

X. APPENDIX III - MATERIAL SAFETY DATA SHEET

General instructions for preparing a Material Safety Data Sheet (MSDS) are presented in this chapter. The examples used in the text are for illustrative purposes and are not intended to apply to any specific compound or product. Applicable information about a specific product or material shall be supplied in the appropriate block of the MSDS.

The product designation is inserted in the block in the upper left corner of the first page to facilitate filing and retrieval. Print in upper case letters as large as possible. It should be printed to read upright with the sheet turned sideways. The product designation is that name or code designation which appears on the label, or by which the product is sold or known by employees. The relative numerical hazard ratings and key statements are those determined by the guidelines in Chapter V, Part B, of the NIOSH publication, "An Identification System for Occupationally Hazardous Materials." The company identification may be printed in the upper right corner if desired.

(a) Section I. Product Identification

The manufacturer's name, address, and regular and emergency telephone numbers (including area code) are inserted in the appropriate blocks of Section I. The company listed should be a source of detailed backup information on the hazards of the material(s) covered by the MSDS. The listing of suppliers or wholesale distributors is discouraged. The trade name should be the product designation or common name associated with the material. The synonyms are those commonly used for the product, especially formal chemical nomenclature. Every known chemical designation or competitor's trade name need not be listed.

(b) Section II. Hazardous Ingredients

The "materials" listed in Section II shall be those substances which are part of the hazardous product covered by the MSDS and individually meet any of the criteria defining a hazardous material. Thus, one component of a multicomponent product might be listed because of its toxicity, another component because of its flammability, while a third component could be included both for its toxicity and its reactivity. Note that a MSDS for a single component product must have the name of the material repeated in this section to avoid giving the impression that there are no hazardous ingredients.

Chemical substances should be listed according to their complete name derived from a recognized system of nomenclature. Where possible, avoid using common names and general class names such as "aromatic amine," "safety solvent," or "aliphatic hydrocarbon" when the specific name is known.

The "%" may be the approximate percentage by weight or volume (indicate basis) which each hazardous ingredient of the mixture bears to the whole mixture. This may be indicated as a range or maximum amount, ie, "10-40% vol" or "10% max wt" to avoid disclosure of trade secrets.

Toxic hazard data shall be stated in terms of concentration, mode of exposure or test, and animal used, ie, "100 ppm LC50 rat," "25 mg/kg LD50-skin-rabbit," "75 ppm LC man," or "permissible exposure from 29 CFR 1910.1000," or, if not available, from other sources of publications such as the American Conference of Governmental Industrial Hygienists or the American National Standards Institute, Inc. Flammable or reactive data could be flash point, shock sensitivity, or other brief data indicating nature of the hazard.

(c) Section III. Physical Data

The data in Section III should be for the total mixture and should include the boiling point and melting point in degrees Fahrenheit (Celsius in parentheses); vapor pressure, in conventional millimeters of mercury (mmHg); vapor density of gas or vapor (air = 1); solubility in water, in parts/hundred parts of water by weight; specific gravity (water = 1); percent volatiles (indicated if by weight or volume) at 70 degrees Fahrenheit (21.1 degrees Celsius); evaporation rate for liquids or sublimable solids, relative to butyl acetate; and appearance and odor. These data are useful for the control of toxic substances. Boiling point, vapor density, percent volatiles, vapor pressure, and evaporation are useful for designing proper ventilation equipment. This information is also useful for design and deployment of adequate fire and spill containment equipment. The appearance and odor may facilitate identification of substances stored in improperly marked containers, or when spilled.

(d) Section IV. Fire and Explosion Data

Section IV should contain complete fire and explosion data for the product, including flash point and autoignition temperature in degrees Fahrenheit (Celsius in parentheses); flammable limits, in percent by volume in air; suitable extinguishing media or materials; special firefighting procedures; and unusual fire and explosion hazard information. If the product presents no fire hazard, insert "NO FIRE HAZARD" on the line labeled "Extinguishing Media."

(e) Section V. Health Hazard Information

The "Health Hazard Data" should be a combined estimate of the hazard of the total product. This can be expressed as a time-weighted average (TWA) concentration, as a permissible exposure, or by some other indication of an acceptable limit. Other data are acceptable, such as lowest LD50 if multiple components are involved.

Under "Routes of Exposure," comments in each category should reflect the potential hazard from absorption by the route in question. Comments should indicate the severity of the effect and the basis for the statement if possible. The basis might be animal studies, analogy with similar products, or human experiences. Comments such as "yes" or "possible" are not helpful. Typical comments might be:

Skin Contact--single short contact, no adverse effects likely; prolonged or repeated contact, irritation, and cracking. Readily absorbed through the skin with severe systemic effects.

Eye Contact--some pain and mild transient irritation; no corneal scarring.

"Emergency and First Aid Procedures" should be written in lay language and should primarily represent first aid treatment that could be provided by paramedical personnel or individuals trained in first aid.

Information in the "Notes to Physician" section should include any special medical information which would be of assistance to an attending physician including required or recommended preplacement and periodic medical examinations, diagnostic procedures, and medical management of overexposed workers.

(f) Section VI. Reactivity Data

The comments in Section VI relate to safe storage and handling of hazardous, unstable substances. It is particularly important to highlight instability or incompatibility to common substances or circumstances such as water, direct sunlight, steel or copper piping, acids, alkalies, etc. "Hazardous Decomposition Products" shall include those products released under fire conditions. It must also include dangerous products produced by aging, such as peroxides in the case of some ethers. Where applicable, shelf life should also be indicated.

(g) Section VII. Spill or Leak Procedures

Detailed procedures for cleanup and disposal should be listed with emphasis on precautions to be taken to protect workers assigned to cleanup detail. Specific neutralizing chemicals or procedures should be described in detail. Disposal methods should be explicit including proper labeling of containers holding residues and ultimate disposal methods such as "sanitary landfill," or "incineration." Warnings such as "comply with local, state, and federal anti-pollution ordinances" are proper but not sufficient. Specific procedures should be identified.

(h) Section VIII. Special Protection Information

Section VIII requires specific information. Statements such as "Yes," "No," or "If Necessary" are not informative. Ventilation requirements should be specific as to type and preferred methods. Specify respirators as to type and NIOSH or US Bureau of Mines approval class, ie, "Supplied air," "Organic vapor canister," "Suitable for dusts not more toxic than lead," etc. Protective equipment must be specified as to type and materials of construction.

(i) Section IX. Special Precautions

"Precautionary Statements" shall consist of the label statements selected for use on the container or placard. Additional information on any aspect of safety or health not covered in other sections should be inserted in Section IX. The lower block can contain references to published guides or in-house procedures for handling and storage. Department of Transportation markings and classifications and other freight, handling, or storage requirements and environmental controls can be noted.

(j) Signature and Filing

Finally, the name and address of the responsible person who completed the MSDS and the date of completion are entered. This will facilitate correction of errors and identify a source of additional information.

The MSDS shall be filed in a location readily accessible to workers potentially exposed to the hazardous material. The MSDS can be used as a training aid and basis for discussion during safety meetings and training of new employees. It should assist management by directing attention to the need for specific control engineering, work practices, and protective measures to ensure safe handling and use of the material. It will aid the safety and health staff in planning a safe and healthful work environment and suggesting appropriate emergency procedures and sources of help in the event of harmful exposure of employees.

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MATERIAL SAFETY DATA SHEET

I PRODUCT IDENTIFICATION		
MANUFACTURER'S NAME	REGULAR TELEPHONE NO. EMERGENCY TELEPHONE NO.	
ADDRESS		
TRADE NAME		
SYNONYMS		
II HAZARDOUS INGREDIENTS		
MATERIAL OR COMPONENT	%	HAZARD DATA
III PHYSICAL DATA		
BOILING POINT, 760 MM HG		MELTING POINT
SPECIFIC GRAVITY (H ₂ O=1)		VAPOR PRESSURE
VAPOR DENSITY (AIR=1)		SOLUBILITY IN H ₂ O, % BY WT.
% VOLATILES BY VOL.		EVAPORATION RATE (BUTYL ACETATE=1)
APPEARANCE AND ODOR		

IV FIRE AND EXPLOSION DATA

FLASH POINT (TEST METHOD)		AUTOIGNITION TEMPERATURE	
FLAMMABLE LIMITS IN AIR, % BY VOL.	LOWER		UPPER
EXTINGUISHING MEDIA			
SPECIAL FIRE FIGHTING PROCEDURES			
UNUSUAL FIRE AND EXPLOSION HAZARD			

V HEALTH HAZARD INFORMATION

HEALTH HAZARD DATA
ROUTES OF EXPOSURE
INHALATION
SKIN CONTACT
SKIN ABSORPTION
EYE CONTACT
INGESTION
EFFECTS OF OVEREXPOSURE
ACUTE OVEREXPOSURE
CHRONIC OVEREXPOSURE
EMERGENCY AND FIRST AID PROCEDURES
EYES:
SKIN:
INHALATION:
INGESTION:
NOTES TO PHYSICIAN

VI REACTIVITY DATA

CONDITIONS CONTRIBUTING TO INSTABILITY

INCOMPATIBILITY

HAZARDOUS DECOMPOSITION PRODUCTS

CONDITIONS CONTRIBUTING TO HAZARDOUS POLYMERIZATION

VII SPILL OR LEAK PROCEDURES

STEPS TO BE TAKEN IF MATERIAL IS RELEASED OR SPILLED

NEUTRALIZING CHEMICALS

WASTE DISPOSAL METHOD

VIII SPECIAL PROTECTION INFORMATION

VENTILATION REQUIREMENTS

SPECIFIC PERSONAL PROTECTIVE EQUIPMENT

RESPIRATORY (SPECIFY IN DETAIL)

EYE

GLOVES

OTHER CLOTHING AND EQUIPMENT

IX SPECIAL PRECAUTIONS

PRECAUTIONARY
STATEMENTS

OTHER HANDLING AND
STORAGE REQUIREMENTS

PREPARED BY: _____

ADDRESS: _____

DATE: _____

XI. TABLES

TABLE XI-1

PHYSICAL PROPERTIES OF CARBON TETRACHLORIDE

Chemical Abstract's serial number	000056235
Synonyms	Tetrachloromethane Perchloromethane Benzinoform Necatorine
Molecular formula	CCl ₄
Formula weight	153.84
Boiling point	76.75 C, 170.15 F (760 mm Hg)
Melting point	-23 C, -9.4 F
Vapor pressure	89.5 mm Hg (20 C) 760.0 mm (76.7 C)
Specific gravity	1.5845 (25 C), (water = 1.000 at 4 C)
Solubility	0.08 g/100 ml water at 25 C; miscible with alcohol, diethyl ether and benzene
Explosive limit	None
Flash point	None
Vapor density	5.32 (air = 1)
Conversion factors (25 C; 760 mm Hg)	1 mg/liter = 159 ppm 1 mg/cu m = 0.159 ppm 1 ppm = 6.29 mg/cu m 1 ppm = 6.29 µg/liter

Adapted from references 1,2

TABLE XI-2
 CARBON TETRACHLORIDE IN EXHALED BREATH FOLLOWING INGESTION

Collection Period after Dose (hours)	CCl ₄ Recovered mg		Concentration CCl ₄ Estimated µg/liter	
	Exp. 1	Exp. 2	Exp. 1	Exp. 2
0.15 - 0.40		135.8		1,810
0.43 - 0.68		170.8		2,372
0.72 - 0.97		111.5		1,328
1.0 - 1.5		199.5		1,177
1.55 - 2.55		313.0		932
2.6 - 3.6		233.0		754
2.9 - 4.9	701.5		895	
4.5 - 6.5		326.5		406
7.3 - 9.3	121.5	241.0	155	291
11.25 - 13.25		66.9		89
12.5 - 14.5	37.9		48	17
23.9 - 25.9		13.1		
26.9 - 28.9	32.8		38	
31.5 - 33.5	9.0		12	
36.5 - 38.5	8.9		11	

Adapted from Wells [18]

TABLE XI-3

CARBON TETRACHLORIDE CONCENTRATIONS IN DRYCLEANING PLANTS
USING CLOSED MACHINES

Plant	Observation Time (min)	Operation	CCl ₄ Vapor, ppm	
			Average	Maximum
1	120	Usual	20	65
2	23	Usual	71	151
2	3	Spraying	11	43
18	67	Usual	38	540
19	64	Usual	29	980
20	112	Usual	47	1,250
20	52	Cleaning machines	338	7,100
21	81	Usual	29	85
22	96	Usual	10	173
22	50	Cleaning machine	206	1,252
23	106	Usual	24	108
24	63	Usual	50	172

Adapted from Smyth and Smyth [57]

TABLE XI-4

CARBON TETRACHLORIDE CONCENTRATIONS IN TEN PLANTS MANUFACTURING
OR USING CARBON TETRACHLORIDE

Area or Process Sampled	Plant No.	Sampling time Minutes	Carbon Tetrachloride, ppm	
			Ave.	Max.
General Room Air	25	10	15	32
	27	58	22	195
	27	5	54	65
	28	27	10	22
	29	19	0	0
	30	23	26	170
Closed System	25	45	62	800
	26	32	59	194
	26	26	84	303
Half-closed System	25	44	58	130
	25	55	70	389
	25	12	508	2,050
	26	53	60	238
	26	13	152	216
	27	5	23	65
	27	8	51	85
	27	195	96	345
	27	54	158	1,680
	27	23	21	43
	28	57	63	282
	29	36	85	240
	29	93	155	324
	30	5	69	174
	31	60	650	1,060
	33	90	31	173
33	76	92	396	
34	14	14	66	
36	36	98	232	
Cleaning tanks, etc.	25	55	286	7,860
	26	47	138	450
	27	22	72	151
	30	14	216	1,042
	30	8	300	392
Spraying, etc.	25	45	41	300
	30	13	191	494
	33	41	20	66
	33	37	110	176
	34	20	62	108
	34	41	82	414

Derived from references 56, 57

TABLE XI-5

WORKERS WITH SLIGHTLY RESTRICTED VISUAL FIELDS (+), DEFINITELY
RESTRICTED VISUAL FIELDS (++), AND ELEVATED ICTERIC INDICES

Plant	Type of Job	CCl 4, ppm		No. of Workers Studied	No. of Workers with:		
		Ave.	Max.		Restricted Visual Fields + ++	Elevated Icteric Index	
25	CCl 4 manufacture	15	32	4	1		
	Filling containers	35	389	3	2		
	Supervision, sales	5	389	1	1		
	Cleaning drums	57	1,252	1			
26	CCl 4 manufacture	39	450	9	1		3
	Filling containers	75	238	4			
	Supervision, sales	10	450	1			
27	CCl 4 manufacture	26	195	6	4		1
	Filling containers	97	1,680	1			
	Cleaning drums	26	450	2			
	Supervision, sales	12	151	1			
28	CCl 4 manufacture	10	22	3	1	1	
	Supervision, sales	5	282	1			
29	CCl 4 manufacture	30	240	4	2		3
	Filling containers	117	324	5	1	2	
	Supervision, sales	30	324	1	1		
30	CCl 4 manufacture	54	1,042	7	1	2	1
	Supervision, sales	26	494	1			1
	Demonstration	50	1,042	1			
33	Filling extinguishers	54	396	3		1	1
	Supervision, sales	27	396	3	2		1
	Extinguisher testing	37	110	3	2		2
	Demonstration	27	396	1			
	CCl 4 analysis	54	396	1			
	Extinguisher inspection	54	396	1			
34	Filling extinguishers	7	66	1		1	
	Supervision, sales	5	108	1	1		
	Extinguisher testing	16	414	2	2		
	Grease removal	8	108	1	1		
22	Drycleaning	10	173	2		1	
36	Filling containers	24	232	2		1	

Adapted from Smyth and Smyth [57]

TABLE XI-6

COMPARISON OF BIOCHEMICAL VARIABLES IN 51 WORKERS EXPOSED TO
CARBON TETRACHLORIDE AND 27 UNEXPOSED WORKERS

Biochemical Variable	Units	Exposed Group	Unexposed Group	Probability %
Erythrocyte sedimentation	mm/hr (range)	6-14	8-17	
Conjugated bilirubin	mg/100ml	0.09	0.05	
Unconjugated bilirubin	mg/100ml	0.60	0.42	0.05
Total bilirubin	mg/100ml	0.69	0.47	0.01
Takata-Ara	mg/100ml	92.5	89.6	0.005
Glutamic-oxaloacetic transaminase	IU	9.3	8.1	
Glutamic-pyruvic transaminase	IU	6.6	4.4	
Lactic dehydrogenase	mI/ml (sic)	130.7	116.8	
Cholesterol	mg/100ml	195.2	211.7	
Serum iron	μ g/100ml	138.9	110.6	0.001
Alkaline phosphatase	MME (sic)	1.92	1.92	
Leucineaminodipeptidase	mU/ml (sic)	1.85	1.73	
Sorbitol dehydrogenase	mU/ml (sic)	1.14	1.45	
Glutamic dehydrogenase	mU/ml (sic)	1.27	0.50	0.001

Adapted from Rabes [61]

TABLE XI-7

SERUM ORNITHINE CARBAMOYL TRANSAMINASE
 LEVELS IN RATS (UNITS/100 ml) AFTER
 A DOSE OF 0.125 ml CARBON TETRACHLORIDE

Hours after Injury	No. of Animals	Range (units x 100)	Average (units x 100)
Control	13	8-25	19
4	6	15-31	23
8	6	31-43	38
12	9	19-43	28
16	7	28-55	43
20	7	55-66	59
24	7	43-88	64
48	7	60-120	78
72	6	19-59	38
96	8	20-59	39
120	6	18-31	25
23 days	2	15-25	20

Adapted from Musser and Spooner [64]

TABLE XI-8

DISTRIBUTION OF DEATHS OF TWO SETS OF GUINEA PIGS EXPOSED TO
CARBON TETRACHLORIDE

Exposure Concentra- tion, ppm	Diet	Cause of Death					
		Killed No.	Age days	Unexplained No.	Age days	Infection No.	Age days
0	Normal	8	(60-130)	0		11	(73-232)
50	Normal	7	(82-205)	9	(57-243)	8	(59-205)
100	Normal	0		16	(51-84)	7	(59-76)
200	Normal	0		13	(51-79)	9	(51-88)
400	Normal	0		19	(50-94)	5	(52-58)
0	Calcium	7	(92-221)	0		0	
25	Calcium	3	(118-199)	5	(133-185)	7	(146-192)
50	Calcium	7	(79-200)	4	(130-169)	5	(118-224)
100	Calcium	5	(79-225)	8	(71-162)	3	(79-102)
200	Calcium	4	(79-200)	7	(79-163)	4	(90-151)

Adapted from Smyth and Smyth [57]

TABLE X1-9

EXPOSURE OF MONKEYS TO CARBON TETRACHLORIDE AT DIFFERENT CONCENTRATIONS

Monkey and Sex	Exposure Concentration ppm	Number of Exposures	Duration of the Experiment days	Interval, Final Exposure to Examination days
506 (F)	50	62	93	0
506 (F)	50	188	275	1
507 (M)	50	225	321	4
508 (M)	50	225	321	28
509 (F)	200	62	93	0
510 (F)	200	186	275	1
512 (M)	200	223	321	23

Adapted from Smyth and Smyth [57]

TABLE XI-10

CARBON TETRACHLORIDE INHALATION EXPOSURES AND EFFECTS

Author	Exposure Variables	Exposure Time	Effects
Prendergast et al [68]	Monkeys, rats, guinea pigs, rabbits, 1 ppm	Continuous 90 days	No pathological findings
Adams et al [69]	Guinea pigs, 5ppm	7 hrs/day, 5 days/wk, 184 days	Increased liver weights
Rabes [61]	Humans, 6.3-9.5 ppm occupational	2-3 times/yr, 14 days each time, 5 years	23% increase in serum iron, 92% increase in GDH
Moeller [58]	Humans, 6.4-9.5 ppm occupational	1 hr/day to 1 hr/week	Reduced corneal sensitivity, restricted visual fields
Smyth and Smyth [57]	Humans, 5-117 ppm occupational	8-hr TWA	Restricted visual fields
Prendergast et al [68]	Monkeys, rats, guinea pigs, rabbits, 10 ppm	Continuous 90 days	Enlarged livers, fatty infiltration
Dellian and Wittgens [37]	Humans, 10-100 ppm occupational	Intermittent	CNS and gastrointestinal effects, fatty degeneration of the liver
Adams et al [69]	Rats, 10 ppm	7 hrs/day 5 days/wk, 184 days	Increased liver weights
	Rabbits, 25 ppm	7 hrs/day, 178 days	Fatty degeneration of the liver, cirrhosis
Smyth and Smyth [57]	Guinea pigs, 25 ppm	8 hrs/day	High mortality
	Rats, 50 ppm	8 hrs/day, 189 days	Cirrhosis of the liver, microscopic nerve changes

TABLE XI-10 (CONTINUED)

CARBON TETRACHLORIDE INHALATION EXPOSURES AND EFFECTS

Author	Exposure Variables	Exposure Time	Effects
Smyth and Smyth [57]	Monkeys, 50 ppm	8 hrs/day, 62 days	Fatty infiltration of the liver
	Humans, 26-54 ppm occupational	8-hr TWA	Elevated icteric indices
Stewart et al [26]	Humans, 49 ppm experimental	70 min	Reduced serum iron
Elkins [54]	Humans, 10-80 ppm occupational	Several days	Nausea, vomiting, lassitude
	Humans, 85 ppm (40-375 ppm) occupational	Once every 2-3 weeks	Nausea, anorexia, weight loss
Heimann and Ford [21]	Humans, 79 ppm (33-124 ppm) occupational	Few hours daily	Fatigue, nausea, vomiting
Prendergast et al [68]	Rats, monkeys, guinea pigs, rabbits, 82 ppm	8 hrs/day 5 days/week 30 weeks	Interstitial inflammation of lungs
Kazantzis and Bomford [59]	Humans, 45-97 ppm occupational	Daily	CNS and gastrointestinal symptoms
Smyth and Smyth [57]	Rats, 200 ppm	8 hrs/day	Reduced fertility indices
Schwetz et al [84]	Rats, 300 ppm	7 hrs/day, 10 days	Decreased fetal weights and crown to rump lengths, subcutaneous edema, reduced maternal body weights
Lehmann and Schmidt-Kehl [24]	Humans, 600 ppm	10 min	Vertigo, headache
	Humans, 600 ppm	30 min	Dizziness
	Humans, 14,000 ppm	50 sec	Unconsciousness

**U.S. DEPARTMENT OF HEALTH,
EDUCATION, AND WELFARE**

Public Health Service
Center for Disease Control
National Institute for Occupational
Safety and Health

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