

IX. APPENDIX II
MATERIAL SAFETY DATA SHEET

The following items of information which are applicable to chloroform shall be provided in the appropriate section of the Material Safety Data Sheet or approved form. If a specific item of information is inapplicable, the initials "na" (not applicable) should be inserted.

(a) Section I. Source and Nomenclature.

(1) The name, address, and telephone number of the manufacturer or supplier of the product.

(2) The trade name and synonyms for a mixture of chemicals, a basic structural material, or for a process material; and the trade name and synonyms, chemical name and synonyms, chemical family, and formula for a single chemical.

(b) Section II. Hazardous Ingredients.

(1) Chemical or widely recognized common name of all hazardous ingredients.

(2) The approximate percentage by weight or volume (indicate basis) which each hazardous ingredient or the mixture bears to the whole mixture. This may be indicated as a range or maximum amount, ie, 10-20% by volume; 10% maximum by weight.

(3) Basis for toxicity for each hazardous material such as an established standard in appropriate units.

(c) Section III. Physical Data.

Physical properties of the total product including boiling point and melting point in degrees Fahrenheit; vapor pressure in millimeters of

mercury; vapor density of gas or vapor (air=1); solubility in water, in parts per hundred parts of water by weight; specific gravity (water=1); percentage volatile, indicate if by weight or volume, at 70 degrees Fahrenheit; evaporation rate for liquids (indicate whether butyl acetate or ether=1); and appearance and odor.

(d) Section IV. Fire and Explosion Hazard Data.

Fire and explosion hazard data about a single chemical or a mixture of chemicals, including flash point, in degrees Fahrenheit; flammable limits in percentage by volume in air; suitable extinguishing media or agents; special fire fighting procedures; and unusual fire and explosion hazard information.

(e) Section V. Health Hazard Data.

Toxic level for total compound or mixture, effects of exposure, and emergency and first-aid procedures.

(f) Section VI. Reactivity Data.

Chemical stability, incompatibility, hazardous decomposition products, and hazardous polymerization.

(g) Section VII. Spill or Leak Procedures.

Detailed procedures to be followed with emphasis on precautions to be taken in cleaning up and safe disposal of materials leaked or spilled. This includes proper labeling and disposal of containers holding residues, contaminated absorbents, etc.

(h) Section VIII. Special Protection Information.

Requirements for personal protective equipment, such as respirators, eye protection, clothing, and ventilation, such as local exhaust (at site of product use or application), general, or other special types.

(i) Section IX. Special Precautions.

Any other general precautionary information.

MATERIAL SAFETY DATA SHEET

Required under USDL Safety and Health Regulations for Ship Repairing,
Shipbuilding, and Shipbreaking (29 CFR 1915, 1916, 1917)

SECTION I

MANUFACTURER'S NAME		EMERGENCY TELEPHONE NO.
ADDRESS (Number, Street, City, State, and ZIP Code)		
CHEMICAL NAME AND SYNONYMS		TRADE NAME AND SYNONYMS
CHEMICAL FAMILY	FORMULA	

SECTION II - HAZARDOUS INGREDIENTS

PAINTS, PRESERVATIVES, & SOLVENTS	%	TLV (Units)	ALLOYS AND METALLIC COATINGS	%	TLV (Units)
PIGMENTS			BASE METAL		
CATALYST			ALLOYS		
VEHICLE			METALLIC COATINGS		
SOLVENTS			FILLER METAL PLUS COATING OR CORE FLUX		
ADDITIVES			OTHERS		
OTHERS					
HAZARDOUS MIXTURES OF OTHER LIQUIDS, SOLIDS, OR GASES				%	TLV (Units)

SECTION III - PHYSICAL DATA

BOILING POINT (°F.)		SPECIFIC GRAVITY (H ₂ O=1)	
VAPOR PRESSURE (mm Hg.)		PERCENT, VOLATILE BY VOLUME (%)	
VAPOR DENSITY (AIR=1)		EVAPORATION RATE (_____ =1)	
SOLUBILITY IN WATER			
APPEARANCE AND ODOR			

SECTION IV - FIRE AND EXPLOSION HAZARD DATA

FLASH POINT (Method used)	FLAMMABLE LIMITS	Lel	Uel
EXTINGUISHING MEDIA			
SPECIAL FIRE FIGHTING PROCEDURES			
UNUSUAL FIRE AND EXPLOSION HAZARDS			

SECTION V - HEALTH HAZARD DATA
THRESHOLD LIMIT VALUE
EFFECTS OF OVEREXPOSURE
EMERGENCY AND FIRST AID PROCEDURES

SECTION VI - REACTIVITY DATA			
STABILITY	UNSTABLE		CONDITIONS TO AVOID
	STABLE		
INCOMPATIBILITY <i>(Materials to avoid)</i>			
HAZARDOUS DECOMPOSITION PRODUCTS			
HAZARDOUS POLYMERIZATION	MAY OCCUR		CONDITIONS TO AVOID
	WILL NOT OCCUR		

SECTION VII - SPILL OR LEAK PROCEDURES	
STEPS TO BE TAKEN IN CASE MATERIAL IS RELEASED OR SPILLED	
WASTE DISPOSAL METHOD	

SECTION VIII - SPECIAL PROTECTION INFORMATION		
RESPIRATORY PROTECTION <i>(Specify type)</i>		
VENTILATION	LOCAL EXHAUST	SPECIAL
	MECHANICAL <i>(General)</i>	OTHER
PROTECTIVE GLOVES		EYE PROTECTION
OTHER PROTECTIVE EQUIPMENT		

SECTION IX - SPECIAL PRECAUTIONS	
PRECAUTIONS TO BE TAKEN IN HANDLING AND STORING	
OTHER PRECAUTIONS	

TABLE X-1

PHYSICAL PROPERTIES OF CHLOROFORM

Chemical Abstracts serial number	000067663
Synonyms	Trichloromethane Trichloroform Methenyl trichloride Formyl trichloride Methyl trichloride Methane, trichloro-
Molecular formula	CHCl ₃
Molecular weight	119.38
Boiling point	61.3 C, 142.3 F (760 mm Hg)
Melting point	-63.2 C, -81.7 F
Vapor pressure	200 mm Hg (25 C)
Specific gravity	1.48069 (25 C), (water = 1.000 at 4 C)
Solubility	1.0 g/100 ml water at 15 C; soluble in ethanol, ethyl ether, benzene, acetone, and carbon disulfide
Explosive limit	None
Flash point	None
Vapor density	4.00 g/liter (25 C; 760 mm Hg)
Conversion factors 25 C; 760 mm Hg	1 mg/liter = 205 ppm 1 mg/cu m = 0.205 ppm 1 ppm = 4.89 mg/cu m

Adapted from references 1,2,3,4

TABLE X-2
 PERCENTAGE ABSORPTION OF CHLOROFORM
 AFTER INHALATION BY TWO SUBJECTS

Subject	A	A	A	B	B	B
	<u>Inhalation Concentration</u>					
ppm	4,448	4,920	5,125	4,264	4,715	4,920
mg/liter	21.7	24	25	20.8	23	24
	<u>Percent Absorbed</u>					
Exposure Period (min)						
0- 5	74.5	73.2	75	68.4	49.4	66.4
5-10	72.4	73.2	75	61.6	63.0	64.2
10-15	68.6	69.0	77	51.2	61.6	64.6
15-20	67.6	60.9	76	50.2	53.0	54.4

Adapted from Lehmann and Hasegawa [34]

TABLE X-3

ABSORPTION OF CHLOROFORM BY SUBJECT C IN CONSECUTIVE
5-MINUTE PERIODS OF INHALATION OF DIFFERENT CONCENTRATIONS
OF CHLOROFORM AND EXCRETION OF CHLOROFORM AFTER EXPOSURE

Exposure	Inhalation Concentration ppm	Inhalation mg/liter	Exposure Period min	Percent Absorbed	Postexposure Period min	CHCl ₃ Excretion mg/liter		
1	4407	21.5	0-5	80.0				
			5-10	74.3				
			10-15	76.9				
			15-20	74.6				
			20-25	74.2				
			25-30	73.8				
							0-10	1.70
							10-20	0.97
							20-30	0.85
			2	7236	35.3	0-5	80.7	
5-10	79.8							
10-15	76.8							
							0-5	2.31
							5-10	1.48
							10-20	1.04

Adapted from Lehmann and Hasegawa [34]

TABLE X-4

CASES OF HABITUAL CHLOROFORM USE

Case and Reference	Daily CHCl ₃ Use	Duration of Habit	Psychiatric and Neurologic Symptoms
1 [36]	1 oz daily for 7 years, 1 oz daily for next 5 years	12 years	Restless, distressed, easily excitable, depressed, hallucinations, convulsions, dysarthria, ataxia, tremor of tongue and fingers. Diagnosed as having chloroform poisoning with cerebellar involvement. Autopsy showed moderate degenerative changes in cerebellum, slightly thickened meninges, many fibroblasts, and dilated blood vessels
2 [37]	Small amount from 6-oz bottle	Over 1 year	Mental and physical wreck; fidgety, nervous, wakeful
3 [37]	Unspecified, every night with occasional spree	5 years	After spree - nausea, vomiting, and death wish; 2 suicide attempts
4 [37]	Unspecified, every night	3 years	Mental and physical wreck
5 [37]	Unspecified, sprees lasting for days or weeks	8-10 years	Physically and mentally sluggishness
6 [37]	Unspecified sprees lasting for days	Years	Moody, gloomy, despondent
7 [38]	20 drops on handkerchief with ether	14 years	Insomnia, depression, delirium, left hemiplegia after 9 years, right hemiplegia 5 years later
8 [39]	20-30 g pure CHCl ₃ or 50 g CHCl ₃ with alcohol 3-7 times/week	15 years	Nervous, unstable, temperamental, overreactive, rheumatic pain, slight tremor of hands
9 [40]	100 g	15 years	Psychologically upset (shell shock, war wounds, divorce, other failures)

TABLE X-5
LIVER FUNCTION TESTS FOLLOWING INGESTION
OF CHLOROFORM

Item Measured	Day After Ingestion					
	1	2	3	4	5	90
SGOT, iu	30	681	8,080	5,300	297	34
SGPT, iu	15	...	9,220	10,250	3,330	
LDH, iu	204	636	9,280	5,680	630	176
Alkaline phos- phatase, iu	6.1	5.2	...	6.4	...	5.0
Bilirubin (total), mg%	0.2	2.3	2.4	2.7	1.3	1.0
Prothrombin time, sec						
a) patient	14.3	19.2	...	18.4	14.3	12.3
b) control	12.6	11.9	...	12.7	11.8	12.2

iu = international units

... = not reported

Adapted from Storms [41]

TABLE X-6

SIX CASES OF DELAYED CHLOROFORM POISONING

Patient	Dose	Effects	Laboratory Test and Autopsy Findings
1 (37 yrs old) [45]	3 administrations 1. 3 capsules, each 20 minims 2. "very little" from drop bottle 3. 3 capsules, each 20 minims and anesthesia on open mask	Restless, coma and convulsions on 2nd day post partum, vomiting, jaundice, increased pulse and temperature. Died on 8th day post partum.	Blood urea: 198 mg/100 cc on 3rd day, 303 mg/100 cc on 5th day Blood NPN: 187 mg Amino acid nitrogen: 8.2 mg % Urine: acid, albumin, red blood cells, pus, high urobilin Liver: soft, yellow advanced necrosis, and fatty degeneration Kidneys: swollen, fatty deposits, necrosis Heart: fatty degeneration
2 (30 yrs old) [45]	2 inhalations of unspecified amount separated by 2 hours, and anesthesia on open mask	Drowsy, swelling of hands, jaundice, coma, increased temperature and pulse, extreme hyperpnea, no vomiting. Died 5th day post partum	Blood urea: 105 mg/100 cc on 2nd day, 360 mg/100 cc on 5th day Plasma bicarbonate: 0.003 molar Urine: uric acid, albumin, pus, 2.35% urea on 3rd day Liver: yellow, mottled, soft, diffuse centrilobular necrosis, fat mostly in periphery
3 (25 yrs old) [45]	Full anesthesia on open mask "long time" then repeated 4 hours later	Drowsy, jaundice, coma on 4th day, muscular twitchings, increased temperature, vomiting. Died on 6th day post partum	Blood: .093 % sugar 60 mg/100 cc urea Urine: deep orange, ph 6.0, .4 % albumin, diacetic acid Liver: soft, flabby, recent shrinkage, yellow, widespread necrosis Kidneys: congestion of cortical vessels Heart: fatty changes

TABLE X-6 (continued)

SIX CASES OF DELAYED CHLOROFORM POISONING

Patient	Dose	Effects	Laboratory Test and Autopsy Findings
4 (24 yrs old) [49]	Unspecified	Restless, delirium, coma, jaundice, drowsy, increased temperature, muscle twitching, no vomiting. Recovered	Urine: showed albumin, bilirubin, urobilin other lab tests in Table X-8
5 (35 yrs old) [49]	Twice, unspecified amount	Drowsiness, mental confusion, coma, jaundice, tenderness over liver, hiccup, restless, no vomiting. Recovered	Urine: showed albumin, bilirubin, urobilin; other lab tests in Table X-8
6 (23 yrs old) [49]	Twice, unspecified amount	Jaundice, nausea general weakening, slight icterus. Recovered	No observations

TABLE X-7

CLINICAL DATA OF DELAYED CHLOROFORM
POISONING IN TWO OBSTETRICAL CASES

Clinical Measurement	Patient		
	A	B	B
	3rd Day	4th day	5th day
Alkaline phosphatase (1)	21.4-22.3	21.1	...
Carbon dioxide, blood vol %	34	54	45
Blood urea, mg %	108	50	24
Blood chloride, mg %	...	570	...
Serum thymol turbidity	0-3.2	2.2	+

(1) King-Armstrong units

Adapted from Lunt [49]

TABLE X-8

CHLOROFORM IN EXHALED AIR (VOL %) COLLECTED
DURING THIRD STAGE ANESTHESIA AT INDICATED TIMES
AFTER INDUCTION OF ANESTHESIA, BY PLANE OF THIRD STAGE

Patient age-sex	Operation	Plane	Time min	CHCl ₃ vol %
1 41F	Exploration and lysis of adhesions	1	10	1.78
2 73M	Biopsy tumor of face	1	10	0.83
3 57M	Excision abdominal skin tumor	1	11	0.46
4 56M	Resection mandible	1	20	0.64
5 68M	Gastric resection	1	84	0.26
5 68M	Gastric resection	1	124	0.49
6 42M	Laminectomy	1-2	40	0.31
7 58F	Radical mastectomy	2	35	0.14
8 38F	Partial gastric resection	2	26	0.62
9 44M	Gastric resection	2	40	0.24
10 53F	Gastric resection; drain gall bladder	2	50	0.34
11 59F	Resection cervical nodes	2-3	40	1.47
2 73F	Biopsy tumor of face	2-3	40	1.47
1 41F	Exploration and lysis of adhesions	3	43	1.57
9 44M	Gastric resection	3	123	0.43

Adapted from Morris [50]

TABLE X-9

THE EFFECT OF CHLOROFORM ON THE URINARY PROTEIN AND URINARY GLUCOSE
OF MICE FOLLOWING 24-HOUR PRETREATMENT WITH PENTOBARBITAL

Dose ml/kg	% Showing significant	
	protein (1)	glucose (2)
0.5	100	100
0.125	60	50
0.063	30	50
0.032	40	0
0.016	10	10

(1) Significant urinary protein = 100 mg % or more

(2) Significant urinary glucose = 250 mg % or more

Adapted from Plaa and Larson [79]

TABLE X-10

PENTOBARBITAL SLEEPING TIMES OF MICE 24-HOURS
AFTER EXPOSURES TO CHLOROFORM

Dose ml/kg	Number of animals	% Showing significant sleeping time (1)
0.016	55	11
0.032	46	22
0.25	10	40
0.5	10	50
1.0	10	80

(1) Sleeping time longer than 6 minutes

Adapted from Plaa and Larson [79]

TABLE X-11

CHLOROFORM INHALATION EXPOSURES AND EFFECTS

Author	Exposure Variables	Exposure Time	Effects
Challen [67]	Humans; 23-35 ppm (30-min averages)	Intermittent 4 hrs/day	Lassitude, dryness of the mouth, irritability
Schwetz [83]	Pregnant rats; 30 ppm	7 hr/day, 10 days	Delayed fetal skull ossification and wavy rib formation
Challen [67]	Humans; 57-71 ppm	Intermittent 4 hrs/day	Flatulence, lassitude, loss of appetite, nausea
Schwetz [83]	Rats; 100 ppm	7 hr/day, 10 days	In fetuses - increased occurrences of acaudia, missing ribs, delayed sternbrae ossification, subcutaneous edema, imperforate anus; in adults - increased liver weights
Kylin [78]	Mice; 100 ppm 200 ppm	4 hrs 4 hrs	Moderate fatty infil- tration of liver some liver necrosis
Bomski [55]	Humans; 2-205 ppm		Headache, nausea, burping, loss of appe- tite, increased inci- dence of viral hepatis, toxic hepatitis with elevated serum gamma globulins, splenomegaly, hepatomagoly
Lehmann and Schmidt- Kehl [35]	Humans; 205 ppm	Brief (approx. 1 minute)	Perception of light, transient odor
Schwetz [83]	Rats; 300 ppm	7 hr/day 10 days	Decreased food con- sumption

TABLE X-11 (Continued)

CHLOROFORM INHALATION EXPOSURES AND EFFECTS

Author	Exposure Variables	Exposure Time	Effects
Kylin [78]	400 ppm and 800 ppm	4 hrs	Liver necrosis, increased serum ornithine carbamoyl transferase activity
Lehmann and Schmidt-Kehl [35]	Humans; 922 ppm and 1,107 ppm	3 min 2 min	Dizziness, vertigo Dizziness, vertigo
Lehmann and Schmidt-Kehl [35]	Cats; 7,175 ppm	7.8	Light narcosis
Lehmann and Hasegawa [34]	Humans; 7,236 ppm	15 min	Dizziness, light intoxication
Fuhner [71]	Mice; 6,765 ppm or 7,380 ppm	1/2 hr 10 min	Narcosis, eventual death, narcosis
von Oettingen [72]	Dogs; 13,950-15,596 ppm	60-285 min	Narcosis, respiratory fluctuation, decrease in blood pressure and body temperature, death
Whitaker and Jones [58]	Humans; 20,000 ppm	30-240 min	Anesthesia, nausea, vomiting, jaundice, delayed chloroform poisoning
Whipple and Sperry [30]	Dogs; 1-2 oz (total amount inhaled)	1-2 hrs	Anesthesia, central hyaline necrosis, acute yellow atrophy, fatty degeneration of the kidneys

DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE

CENTER FOR DISEASE CONTROL

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH

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