroethane (July 1976)	350 ppm, 8-hr TWA	350 ppm ceiling (1,910 mg/m^3) (15 min)	Nervous system, liver, and heart effects	Action level set at 200 ppm TWA; workers to be warned of possible congenital abnormalities
Trichloroethylene (July 1973; Special Hazard Review February 1978)	100 ppm, 8-hr TWA; 200 ppm acceptable ceiling; 300 ppm maximum ceiling (5 min in 2 hr)	100 ppm, 8-hr TWA; 150 ppm ceiling (10 min)	Central nervous system depressant; cancer	Workers to be warned of hazards; engineering feasibility indicates 25 ppm attainable*
Tungsten and cemented tungsten carbide (September 1977)	None	Insoluble tungsten: 5 mg/m^3 TWA; soluble tungsten: 1 mg/m^3 TWA; dust of cemented tungsten carbide containing > 2% cobalt: 0.1 mg cobalt/m^3 TWA; dust of cemented tungsten carbide containing > 0.3% nickel: 15 μg nickel/m^3 TWA	Lung and skin effects	Pulmonary function testing and chest X-ray required
Ultraviolet radiation (December 1972)	None	1.0 mW/cm^2 for periods > 1,000 sec; for exposure times ≤ 1,000 sec total radiant energy shall not exceed 1,000 mWsec/cm^2 (1.0 J/cm^2)	Skin and eye effects	
Vanadium (August 1977)	Vanadium pentoxide (dust): 0.5 mg/m^3 ceiling; (fume): 0.1 mg/m^3 ceiling ferrovanadium: 1 mg/m^3, 8-hr TWA	Vanadium compounds: 0.05 mg/m^3 ceiling (15 min); metallic vanadium and vanadium carbide: 1 mg/m^3 TWA	Eye, skin, and lung effects	Pulmonary function testing and chest X-ray required

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Potential Hazard	OSHA Standard	NIOSH Recommended Exposure Limit*	Health Effect Considered	Comments
Vinyl acetate (September 1978) †	None	15 mg/m^3 (4 ppm) ceiling (15 min)	Irritation	
Vinyl chloride (March 1974)	1 ppm, 8-hr TWA, 5 ppm ceiling (15 min) (Standard promulgated October 4, 1974)	Minimum detectable level; air-supplied respirator to be worn	Liver cancer	Liver function testing required
Vinyl halides (September 1978)	1 ppm, 8-hr TWA; 5 ppm ceiling (15 min)	As promulgated for vinyl chloride in 29 CFR 1910.1017 with eventual goal of zero exposure	Cancer	Document includes vinyl chloride, vinylidene chloride, vinyl bromide, vinyl fluoride, and vinylidene fluoride monomers (document has not been printed)
Xylene (May 1975)	100 ppm, 8-hr TWA	100 ppm TWA (434 mg/m^3); 200 ppm ceiling (868 mg/m^3) (10 min)	Central nervous system depressant; respiratory irritation	
Zinc oxide (October 1975)	5 mg/m^3, 8-hr TWA	5 mg/m^3 TWA, 15 mg/m^3 ceiling (15 min)	Metal fume fever	

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*U.S. GOVERNMENT PRINTING OFFICE: 1984 - 750-260/5191

UNITED STATES GOVERNMENT PRINTING OFFICE
SUPERINTENDENT OF DOCUMENTS
Washington, D.C. 20402

OFFICIAL BUSINESS
Penalty for Private Use, $300

Postage and Fees Paid
U.S. Government Printing Office
375

THIRD CLASS
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HHS Publication No. (CDC) 83-8017