

XI. APPENDIX III
MATERIAL SAFETY DATA SHEET

The following items of information which are applicable to a specific product or material shall be provided in the appropriate block of the Material Safety Data Sheet (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 rules 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 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, eg, "100 ppm LC50-rat," "25mg/kg LD50-skin-rabbit," "75 ppm LC man," or "permissible exposure from 29 CFR 1910.93," 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. Flammability or reactivity data could be flashpoint, 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 flashpoint 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 TWA concentration, as a

permissible exposure, or by some other indication of an acceptable standard. 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, mild irritation and possibly some blistering.

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 employees.

(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 employees 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 antipollution ordinances" are proper but not sufficient. Specific procedures shall 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. Respirators shall be specified 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 employees 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 in 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 (H₂O=1)		VAPOR PRESSURE
VAPOR DENSITY (AIR=1)		SOLUBILITY IN H₂O % 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 _____

XII. TABLES AND FIGURES

TABLE XII-1

PROPERTIES AND CHARACTERISTICS OF FORMALDEHYDE (FM)

Formula	HCHO
Molecular weight	30.03
Physical state	Gas
Melting point	-92 C
Boiling point	-21 C
Specific gravity	0.815
Relative vapor density	1.075 (air = 1)
Solubility	Soluble in water, alcohol, and ether
Color	Colorless
Odor	Pungent and irritating
Explosive limits:	
Gas	7.0-73% by volume in air
Aqueous solution	Vapor may be flammable
Flashpoint (closed cup) of aqueous solution	50 C (122 F)
Autoignition temperature	430 C (806 F)
1 mg/cu m = 0.81 ppm	
1 ppm = 1.23 mg/cu m	

Derived from references 6,213

TABLE XII-2

USE OF FORMALDEHYDE IN THE UNITED STATES

Supply capacity - 1972	7,530 million pounds*
Demand - 1972	5,000 million pounds*
Demand - 1976 (estimated)	6,300 million pounds*
Growth (1961-1971)	7.9%/year
Growth through 1976 (estimated)	7.5%/year

*expressed as 37% solution

From reference 137 (1972)

TABLE XII-3

FORMS OF FORMALDEHYDE POLYMERS

Substance	Type Formula	Range of Polymerization, n	CH ₂ O Content, Wt %	Melting Range, C	Acetone	Water	Dilute Alkali	Dilute Acid
1. Linear polymers (On vaporization these depolymerize to monomeric formaldehyde gas.)								
Lower polyoxymethylene glycols	HO(CH ₂ O) _n H	2-8	77-93	80-120	s-i	vs	vs	vs
Paraformaldehyde	HO(CH ₂ O) _n H	8-100	91-99	120-170	s-i	ds	s	s
alpha-Polyoxymethylene	HO(CH ₂ O) _n H	100-300	99.0-99.9	170-180	i	vds	s	s
beta-Polyoxymethylene	HO(CH ₂ O) _n H +H ₂ SO ₄ (trace)	100-300	98-99	165-170	i	vds	ds	ds
152 Polyoxymethylene glycol derivatives*** polyoxymethylene diacetates								
	CH ₃ COO(CH ₂ O) _n COCH ₃	2-200	37-93	up to ca 165	i for n >10	i	ds	ds
Lower polyoxymethylene dimethyl ethers	CH ₃ O(CH ₂ O) _n CH ₃	2-200	72-93	up to ca 175		i for n >15	i for n >15	ds
gamma-Polyoxymethylene (higher polyoxymethylene dimethyl ethers)	CH ₃ O(CH ₂ O) _n CH ₃	200-500	93-99	160 to ca 180	i	i	i	ds
delta-Polyoxymethylene	CH ₃ O(CH ₂ O) _n CH ₂ CH(OH)OCH ₃	g100	96-97	150-170	i	i	i	ds
epsilon-Polyoxymethylene high-molecular-weight polyoxymethylenes****	(CH ₂ O) _n HO(CH ₂ O) _n H	probably g100 500-5000	99.7-99.9 99.9-100	195-200 170-185	i i	i i	vds	vds
2. Cyclic polymers (On vaporization these do not depolymerize.)								
Trioxane (alpha-trioxymethylene)	(CH ₂ O) ₃	3	100	61-62	s	s	s	s
Tetraoxymethylene	(CH ₂ O) ₄	4	100	112	s	s	s	s

From Walker [2]

TABLE XII-4
USES OF FORMALDEHYDE

Phenolic resins	25 %
Urea-formaldehyde resins	25
Polyacetal resins	8
Melamine	8
Pentaerythritol	7
Hexamethylenetetramine	6
Fertilizers	5
Acetylenics	2
Export and miscellaneous	<u>14</u>
Total	100 %

From reference 137

TABLE XII-5

POTENTIAL OCCUPATIONAL EXPOSURES TO FORMALDEHYDE

Occupation	Reference
Anatomists	214
Agricultural workers	215,216,217
Bakers	214
Beauticians	65,71,72,73
Biologists	214
Bookbinders	214
Botanists	214
Crease-resistant textile finishers	214
Deodorant makers	214
Disinfectant makers	68,74,217
Disinfectors	214,217,218
Dress goods store personnel	214
Dressmakers	214
Drugmakers	214
Dyemakers	1,215,217
Electrical insulation makers	88
Embalmers	214,215,217
Embalming fluid makers	214,215,217
Ethylene glycol makers	214
Fertilizer makers	2,215
Fireproofers	1
Formaldehyde resin makers	214,217,218
Formaldehyde employees	214,215
Foundry employees	219
Fumigators	217
Fungicide workers	214,215,217
Furniture dippers and sprayers	214
Fur processors	214
Glass etchers	214
Glue and adhesive makers	92,70
Hexamethylenetetramine makers	214
Hide preservers	214
Histology technicians	214
Ink makers	214
Lacquerers and lacquer makers	214
Medical personnel	215,217,220
Mirror workers	1
Oil well workers	214
Paper makers	76,77,89,214,217

TABLE XII-5 (CONTINUED)

POTENTIAL OCCUPATIONAL EXPOSURES TO FORMALDEHYDE

Pentaerythritol makers	214
Photographic film makers	1,214,215,218
Plastic workers	1,218
Resin makers	214,217,218
Rubber makers	214,217
Soil sterilizers and greenhouse workers	216
Surgeons	220
Tannery workers	1,215,217,218
Taxidermists	215,221
Textile mordanters and printers	214,215
Textile waterproofers	214,215
Varnish workers	88,65
Wood preservers	214

TABLE XII-6

DOSE-RESPONSE RELATIONSHIPS IN ANIMALS EXPOSED TO FORMALDEHYDE

Species No.	Route	Dose	Response	Ref.	
Cat	3	Inhal	1,630-7,830 ppm for 4.7 hr	Death occurred after 20 min, 4.7 hr, and 4 days	108
"	2	"	667 ppm for 8-8.7 hr	Deaths occurred on days 4 and 6, after salivation, acute dyspnea, vomiting, and cramps	108
"	2	"	211-667 ppm for 3.5-4 hr	Irritation of mucous membranes, slight dyspnea, recovery in 2 days	108
Dog	2	"	3.7 ppm, 24 hr/d/90d	Interstitial inflammation of lungs	121
Guinea pig	6	"	6,000 ppm for 1 hr	Increased airway resistance, decreased respiration rate, increased tidal volume, decreased minute volume, no change in compliance	119
Guinea pig (tracheotomized)	6	"	"	No changes in any of above parameters	119
Guinea pig	6	"	1,000 ppm for 1 hr	Increased airway resistance, decreased respiration rate, increased tidal volume, decreased minute volume, no change in compliance	119
Guinea pig (tracheotomized)	6	"	"	No changes in any of above parameters	119
Guinea pig	6	"	50 ppm for 1 hr	Increased airway resistance, decreased respiration rate, increased tidal volume, decreased minute volume, no change in compliance	119
Guinea pig (tracheotomized)	6	"	"	No changes in any of above parameters	119
Guinea pig	3	"	50 ppm for 4 hr	Increased flow resistance for 1 hr then drop off, decreased compliance	113
"	11	"	49 ppm for 1 hr	Increased, airway resistance, decreased compliance, increased tidal volume, decreased breathing frequency, decreased minute volume, increased elastic work, increased resistive work, increased total work	114
"	8	"	47 ppm + 10 mg NaCl/cu m for 1 hr	Increased airway resistance	112

TABLE XII-6 (CONTINUED)
DOSE RESPONSE RELATIONSHIPS IN ANIMALS EXPOSED TO FORMALDEHYDE

Species	No.	Route	Dose	Response	Ref.
Guinea pig	12	Inhal	27 ppm + 12.1 mg NaCl/cu m for 1 hr	Increased resistance	114
"	20	"	16.3 ppm for 10 hr (aerosol)	Initial increase in activity, animals blinked, closed eyes, rubbed faces with paws, settled down, slow deep res-	112
"	20	"	15.4 ppm for 10 hr (gas)		
"	10	"	11.0 ppm for 1 hr	Increase in airway resistance, decreased compliance, decrease in breath frequency, decrease in minute volume	114
"	8	"	10.8 ppm + 10.7 mg NaCl/cu m for 1 hr	Increased resistance	114
"	7	"	9.6 ppm + 30 mg NaCl/cu m for 1 hr	"	114
"	5	"	4.8 ppm + 4.1 mg NaCl/cu m for 1 hr	"	114
"	9	"	3.9 ppm for 1 hr	69% increase in slow airway resistance, 29% increase in tidal volume, 27% decrease in respiratory rate	118
"	15 M 15 F	"	3.7 ppm, 24 hr/d/90 d	Interstitial inflammation of lungs, focal chronic inflammatory changes in heart and kidney, no clinical illness	121
"	10	"	3.6 ppm for 1 hr	Increased airway resistance, decreased compliance, increased resistive work, increased total work	114
"	10	"	3.5 ppm for 1 hr	Increase in flow resistance, decrease in compliance	113
"	15	"	3.5 ppm + 26 mg NaCl/cu m for 1 hr	Increased airway resistance	114
"	8	"	2.6 ppm + 8.7 mg NaCl/cu m for 1 hr	"	114
"	4	"	1.22 ppm for 1 hr	Increased airway resistance, increased elastic work, increased resistive work, increased total work	114
"	6	"	1.2 ppm + 3.5 mg NaCl/cu m for 1 hr	Increased airway resistance	114

TABLE XII-6 (CONTINUED)
DOSE RESPONSE RELATIONSHIPS IN ANIMALS EXPOSED TO FORMALDEHYDE

Species No,	Route	Dose	Response	Ref.
Guinea pig	7	Inhal 1.01 ppm + 22 mg NaCl/cu m for 1 hr	Increased resistance	114
"	8	" 0.76 ppm + 12.8 NaCl/cu m for 1 hr	"	114
"	23	" 0.58 ppm for 1 hr	Increased resistance, decreased compliance	114
"	7	" 0.58 ppm + 3.0 mg NaCl/cu m for 1 hr	Increased resistance	114
"	8	" 0.34 ppm + 35 mg NaCl/cu m for 1 hr	"	114
"	8	" 0.32 ppm + 11.3 mg NaCl/cu m for 1 hr	"	114
"	13	" 0.31 ppm for 1 hr	Increased resistance, decreased compliance	114
"	10	" 0.24 ppm + 4.3 mg NaCl/cu m for 1 hr	Increased resistance	114
"	13	" 0.11 ppm + 3.9 mg NaCl/cu m for 1 hr	"	114
"	4	" 0.07 ppm + 7.5 mg NaCl/cu m for 1 hr	No resistance change	114
"	13	" 0.06 ppm + 3.5 mg NaCl/cu m for 1 hr	"	114
"	18	" 0.05 ppm for 1 hr	No change	114
Monkey	3	" 3.7 ppm, 24 hr/d/90 d	Interstitial inflammation of lungs, no clinical signs of illness	121

TABLE XII-6 (CONTINUED)
DOSE RESPONSE RELATIONSHIPS IN ANIMALS EXPOSED TO FORMALDEHYDE

Species	No.	Route	Dose	Response	Ref
Mouse	?	Inhal	731 ppm for 2 hr	Death from massive pulmonary hemor- rhage and edema	122
"	42	"	162 ppm, 1 hr/d, 3 d/wk, 11 total ex- posures	4 tracheobronchial basal cell hy- perplasias, 8 tracheobronchial stratifications, 16 squamous cell metaplasias, 5 atypical metaplasias, no tumors, 12 deaths	122
"	60	"	81 ppm, 1 hr/d, 3 d/wk, 35 wk, 105 exposures	10 tracheobronchial basal cell hy- perplasias, 14 tracheobronchial stratifications, 6 squamous cell metaplasias, no tumors in 64 weeks. Subsequent exposure of the mice at 300 mg/cu m coal tar indicated no pre- disposition to cancer from the HCHO exposure	122
"	60	"	41 ppm, 1 hr/d, 3 days/wk, 35 wk, 105 exposures	6 tracheobronchial basal cell hy- perplasias, 9 tracheobronchial stratifications, no metaplasia, no tumors. Subsequent exposure at 150 mg/cu m from the 35th to the 70th week failed to produce any tumors in 37 of the animals so exposed	122
"	?	"	33 ppm, 2 hr/d/4 d	no "Substantial" distress or weight loss	122
"	50	"	16.3 ppm aero- sol for 10 hr	Initial increase in activity, blinked, closed eyes, rubbed faces with paws, settled down, slow deep respira- tion, convulsion, death in 48 animals	112
"	50	"	15.4 ppm for 10 hr	Same as above but death in 17 animals	112
Rabbit	5	"	16.3 ppm aero- sol for 10 hr	Same as above but death in 1 animal	112
"	5	"	15.4 ppm for 10 hr	Same as above but death in 3 animals	112
"	3	"	3.7 ppm, 24 hr/d/90 d	Interstitial inflammation of lungs, no clinical signs of illness, however	121

TABLE XII-6 (CONTINUED)
DOSE RESPONSE RELATIONSHIPS IN ANIMALS EXPOSED TO FORMALDEHYDE

Species	No.	Route	Dose	Response	Ref
Rat	72	"	490-1400 ppm	LC50 = 81 ppm	108
"	8	"	35 ppm for 18 hr	Increased liver alkaline phosphatase activities; dyspnea and nasal irritation	110
"	15	"	3.7 ppm, 24 hr/d/90 d	Interstitial inflammation of lungs, 1 death, focal chronic inflammatory changes in heart and kidney	121
"	25	Inhal	2.5 ppm/3 mo	Lymphohistologic elements in interalveolar walls, peribronchial and perivascular spaces, moderate hyperemia, mild histologic changes in cells of respiratory tract, liver, kidney, and cerebral cortex	93
"	25	"	0.8 ppm/3 mo	"	93
"	25	"	0.03 ppm/3 mo	No histologic changes	93
"	25	"	0.01 ppm/3 mo	"	93
Rat (pregnant)	12	"	0.01 ppm 16-21 d 24 hr/d	Increased litter size, increased mean duration of pregnancy, increased weight of fetal adrenals and mean duration of pregnancy, infetal lungs and liver	125
Rat (pregnant)	12	"	0.8 ppm for 24 hr/d for 16-21 d	Increased litter size, and mean duration of pregnancy, decreased weight of fetal lung and liver, increased adrenals, kidney, and total body weight	125
Mouse	72	Sc	0.15-0.46 g/kg	LD50=0.30 g/kg (Deaths within 20 min) Survivors recovered in 2-3 d	107
Rat	64	"	0.30-0.64 g/kg	LD50=0.42 g/kg (Deaths within 68 hrs) Survivors recovered 2-3 d	122

TABLE XII-7
FORMALDEHYDE STANDARDS IN EFFECT

Country	Standard			References
	mg/cu m	ppm	Type	
USA 1) Federal Standard	--	3	TWA	FR 39 (125):23540-43, 1974
	--	5	Ceiling	"
	--	10	30 min Ceiling	"
2) ACGIH TLV	2.5	2	Ceiling	222
3) ANSI Z-37	--	3	TWA	204
	--	5	Ceiling	204
	--	10	30 min Ceiling	204
Bulgaria	5	4	Ceiling	210
Czechoslovakia	2	--	"	208
	5	--	Peak	208
Finland	6	5	Ceiling	210
Federal Republic Germany	6	5	"	210
German Democratic Repub.	5	--	"	208
Great Britain	12	10	"	208
Hungary	1	--	"	210
Italy	5	--	"	210
Japan	6	5	"	210
Poland	5	--	"	210
Rumania	3	--	"	210
UAR	--	20	"	210

TABLE XII-7 (CONTINUED)
FORMALDEHYDE STANDARDS IN FORCE

Country	Standard		Type	References
	mg/cu m	ppm		
USSR	0.5	0.4	Ceiling	210
Yugoslavia	6	5	"	210
USA - Florida	--	5	"	210
- Hawaii	--	10	"	210
- Massachusetts	--	3	"	210
- Mississippi	--	5	"	210
- Pennsylvania	--	5	TWA	210
"	--	5	5 min Ceiling	210
- South Carolina	--	5	Ceiling	210

TABLE XII-8
 CONCENTRATION EFFECT RELATIONSHIPS COMPILED BY CZECHOSLOVAK
 COMMITTEE OF MAC

Author	Year	mg/cu m	Symptoms
Lazareff	1959	0.2	Odor
Morill	1961	0.2	Odor
Bourne	1959	1.2-2.5	Strong subjective neurasthenic complaints
Chifman acc. to Lazareff		1.0-9.5	Light irritation of conjunctivas and mucosa of upper respiratory tract
Smyth	1956	6	Slight irritation of eyes, nose, respiratory tract
Elkins	1950	±6-7	Irritation of conjunctivas in unaccustomed persons
		6-7	Irritation at inspiration
Smyth	1956	12	Odor
Fairhall	1949	24	"Such low" concentration irritates mucosa strongly
Lazareff	1959	25	Severe irritation of mucosa
Smyth	1956	60	Significant irritation of eyes, nose, and resp. tract danger of lung damage
Patty	1949	250	In cats after 3.5-hour exposure, rapid recovery without damage
		800	After 8 hour-exposure, edema and hemorrhage in lungs, later inflammation of lungs, and usually death

From reference 208

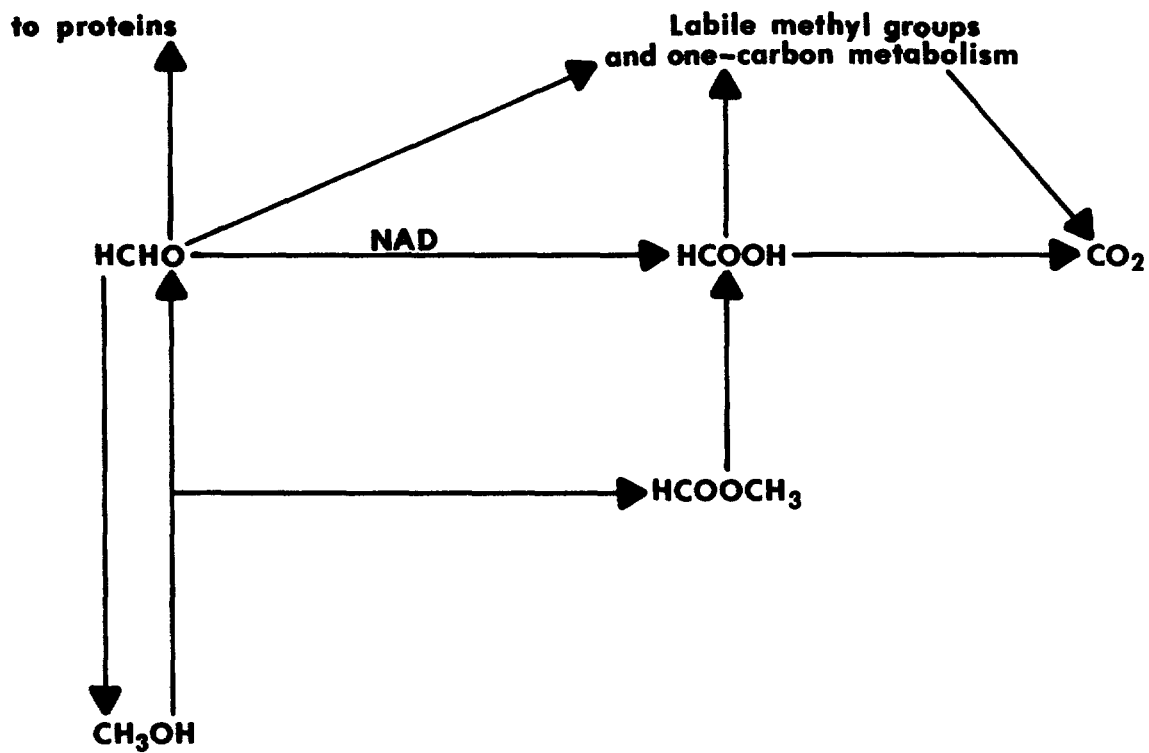


FIGURE XII-1
 PROPOSED METABOLIC FATE OF FORMALDEHYDE

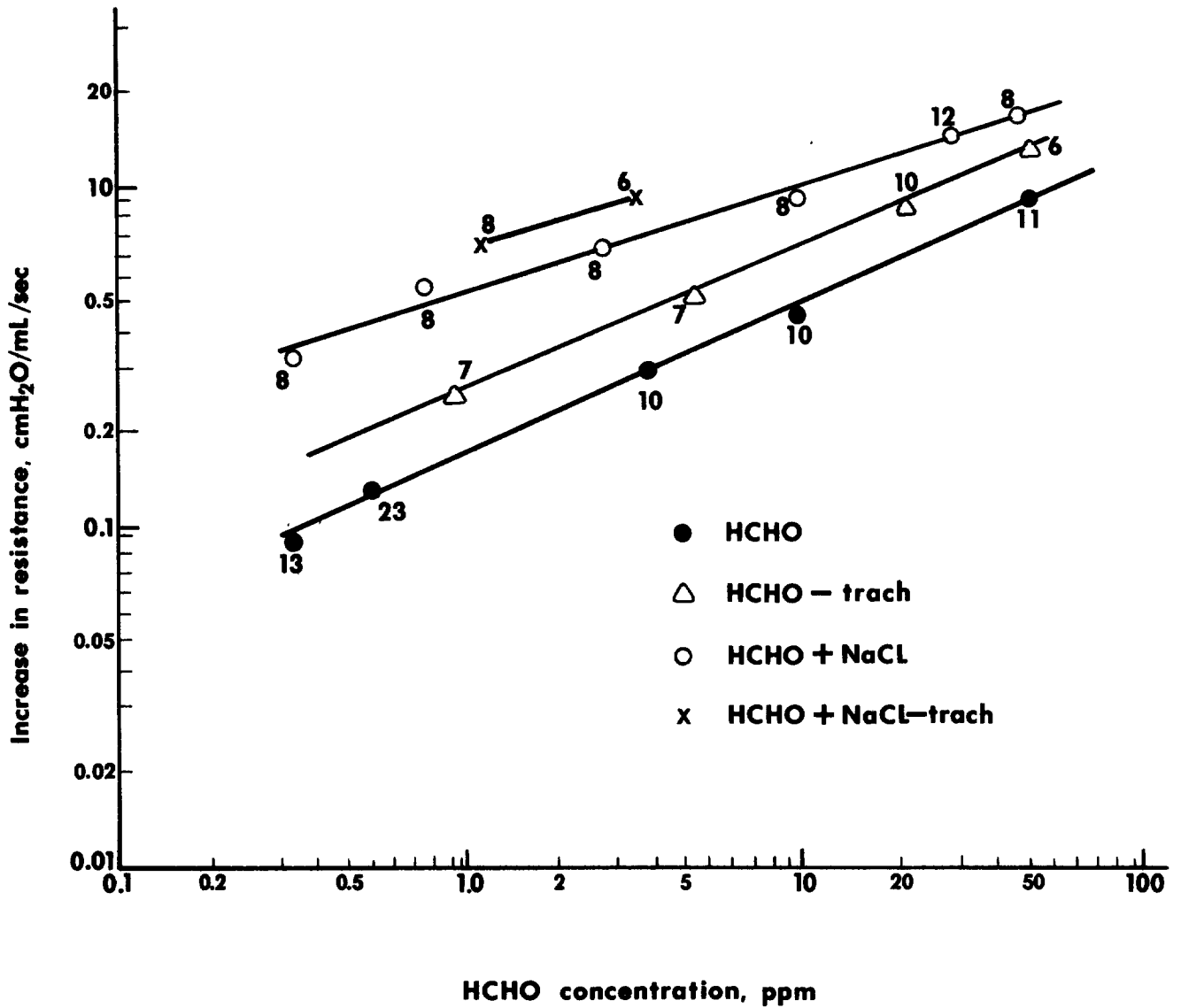


FIGURE XII-2
DOSE RESPONSE RELATIONSHIPS FOR TRACHEOTOMIZED AND UNTRACHEOTOMIZED
GUINEA PIGS EXPOSED TO HCHO AND HCHO IN THE PRESENCE OF AN AEROSOL
OF 1% AQUEOUS SOLUTION OF SODIUM CHLORIDE AT 10 MG NaCl/CU M

DEPARTMENT OF
HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
CENTER FOR DISEASE CONTROL
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
ROBERT A TAFT LABORATORIES
4676 COLUMBIA PARKWAY CINCINNATI OHIO 45226

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE \$300



POSTAGE AND FEES PAID
U S DEPARTMENT OF H E W
HEW 396