

Industrial Process Profiles for Environmental Use. Chapter 10b Plastics  
Additives

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Prepared for

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U.S. DEPARTMENT OF COMMERCE  
National Technical Information Service

**NTIS**®



TABLE A-15 (Continued)

Chemical	Molecular Weight	Solubility			Boiling Point, °C (Melting Point)†	Specific Gravity (at 20°C)	Flash Point °C (OCC)#	Applicability to Polymer Type (See First Page of Table for Number Code)																									
		Water	Alcohol	Benzene				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
SOLVENTS (Continued)																																	
2-Ethoxyethyl acetate [CH <sub>3</sub> CO <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> OCH <sub>2</sub> CH <sub>3</sub> ]	132.2	Soluble	Miscible		156.4	0.9749									X																		
Ethyl acetate [CH <sub>3</sub> COOC <sub>2</sub> H <sub>5</sub> ]	88.1	Soluble	Soluble	Soluble	77	0.902	7.2	X																					X			X	
Ethylbenzene [C <sub>8</sub> H <sub>10</sub> C <sub>2</sub> H <sub>5</sub> ]	106.2	Insoluble	Soluble	Soluble	136.2	0.867	15	X												X						X	X					X	
Furfuryl alcohol [C <sub>4</sub> H <sub>3</sub> OCH <sub>2</sub> OH] or [OCH=CHCH=OCH <sub>2</sub> OH]	98.1	Soluble	Soluble	Soluble	170	1.1285	75		X																								
Heptane [CH <sub>3</sub> (CH <sub>2</sub> ) <sub>5</sub> CH <sub>3</sub> ]	100.2	Insoluble	Soluble	Soluble	98.4	0.68368	-3.9 (closed cup)								X					X			X					X					
Hexane [CH <sub>3</sub> (CH <sub>2</sub> ) <sub>4</sub> CH <sub>3</sub> ]	86.2	Insoluble	Soluble		68.7	0.6603	-23	X								X				X	X		X				X						
Isobutane [See Chain Transfer Agents]																					X	X											
Isobutyl alcohol [See Chain Transfer Agents]									X																								
Isobutyric acid [(CH <sub>3</sub> ) <sub>2</sub> CHCOOH]	88.1	Soluble	Soluble		154.4	0.946-0.950	77 (TCC)	X																				X					
Isooctane [(CH <sub>3</sub> ) <sub>3</sub> COCH <sub>2</sub> CH(CH <sub>3</sub> ) <sub>2</sub> ]	114.3	Insoluble	Slight		99.2	0.6919	-12													X		X											
Isopentane [(CH <sub>3</sub> ) <sub>2</sub> CHCH <sub>2</sub> CH <sub>3</sub> ]	72.2	Insoluble	Very Slight	Soluble	27.85	0.61967	-57													X	X												
Isopropyl alcohol [See Chain Transfer Agents]									X							X								X									
Isopropyl benzene [See Chain Transfer Agents (Cumene)]																													X				
Kerosene	—	Insoluble		Miscible	180-300	0.81	38-65													X	X									X			

(Continued)

TABLE A-15 (Continued)

Chemical	Molecular Weight	Solubility			Boiling Point, °C (Melting Point)†	Specific Gravity (at 20°C)	Flash Point °C (OCC)#	Applicability to Polymer Type (See First Page of Table for Number Code)																									
		Water	Alcohol	Benzene				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
SOLVENTS (Continued)																																	
Methanol [See Chain Transfer Agents]									X		X	X	X		X			X		X							X	X	X				
Methyl acetate [See Chain Transfer Agents]																				X							X	X					
Methylene chloride [CH <sub>2</sub> Cl <sub>2</sub> ]	84.9	Slight	Soluble		40.1	1.335 (15°)	Nonflammable				X		X		X																		
Methyl ethyl ketone [See 2-Butanone]																																	
Methyl isobutyl ketone [(CH <sub>3</sub> ) <sub>2</sub> CHCH <sub>2</sub> COCH <sub>3</sub> ]	100.2	Slight		Miscible	115.8	0.8042	23	X																							X		
Methyl isobutyrate	102.2							X																									
Mineral oil																			X		X												
Naphtha				Miscible	160	0.862-0.892	-49	X	X									X															
Nitrobenzene [C <sub>6</sub> H <sub>5</sub> NO <sub>2</sub> ]	123.1	Slight	Soluble	Soluble	210.9	1.19867	88						X		X																		
Pentane [CH <sub>3</sub> (CH <sub>2</sub> ) <sub>3</sub> CH <sub>3</sub> ]	72.2	Insoluble	Very Slight	Soluble	36.07	0.62624	-49											X	X			X	X						X				
3-Pentanone [Diethyl ketone], [C <sub>2</sub> H <sub>5</sub> COCC <sub>2</sub> H <sub>5</sub> ]	86.2	Slight	Soluble		101	0.816	13	X																									
2-Propanol [Isopropyl alcohol], [See Chain Transfer Agent]								X																									
n-Propyl acetate [C <sub>3</sub> H <sub>7</sub> COOCH <sub>3</sub> ]	102.2	Slight	Miscible	Miscible	96-102	0.887	14																							X			
Pyridine [N(CH) <sub>3</sub> CN]	79.1	Soluble	Soluble	Soluble	115.5	0.978	20					X						X															
1, 1, 2, 2-Tetrafluorodichloroethane [CClF <sub>2</sub> CClF <sub>2</sub> ], [Freon 114]		Insoluble			3.55																										X		
Tetrahydrofuran [CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> O]	72.1	Soluble	Soluble	Soluble	66	0.888	-15	X																						X	X		

(Continued)



TABLE A-15 (Continued)

Chemical	Molecular Weight	Solubility			Boiling Point, °C (Melting Point)†	Specific Gravity (at 20°C)	Flash Point °C (COC)#	Applicability to Polymer Type (See First Page of Table for Number Code)																									
		Water	Alcohol	Benzene				1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
SOLVENTS (Continued)																																	
Toluene [See Chain Transfer Agents]									X	X	X	X	X					X										X			X	X	
Triethylamine [See Chain Transfer Agents]									X																								
2,2,4-Trimethylpentane [See Isooctane]																																	
Water									X				X		X		X	X	X									X	X	X	X		
Xylene [C6H4(CH3)2]		Insoluble	Soluble	Soluble		0.86	27-46		X	X	X		X				X				X											X	
THICKENERS																																	
Glycerol [C3H5(OH)3]		Soluble	Soluble	Insoluble	290	>1.249 (25°)	160	X																									
Glycols								X																									
Polyglycols								X																									

## FOOTNOTES:

†Key for boiling point, (melting point): d = decomposes.

‡Key for flash point: COC = Cleveland Open Cup; TOC = Tagliabue Open Cup.

**TABLE A-16. ULTRAVIOLET STABILIZERS  
PHYSICAL AND CHEMICAL CHARACTERISTICS WITH POLYMER APPLICATION**

Ultraviolet Stabilizer	Form	Solubility		Melting Point (Boiling Point), °C	Specific Gravity at 20°C	Use Concen- tration %	FDA Sanction†	Applicability to Polymer Type (Number Coded Below)																											
		Water	Organics					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	
BENZOPHENONES																																			
4-Alkoxy-2-hydroxybenzophenone [Uvinul 410]	Powder			49-50																															
4-Butoxy-2,2'-dihydroxybenzophe- none [Cyasorb UV287]																																			
5-Chloro-2-hydroxybenzophenone [C <sub>6</sub> H <sub>4</sub> OCCH <sub>2</sub> Cl]	Crystals	Insoluble	Soluble	93-45		0.1-2.0														X	X	X			X	X	X		X					X	
Cyasorb UV 2126 [Polymer of 4-(2-Ac ryloyloxyethoxy)-2-hydroxybenzo- phenone]	Powder		Soluble																																
4-Decyloxy-2-hydroxybenzophenone																																			
2,4-Dibenzoyl resorcinol [DBR]	Crystals	Insoluble	Soluble	125-128																															
2,4-Dihydroxybenzophenone [C <sub>6</sub> H <sub>4</sub> OCCH <sub>3</sub> (OH) <sub>2</sub> ]	Powder	Insoluble	Soluble	136-149 (194 (130 Pa))	1.274	0.1-1.0							X												X	X								X	
2,2'-Dihydroxy-4,4'-dimethoxy- benzophenone [Uvinul D-49]	Powder			125-130	1.345	0.1-1.5							X																					X	
2,2'-Dihydroxy-4-methoxybenzophe- none [Cyasorb UV 24]	Powder		Soluble	68-70 (160-170 (70-130 Pa))	1.382 (25°C)	0.25-3.0						X			X								X				X			X					
2,2'-Dihydroxy-4(octoxy)benzo- phenone [Cyasorb UV 314]																																			
Disodium 2,2'-dihydroxy-4,4'-di- methoxy-5,5'-disulfobenzophenone [Uvinul DS-49]	Powder			>350		0.1-1.5																													
4-Dodecyloxy-2-hydroxybenzophenone [Rylex D]	Powder Flakes	Insoluble	Soluble	43-52	4.1 lbs/gal	0.25-2.0						X	X		X					X	X	X		X	X	X	X		X	X	X		X		

NOTE: 1 - Acrylic Resins; 2 - Acrylonitrile-Butadiene-Styrene; 3 - Alkyd Resins; 4 - Amino Resins; 5 - Engineering Thermoplastics (Polyphenylene Oxide and Polyphenylene Sulfide); 6 - Epoxy Resins; 7 - Fluoropolymers; 8 - Phenolic Resins; 9 - Polyacetals; 10 - Polyamide Resins; 11 - Polybutylene; 12 - Polycarbonate; 13 - High Density Polyethylene; 14 - Linear Low Density Polyethylene; 15 - Low Density Polyethylene; 16 - Polyethylene Terephthalate/Polybutylene Terephthalate; 17 - Polypropylene; 18 - Polystyrene/General Purpose; 19 - Polystyrene/Impact Modified; 20 - Polyurethane; 21 - Polyvinyl Acetate; 22 - Polyvinyl Alcohol; 23 - Polyvinyl Chloride/Flexible; 24 - Polyvinyl Chloride/Rigid; 25 - Polyvinylidene Chloride; 26 - Styrene-Acrylonitrile; 27 - Unsaturated Polyester Resin.

(Continued)

TABLE A-16 (Continued)

Ultraviolet Stabilizer	Form	Solubility		Melting Point (Boiling Point), °C	Specific Gravity at 20°C	Use Concen- tration %	FDA Sanction†	Applicability to Polymer Type (See First Page of Table for Number Code)																										
		Water	Organics					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
BENZOPHENONES (Continued)																																		
4(Heptyloxy)-2-hydroxybenzophenone [Uvistat 247]																																		
2-Hydroxy-4-acryloxyethoxybenzo- phenone	Powder					0.25-1.0														X	X	X		X								X		
2-Hydroxy-4(-2-ethylhexoyl)benzo- phenone																																		
2-Hydroxy-4-1sooctoxybenzophenone	Liquid					0.1-1.0	X							X						X				X	X	X				X	X	X	X	
2-Hydroxy-4-methoxybenzophenone [Uvinul M 40], [Cyasorb UV9]	Powder		Soluble	62-63.5 (150-160 (670 Pa))	1.324 (25°C)	0.1-1.5	X		X	X	X													X	X	X				X	X	X	X	
2-Hydroxy-4-methoxy-5-methylbenzo- phenone [Uvistat 2211]																																		
2-Hydroxy-5-methoxybenzophenone																																		
2-Hydroxy-1-methoxy-5-sulfobenzo- phenone [Uvinul MS-40]	Powder			145																														
2-Hydroxy-4-methoxy-5-sulfobenzo- phenone [Cyasorb UV-284]																																		
2-Hydroxy-4-n-octyloxybenzophenone [Cyasorb UV 531]	Powder		Soluble	48-49	1.160 (25°C)	0.1-1.0	X		X	X	X			X	X				X	X	X	X		X	X	X	X			X	X	X	X	
Mark 1535	Liquid					0.1-1.0			X		X								X	X	X		X	X	X				X	X	X		X	
Permyl B100 [Substituted phenone]	Powder					0.3-0.7													X	X	X		X	X				X	X			X		
Resyn 78-6121 [low molecular weight alkyl methacrylate-substi- tuted benzophenone]																																		
2,2',4,4'-Tetrahydroxybenzophenone [Uvinul D-50]	Powder				1.216																													
Uvinul 490 [mixture of 2,2'-dihy- droxy-4,4'-dimethoxybenzophenone]	Powder			Mixture 80	1.084	0.1-1.5								X																			X	

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TABLE A-16 (Continued)

Ultraviolet Stabilizer	Form	Solubility		Melting Point (Boiling Point), °C	Specific Gravity at 20°C	Use Concen- tration %	FDA Sanction†	Applicability to Polymer Type (See First Page of Table for Number Code)																										
		Water	Organics					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
<u>BENZOTRIAZOLES</u>																																		
2(3'-t-Butyl-2'-hydroxy-5'-methyl-phenyl)-5-chlorobenzotriazole [Tinuvin 326]	Powder	Insoluble	Slight	140-141		0.1-3.0	X	X	X										X	X	X	X							X	X	X	X		
2(3',5'-Di-t-butyl-2'-hydroxy-phenyl)-5-chlorobenzotriazole [Tinuvin 327]	Powder	Insoluble	Soluble	154-158	1.20	0.1-3.0		X	X										X	X	X	X			X				X	X	X	X		
2(2'-Hydroxy-3',5-di-t-amyl-phenyl)benzotriazole [Tinuvin 328]	Powder	Insoluble	Soluble	81 (391(d))	0.91	0.1-3.0		X	X										X	X	X	X	X	X					X	X	X	X		
2(2'-Hydroxy-3',5'-di-t-butyl-phenyl)benzotriazole [Tinuvin 320]	Powder			152-154		0.1-3.0		X	X										X	X	X								X	X	X	X		
2(2'-Hydroxy-5'-methylphenyl)-benzotriazole [Tinuvin P]	Powder	Insoluble	Slight	128-132 (225 (1300 Pa))	1.51	0.01-1.5	X	X	X										X						X	X			X	X	X	X		
2(2'-hydroxy-5-t-octylphenyl)-benzotriazole	Powder	Insoluble	Soluble	101-105	1.18 (25°C)	0.1-1.0	X	X	X	X									X	X	X	X	X	X	X	X			X	X	X	X		
Mark 446	Powder			55-58		0.1-1.0														X	X	X			X	X			X	X	X	X		
<u>NICKEL ORGANICS</u>																																		
Bis(2,2'-thiobis(4-t-octylphenylato))nickel [See Nickel bis(octylphenyl sulfide)]																																		
Mark 1306A	Powder					0.1-1.0														X	X	X	X											
Negopex A																																		
Nickel bis(O-ethyl(3,5-di-t-butyl-4-hydroxybenzyl))phosphonate [Irgastab 2002]	Powder			137-149		0.1-1.0														X	X	X	X											
Nickel bis(octylphenyl sulfide) [Ferro AM-101 and AM-105]	Flakes			130	1.060	0.1-1.5														X	X	X	X											
Nickel dibutyldithiocarbamate [Ni(SC(S)N(C <sub>4</sub> H <sub>9</sub> ) <sub>2</sub> ) <sub>2</sub> ]	Flakes	Insoluble	Soluble	86-88	1.26	0.25-1.5														X	X	X	X											

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TABLE A-16 (Continued)

Ultraviolet Stabilizer	Form	Solubility		Melting Point (Boiling Point), °C	Specific Gravity at 20°C	Use Concen- tration %	FDA Sanction†	Applicability to Polymer Type (See First Page of Table for Number Code)																										
		Water	Organics					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
NICKEL ORGANICS (Continued)																																		
Nickel diisobutyldithiocarbamate [ISO Butyl Niclate]	Powder	Insoluble	Slight	173-181	1.27	0.1-0.5														X	X	X		X										
Nickel dimethyldithiocarbamate [Methyl Niclate]	Powder	Insoluble	Slight	>290(d)	1.77	0.1-2.5														X	X	X		X										
10% Nickel Hex-Cem	Liquid					Normal																									X	X	X	
10071 PE MB	Pellets					5.0-10.0														X	X	X												
Sanduvor NFU [Phenylmethyl- decanoyl pyrazolate-Nickel]	Powder			140-160		0.1-1.0														X	X	X		X										
(2,2'-Thiodis(4-t-octylpheno- lato))-n-butylamine nickel [Cyasorb UV 1084]	Powder		Soluble	258-261	1.13 (25°C)	0.25-0.5		X												X	X	X		X										
UV Chex AM-205	Flakes			140		0.1-1.5														X	X	X		X										
MISCELLANEOUS, ACRYLATES																																		
Butyl 2-cyano-3-methyl-3-(p-meth- oxyphenyl)acrylate [UV Absorber 317]	Liquid																																	
N-(8-Cyano-8-carbomethoxyvinyl)- 2-methylindoline [UV Absorber 340]	Powder			98		0.5-5.0																		X	X			X	X	X		X		
Ethyl 2-cyano-3,3-diphenylacrylate [Uvinul N-35]	Powder			96-98		1.164																												
2-Ethylhexyl 2-cyano-3,3-diphenyl- acrylate [Uvinul N-539]	Liquid			-10		1.048																												
Methyl-2-carbomethoxy-3-(p-meth- oxyphenyl)acrylate [Cyasorb UV-1988]	Powder			58																														
Methyl 2-cyano-3-methyl-3-(p-meth- oxyphenyl)acrylate [UV Absorber 318]	Powder			65-85																														

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TABLE A-16 (Continued)

844

Ultraviolet Stabilizer	Form	Solubility		Melting Point (Boiling Point), °C	Specific Gravity at 20°C	Use Concen- tration %	FDA Sanction†	Applicability to Polymer Type (See First Page of Table for Number Code)																										
		Water	Organics					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
<u>MISCELLANEOUS, SALICYLATES</u>																																		
p-t-Butyl phenyl salicylate	Colorless Crystal	Insoluble	Soluble	62-66		0.2-0.6	X	X	X								X	X	X		X	X	X							X	X			
10316 COP MP [Proprietary]	Pellets					10.0											X	X	X															
Diethylene glycol salicylate [C <sub>6</sub> H <sub>5</sub> (OCCOC <sub>2</sub> H <sub>4</sub> O) <sub>2</sub> C <sub>6</sub> H <sub>5</sub> ]	Liquid	Insoluble	Soluble		1.16 (40°C)																													
2-Ethylhexyl salicylate																																		
p-Octylphenyl salicylate [C <sub>6</sub> H <sub>5</sub> (OCCOC <sub>8</sub> H <sub>17</sub> )C <sub>6</sub> H <sub>5</sub> ] [Inhibitor OPS]	Powder	Insoluble	Soluble	72-74	5.6 lbs/gal	0.5-2.0											X	X	X		X													
Phenyl salicylate [C <sub>6</sub> H <sub>5</sub> (OCCOC <sub>6</sub> H <sub>5</sub> )C <sub>6</sub> H <sub>5</sub> ]	Solid	Sparingly	Soluble	42 (172-173)	1.2614												X	X	X										X	X	X			
p-(1,1,3,3-Tetramethylbutyl)phenyl salicylate [See Octylphenyl salicylate]																																		
<u>OTHER MISCELLANEOUS AND PROPRIETARY</u>																																		
AST-1001	Liquid					1.0-50.0											X	X	X		X	X			X	X	X		X	X	X	X		
Barium metaborate, modified	Powder			>1000		2.0-10.0		X		X							X	X	X		X	X	X		X	X		X	X		X			
Bis(2,2,6,6-tetramethyl-4-piperi- dinoxy)sebacate																	X	X	X		X													
Carbon black [C]	Powder	Insoluble	Insoluble														X	X			X	X	X		X									
Chimassorb 944 [Hindered amine]	Powder					0.1-0.4											X	X	X		X													
C-HDPE-2764 [Hindered amine]	Powder																																	
C-PFR-8004 [Hindered amine]	Powder																																	
C-PFR-8005 [Hindered amine]	Powder																																	

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TABLE A-16 (Continued)

Ultraviolet Stabilizer	Form	Solubility		Melting Point (Boiling Point), °C	Specific Gravity at 20°C	Use Concen- tration %	FDA Sanction†	Applicability to Polymer Type (See First Page of Table for Number Code)																										
		Water	Organics					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
OTHER MISCELLANEOUS AND PROPRIETARY (Continued)																																		
Copper Iodide	Powder	Insoluble		606	5.653 (15°C)														X															
2,4-Dibenzoyl resorcinol	Crystals	Insoluble	Soluble	125-128																														
3,5-Di-t-butyl-p-hydroxybenzoic acid	Powder			200-210		0.5-1.0														X	X	X		X										
2,4-Di-t-butylphenyl-3,5-di-t-butyl-4-hydroxybenzoate [UV Check AM-340]	Powder			196		0.2-1.0														X	X	X		X										
2,4-Di-t-butylphenyl-3,5-di-t-butyl-4-hydroxybenzoate	Powder			196		0.2-1.0														X	X	X		X										
Dimethyl-2-(4-methoxybenzylidene) malonate																																		
Good-rite UV 3034 [Hindered amine]								X												X	X			X									X	
N-Hexadecyl-3,5-di-t-butyl-4-hydroxybenzoate	Powder			60		0.1-1.0		X												X	X	X		X									X	
Hexamethyl phosphoric triamide [Inhibitor HPT]	Liquid	Soluble	Soluble	(230-239)	1.021 (16°C)																										X			
Hostavin N20	Crystalline Powder	Insoluble		225		0.1-1.0		X											X	X	X	X	X		X		X							
2-(2-Hydroxy-4-methoxybenzoyl) benzoic acid [Oyasorb UV 207]																																		
Manganese Iodide	Solid	Soluble		638	5.01														X															
Parabolix-100	Liquid					0.1-10.0		X																	X	X	X						X	
FDI-0199 [benzophenone/hindered amine mixture]															X												X						X	
10328 PE MB, 10359 PE MB	Pellets					2.0-8.0														X	X	X												
40375 PP MP [Hindered amine]	Pellets					1.0-2.0																				X								

(Continued)

TABLE A-16 (Continued)

Ultraviolet Stabilizer	Form	Solubility		Melting Point (Boiling Point), °C	Specific Gravity at 20°C	Use Concen- tration %	FDA Sanction†	Applicability to Polymer Type (See First Page of Table for Number Code)																											
		Water	Organics					1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	
OTHER MISCELLANEOUS AND PROPRIETARY (Continued)																																			
Resorcinol monobenzoate [C <sub>6</sub> H <sub>4</sub> (COOC <sub>6</sub> H <sub>5</sub> )OH]	Powder	Slight	Slight	132-135 (140 (20 Pa))		1.0-2.0																									X	X		X	X
Sanduvor EPU [oxalanilide]	Powder			116-124		0.1-0.5											X	X	X		X														
Sanduvor VSU [oxalanilide]	Powder			127		0.1-0.5																								X	X		X	X	
Tinuvin 144 [stearically hindered amine]	Powder			150		0.1-0.5			X		X						X	X	X		X		X											X	
Tinuvin 770 [stearically hindered amine]	Powder			150		0.1-0.5			X		X						X	X	X		X		X											X	
Tinuvin 662 [hindered amine]	Powder	Insoluble		(300)		0.25-1.0	X																								X			X	
Titanium dioxide	Powder	Insoluble	Insoluble																																
UV-Chek 541A	Powder					0.1-2.0																											X	X	X
UV-Chek AM-595	Powder					0.1-2.0																											X	X	X
Vanstay L [phosphate-type stabilizer]	Powder					2.60 mg/m <sup>3</sup>	3.0																										X		
Zinc oxide	Powder	Insoluble	Insoluble	>1800	5.47	2.0-10.0			X		X							X	X	X		X	X	X											X

FOOTNOTES: †The Federal Register and Code of Federal Regulations detail UV Stabilizers approved for food contact applications. FDA Sanctions are given for specific chemicals and approval is generally based upon extent of extraction of the stabilizer from the polymer. Maximum use concentrations may also be delineated. The Code of Federal Regulations subparts 175.105 for adhesives; 177.2660 for rubbers and 178.2010 for plastics should be consulted to determine specific regulations for UV Stabilizers.



# APPENDIX B. CONSUMPTION AND OTHER USES FOR PLASTICS ADDITIVES

## TABLE B-1. ANTIOXIDANTS

<u>Antioxidant</u>	<u>Consumption†</u>	<u>Use</u>
<u>PHENOLICS</u>		
1,2-Bis(3,5-di-t-butyl-4-hydroxyhydrocinnamoyl)hydrazine [Irganox MD 1024]		
2,6-Bis(1-methylheptadecyl)-p-cresol		
4-((4,6-Bis(octylthio)-s-triazin-2-yl)-amino)-2,6-di-t-butylphenol		
Bisphenol A [(CH <sub>3</sub> ) <sub>2</sub> C(C <sub>6</sub> H <sub>4</sub> OH) <sub>2</sub> ]	1.4 x 10 <sup>8</sup> kgs (75) (total)	Intermediate in manufacture of epoxy, polycarbonate, phenoxy, polysulfone and certain polyester resins; flame retardants; rubber chemicals
Butylated Bisphenol A [Vanox 1004]		
Butylated hydroxyanisole [BHA], [(CH <sub>3</sub> ) <sub>3</sub> CC <sub>6</sub> H <sub>3</sub> OH(OCH <sub>3</sub> )]	1.9 x 10 <sup>5</sup> kgs (80) (in plastics)	Antioxidant for fats and oils; food packaging
Butylated hydroxytoluene [BHT], [DBPC], [Di-t-butyl-p-cresol]	6.4 x 10 <sup>6</sup> kgs (80) (in plastics)	30% antioxidant in rubber; 30% antioxidant in plastics; 20% antioxidant in petroleum; 15% antioxidant in food and animal feed; 5% in miscellaneous applications
Butylated octylated phenol		
Butylated reaction product of p-cresol and dicyclopentadiene		
Butylated styrenated cresols		
4,4'-Butylidenebis(6-t-butyl-m-cresol) [Santowhite powder]		Antioxidant for rubber, dry or latex
Cyclohexylidenebis(2-cyclohexylphenol)		
2,6-Di-t-butyl dimethyl amino-p-cresol [Ethanox 703], [(C <sub>4</sub> H <sub>9</sub> ) <sub>2</sub> C <sub>6</sub> H <sub>2</sub> OH(CH <sub>2</sub> N(CH <sub>3</sub> ) <sub>2</sub> )]		
2,6-Di-t-butyl-4-ethylphenol		

(Continued)

TABLE B-1 (Continued)

<u>Antioxidant</u>	<u>Consumption†</u>	<u>Use</u>
<u>PHENOLICS (Continued)</u>		
3,5-Di-t-butyl-4-hydroxybenzyl alcohol [Antioxidant 754]		
3,5-Di-t-butyl-4-hydroxyhydrocinnamic acid, 1,3,5-tris(2-hydroxyethyl)-s- triazine-2,4,6(1H,3H,5H)-trione [Good-Rite 3125]		
2,6-Di-t-butyl methylamino-p-cresol		
2,4-Di(α-methylbenzyl)-4-methylphenol		
Dioctadecyl(3,5-di-t-butyl-4-hydroxy- benzyl)phosphonate [Irganox 1093]		
Hexamethylenebis(3,5-di-t-butyl hydroxy- cinnamate) [Irganox 259]		
N,N-Hexamethylenebis-(3,5-di-t-butyl-4- hydroxyhydrocinnamamide) [Irganox 1098]		
2(-4-Hydroxy-3,5-t-butylanilino)-4,6-bis- (n-octylthio)1,3,5-triazine [Irganox 565]		
4-Hydroxymethyl-2,6-di-t-butylphenol		Antioxidant for gasoline and other hydrocarbons
3-Methyl-6-t-butylphenol/crotonaldehyde condensate		
2,2-Methylenebis(6-t-butyl-4-ethylphenol) [Cyanox 425]		
2,2'-Methylenebis(6-t-butyl-4-methyl- phenol) [See 2,2'-Methylenebis(4-methyl- 6-t-butylphenol)]		

(Continued)

TABLE B-1 (Continued)

<u>Antioxidant</u>	<u>Consumption†</u>	<u>Use</u>
<u>PHENOLICS</u> (Continued)		
4,4'-Methylenebis(2,6-di-t-butylphenol) [Ethanox 702]		Oxidation inhibitor and antiwear agent for motor oils, aviation piston engine oils, and industrial oils; antioxidant for rubbers, resins and adhesives
2,2'-Methylenebis(4-methyl-6-t-butylphenol) [CAO 5], [Bis(2-Hydroxy-3-t-butyl-5-methyl phenyl)methane], [Cyanox 2246]		
2,2-Methylenebis(6(1-methylcyclohexyl)-p-cresol) [Nonox WSP]		Antioxidant
2,2-Methylenebis(4-methyl-6-nonylphenol) [Naugawhite]		
4-Methyl-2-(1-methylcyclohexyl)phenol [Nonox WSL]		
Octadecyl 3,5-di-t-butyl-4-hydroxyhydrocinnamate [Irganox 1076]	5.4 x 10 <sup>5</sup> kgs (80) (in plastics)	
Phenol alkylated with approximately 1:4 ratio of 2,3-Benzofuran and Indene [Nevastain A], [Nevastain B]		
Tetrakis(methylene(3,5-di-t-butyl-4-hydroxyhydrocinnamate))methane [Irganox 1010]	1.3 x 10 <sup>6</sup> kgs (80) (in plastics)	
4,4'-Thiobis(6-t-butyl-m-cresol) [Santonox]		Protection of light-colored rubber from oxidation and of non-staining neoprene compounds against deterioration; antioxidant for olefins
4,4'-Thiobis(6-t-butyl-o-cresol) [Antioxidant 736], [Santonox R]		
2,2'-Thiobis(6-t-butyl)-4-methylphenol) [CAO 4]		

(Continued)

TABLE B-1 (Continued)

<u>Antioxidant</u>	<u>Consumption†</u>	<u>Use</u>
<u>PHENOLICS (Continued)</u>		
4,4'-Thiobis(2-t-butyl)5-methylphenol) [see 4,4'-Thiobis(6-t-butyl-m-cresol)]		
Thiodiethylenebis(3,5-di-t-butyl-4-hydroxy)hydrocinnamate [Irganox 1035]		
2,2'-(3,5,5-Trimethylhexylidene)bis(4,6-dimethyl phenol) [Nonox WSO]		
1,3,5-Trimethyl-2,4,6-tris(3,5-di-t-butyl-4-hydroxybenzyl)benzene [Ethyl 330]		Antioxidant for polypropylene, high-density polyethylene, spandex fibers, polyamides and specialty rubbers
1,3,5-Tris(4-t-butyl-3-hydroxy-2,6-dimethylbenzyl)1,3,5-triazine-2,4,6-(1H, 3H, 5H)-trione [Cyanox 1790]		
1,3,5-Tris(3,5-di-t-butyl-4-hydroxy-phenyl)methyl-1,3,5-triazine-2,4,6-(1H, 3H, 5H)-trione [Good-Rite 3114]		
Tris(2-methyl-4-hydroxy-5-t-butylphenyl)-butane [Topanol CA]		
<u>AROMATIC AMINES</u>		
N-(1,3-Dimethylbutyl)-N'-phenyl-1,4-benzendiamine [Vulkanox 4020]		
Di-β-naphtha-p-phenylenediamine		
4-Isopropyl-N'-phenyl-p-phenylenediamine [Vulkanox 1040 NA]		Protection of rubbers against oxidation, ozone, flex-cracking and poisoning by copper and manganese
4-(1-Methyl-1-phenylethyl)-N-(4-(1-methyl-1-phenylethyl)phenyl)benzenamine [Naugard 445]		

(Continued)

TABLE B-1 (Continued)

<u>Antioxidant</u>	<u>Consumption†</u>	<u>Use</u>
<u>THIOESTERS</u>		
Dicetyl thiodipropionate		
Dilauryl thiodipropionate	1.1 x 10 <sup>6</sup> kgs (80) (in plastics)	Antioxidant; additive for high-pressure lubricants and greases; plasticizer and softening agent; antioxidant for edible fats and oils; stabilization of food packaging films
Dimethyl thiodipropionate		
Dimyristyl thiodipropionate	1.4 x 10 <sup>5</sup> kgs (80) (in plastics)	
Distearyl thiodipropionate	1.1-1.4 x 10 <sup>6</sup> kgs (80) (in plastics)	Antioxidant; plasticizer; softening agent
Ditridecyl thiodipropionate		Stabilizer; plasticizer and softening agent for plastics; lubricant additive
Mixed lauryl-stearyl thiodipropionate [Cyanox 1212]		
Pentaerythritol tetrakis(8-lauryl thiodipropionate)		
<u>PHOSPHORUS COMPOUNDS</u>		
Alkylaryl bisphenol phosphite		
Bis-tridecyl phosphite		
2-t-Butyl-a(3-t-butyl-4-hydroxyphenyl)-p- cumenyl-bis(p-nonylphenyl)phosphite		
Dibutyl phosphite	>4.5 x 10 <sup>2</sup> kgs (75) (total)	Solvent; antioxidant; intermediate
Didecyl phosphite		
Disodecyl pentaerythritol phosphite [Weston 600]		

(Continued)

TABLE B-1 (Continued)

<u>Antioxidant</u>	<u>Consumption†</u>	<u>Use</u>
<u>PHOSPHORUS COMPOUNDS</u> (Continued)		
Diisodecyl pentaphosphite		
Dilauryl phosphite [(C <sub>12</sub> H <sub>25</sub> O) <sub>2</sub> PHO]		Synthesis of organic phosphorus compounds for extreme pressure lubricants, adhesives, textile finishing agents, pesticides; catalyst in polymerization of unsaturated compounds
Dimethyl phosphite [(CH <sub>3</sub> O) <sub>2</sub> PHO]	>4.5 x 10 <sup>2</sup> kgs (75) (total)	Lubricant additives; intermediate; adhesive; fire retardant
Diocetyl phosphite [(C <sub>8</sub> H <sub>17</sub> O) <sub>2</sub> PHO]		Solvent; antioxidant; intermediate
Dioleyl phosphite	>4.5 x 10 <sup>2</sup> kgs (75) (total)	Antioxidant
Diphenyl decyl phosphite [(C <sub>6</sub> H <sub>5</sub> O) <sub>2</sub> POC <sub>10</sub> H <sub>21</sub> ]		Chemical intermediate; stabilizer for polyvinyl and polyolefin resins
Diphenyl isodecyl phosphite [Weston DPDP]		
Diphenyl phosphite [Weston DPP]		Synthesis of organophosphorus compounds
Distearyl pentaerythritol diphosphite [Weston 618]	5.9 x 10 <sup>5</sup> kgs (80) (in plastics)	
Ditetradecyl phosphite [Dimystyl phosphite]		
Isooctyl diphenyl phosphite [Mark C]		
Octyl diphenyl phosphite		
Phenyl didecyl phosphite [C <sub>6</sub> H <sub>5</sub> OP(OC <sub>10</sub> H <sub>21</sub> ) <sub>2</sub> ]		Chemical intermediate; antioxidant; ingredient in stabilizer systems for resins
Tetrakis(2,4-di-t-butylphenyl)-(1,1-bisphenyl)-4,4'-diylbisphosphite [Sandostab P-EPQ]		
Tributyl phosphite [(C <sub>4</sub> H <sub>9</sub> O) <sub>3</sub> P]		Additive for greases and extreme-pressure lubricants; stabilizer for fuel oils and polyamides; gasoline additive

(Continued)

TABLE B-1 (Continued)

<u>Antioxidant</u>	<u>Consumption†</u>	<u>Use</u>
<u>PHOSPHORUS COMPOUNDS</u> (Continued)		
Tridecyl phosphite [(C <sub>10</sub> H <sub>20</sub> ) <sub>3</sub> P]		Chemical intermediate; stabilizer for polyvinyl and polyolefin resins
Trisodecyl phosphite [Weston TDP]		
Trisononylphenyl phosphite		
Trisooctyl phosphite [Weston TIOP]		Intermediate for insecticides; component of vinyl stabilizers; lubricant additive; specialty solvent
Triisopropyl phosphite [(CH <sub>3</sub> ) <sub>2</sub> CH] <sub>3</sub> PO <sub>3</sub>	>4.5 x 10 <sup>2</sup> kgs (75) (total)	Intermediate for insecticides; component of vinyl stabilizers; lubricant additive; specialty solvent; antioxidant
Trilauryl phosphite [Weston TLP]		Stabilizer in polymers; chemical intermediate
Trilauryl trithiophosphite [Weston TLTP]		Stabilizer; lubricant; chemical intermediate
Trimethyl phosphite [(CH <sub>3</sub> O) <sub>3</sub> P]		Chemical intermediate, especially for insecticides
Trioctyl phosphite [Tris-2-ethylhexyl phosphite], [C <sub>4</sub> H <sub>9</sub> CH(C <sub>2</sub> H <sub>5</sub> )CH <sub>2</sub> O] <sub>3</sub> P]		Synthesis; plasticizers; stabilizers; lube and grease additives; flameproofing compositions
Triphenyl phosphite [(C <sub>6</sub> H <sub>5</sub> O) <sub>3</sub> P]		Chemical intermediate; stabilizer system for resins; metal scavenger; diluent for epoxy resins
Tri(polynonylphenyl)phosphite [Polygard]		
Tris(2-chloroethyl)phosphite [(ClC <sub>2</sub> H <sub>4</sub> O) <sub>3</sub> P]	>9.1 x 10 <sup>2</sup> kgs (75) (total)	Intermediate; component of vinyl stabilizers; grease additives; flameproofing compositions; color inhibitor in esterification
Tris(2,4-di-t-butylphenyl)phosphite		
Trisnonylphenyl phosphite	7.7 x 10 <sup>5</sup> kgs (80) (in plastics)	
Trisnonylphenyl phosphite/formaldehyde polymer [Wytox 438]		
Tristearyl phosphite [Weston TSP]		

(Continued)

TABLE B-1 (Continued)

<u>Antioxidant</u>	<u>Consumption†</u>	<u>Use</u>
<u>MISCELLANEOUS, QUINONES</u>		
p-Benzoquinone [C <sub>6</sub> H <sub>4</sub> O <sub>2</sub> ]		Manufacture of dyes and hydroquinone; fungicides; chemical intermediate; rubber accelerator; oxidizing agent; polymerization inhibitor; photographic chemical; strengthening animal fibers; reagent
2,5-Di-t-butylhydroquinone		Polymerization inhibitor; antioxidant; stabilizer against ultraviolet deterioration of rubber
Hydroquinone [C <sub>6</sub> H <sub>4</sub> (OH) <sub>2</sub> ]		Photographic developer; dye intermediate; medicine; antioxidant; inhibitor; stabilizer in paints and varnishes, motor fuels and oils; antioxidant for fats and oils; inhibitor of polymerization
Hydroquinone monomethyl ether [CH <sub>3</sub> OC <sub>6</sub> H <sub>4</sub> OH]		Manufacture of antioxidants, pharmaceuticals, plasticizers, dyestuffs; stabilizer for chlorinated hydrocarbons and ethyl cellulose; inhibitor for acrylic monomer and acrylonitriles; ultraviolet inhibitor; stabilizer in textile lubricating oils; chemical intermediate
Mono-t-butylhydroquinone [C <sub>6</sub> H <sub>3</sub> (OH) <sub>2</sub> C(CH <sub>3</sub> ) <sub>3</sub> ]	>2.3 x 10 <sup>3</sup> kgs (76) (total)	Intermediate; antioxidant in vegetable fats and oils
Toluhydroquinone [CH <sub>3</sub> C <sub>6</sub> H <sub>3</sub> (OH) <sub>2</sub> ]		Antioxidant; polymerization inhibitor
<u>MISCELLANEOUS, OTHER</u>		
Distearyl disulfide		
Mark 1475 [N-(2H,1,2,4-triazol-5-yl)- salicylamide]		
Thermolite 31 [Bis(isooctyloxycarbonyl- methylthio)dibutylstannate]		
Thiodipropionic acid [HOOCCH <sub>2</sub> SCH <sub>2</sub> CH <sub>2</sub> COOH]		Preservative and antioxidant for edible fats and oils; pharmaceuticals; food packaging ingredient
Zinc dibutyldithiocarbamate [Zn(SC(S)N(C <sub>4</sub> H <sub>9</sub> ) <sub>2</sub> ) <sub>2</sub> ]		Accelerator for latex dispersions, cements, etc.; ultra-accelerator for lubricating oil additive

†Annual Consumption is presented parenthetically for the most recent year available.



TABLE B-2. ANTISTATIC AGENTS  
CONSUMPTION AND OTHER USES

<u>Antistatic Agent</u>	<u>Consumption†</u>	<u>Use</u>
<u>AMINES</u>		
Bis(hydroxyethyl) coco amine		
Bis(hydroxyethyl) tallow amine		
Ethoxylated amines		
Octadecyl amine salt of stearic acid		
2,2'-(Octadecylimino)bisethanol		
Polyoxyethylene alkyl amine [Milstat N-20]		
Triethanolamine		Fatty acid soaps used in dry cleaning, cosmetics, household detergents, and emulsions; wool scouring; textile antifume agent and water repellent; dispersion agent; corrosion inhibitor; softening agent, humectant, and plasticizer; insecticide; chelating agent; rubber accelerator
Triethanolamine salt of octadecyl phosphonic acid		
<u>QUATERNARY AMMONIUM COMPOUNDS</u>		
AHCO C-330		
Baraquat CME [N-Cetyl-n-ethyl-morpholinium etho sulfate]		Shampoos; disinfectant; deodorant; antistatic agent
Benzyl hexadecyldimethyl ammonium chloride		Medicine; gericide; fungicide; surface-active agent
N,N-Bis(2-hydroxyethyl)-N-(3-dodecyloxy-2-hydroxypropyl) methylammonium methosulfate		Antistatic agent
(Carboxymethyl)dimethyl-octadecyl ammonium hydroxide		

(Continued)

TABLE B-2 (Continued)

<u>Antistatic Agent</u>	<u>Consumption†</u>	<u>Use</u>
<u>QUATERNARY AMMONIUM COMPOUNDS</u> (Continued)		
(Carboxymethyl)hexadecyl- dimethyl ammonium hydroxide		
Dihexadecyldimethyl ammonium chloride		
Dimethyldioctadecyl ammonium chloride		
Dioctyldimethyl ammonium bromide		
(3-(Dodecyloxy)2-hydroxypropyl) bis(2-hydroxyethyl)methyl ammonium methyl sulfate		
Salt of Guanidine and octa- decyltrimethyl ammonium chloride		
(2-Hydroxyethyl)dimethyl(3- stearamidopropyl) ammonium nitrate		
(3-Lauramidopropyl)trimethyl- ammonium methyl sulfate		
Stearamidopropyldimethyl-2- hydroxyethylammonium dihydrogen phosphate		Antistatic for plastics, waxes, textiles, and glass; emulsifier; dispersant
Stearamidopropyldimethyl-2- hydroxyethylammonium nitrate		Antistatic agent for plastics, surface coatings, paper, and glass; dispersant
Tetrabutyl ammonium bromide		
Trimethyl ammonium methyl- sulfate		

(Continued)

TABLE B-2 (Continued)

<u>Antistatic Agent</u>	<u>Consumption†</u>	<u>Use</u>
<u>ANIONICS</u>		
Didodecyl hydrogen phosphate		
$\alpha$ -Dodecyl- $\omega$ -hydroxypoly(oxy-1,2-ethanediyl)phosphate		
Garfac RS 710		
$\alpha$ -Nonylphenyl- $\omega$ -hydroxypoly(oxy-1,2-ethanediyl) phosphate		
Potassium alkyl phosphate		
Sodium dodecylbenzene sulfonate		Synthetic detergent
$\alpha$ -Tridecyl- $\omega$ -hydroxypoly(oxy-1,2-ethanediyl) phosphate		
<u>MISCELLANEOUS</u>		
Butyl stearate		Ingredient of polishes, special lubricants and coatings; lubricants for metals, and in textile and molding industries; in wax polishes as dye solvent; plasticizer for laminated fiber products, rubber hydrochloride, chlorinated rubber, and cable lacquers; carbon paper and inks; emollient in cosmetics and pharmaceutical products; lipsticks; damp-proofer for concrete; flavoring
Glycerol		Alkyd resins; explosives; ester gums; pharmaceuticals; perfumery; plasticizer for regenerated cellulose; cosmetics; foodstuffs, conditioning tobacco; liqueurs; solvent; printers ink rolls; polyurethane polyols; emulsifying agent; rubber stamp and copying inks; binder for cements and mixes; paper coatings and finishes; special soaps; lubricant and softener; bacteriostat; penetrant; hydraulic fluid; humectant

(Continued)

TABLE B-2 (Continued)

<u>Antistatic Agent</u>	<u>Consumption†</u>	<u>Use</u>
<u>MISCELLANEOUS (Continued)</u>		
Glycerol monostearate [1-mono-stearin]		Thickening and emulsifying agent for margarine, shortenings and other food products; flavoring; emulsifying agent for oils, waxes and solvents; protective coating for hygroscopic powders; cosmetics; opacifier; detackifier; resin lubricant
Polyethylene glycol hexadecyl ether		
Polyethylene glycol monodecyl ether		
Polyethylene glycol 200 monolaurate		
Polyethylene glycol monostearate	3.1 x 10 <sup>6</sup> kgs (75)	Emulsifier in cosmetics; pharmaceuticals; textile finishes; defoamers; dye assistant; lubricant; antistatic agent
Sorbitan, dodecanoate, poly-(oxy-1,2-ethanediyl) derivatives		
Tris(isooctadecanoato-0)-(2-propanolato)titanium		
<u>INORGANICS</u>		
Aluminum flakes		POWDER: Paints and protective coatings; rocket fuel; incendiary mixtures; catalyst; foamed concrete; vacuum metallizing and coating plastics FLAKES: Insulation of liquid fuels; plastics
Carbon black		Pigment; reinforcing agent; pigment for cements, ceramic ware, mortar, inks, linoleum, surface coatings, crayons, polishes, carbon paper, soap, etc.; in insulating compositions; liquid-air explosives; matches; fertilizers; furnace lutes; lubricating compositions; carbon brushes

(Continued)

TABLE B-2 (Continued)

<u>Antistatic Agent</u>	<u>Consumption†</u>	<u>Use</u>
<u>INORGANICS (Continued)</u>		
Lithium chloride		Air conditioning; welding and soldering flux; dry batteries; heat exchange media; salt baths; desiccant; humectant; production of lithium metal; soft drinks and mineral water to reduce the escape of carbon dioxide

†Annual Consumption is presented parenthetically for the most recent year available.

TABLE B-3. BLOWING AGENTS AND OTHER ADDITIVES FOR FOAMED PLASTICS  
CONSUMPTION AND OTHER USES

<u>Blowing Agent/Foam Modifier</u>	<u>Consumption†</u>	<u>Use</u>
<u>PHYSICAL BLOWING AGENTS</u>		
Acetone [ $\text{CH}_3\text{COCH}_3$ ]	$8.2 \times 10^8$ kgs (82) (total)	Chemicals (methyl isobutyl ketone, methyl isobutyl carbinol, methyl methacrylate, bisphenol-A); paint, varnish and lacquer solvent; cellulose acetate, especially as spinning solvent; to clean and dry parts of precision equipment; solvent for potassium iodide and permanganate; delusterant for cellulose acetate fibers; specification testing of vulcanized rubber products; photographic films; storing acetylene gas; hardening and hydrating tissues; nail polish remover; food additive
Air		
Ammonia [ $\text{NH}_3$ ]	$1.4 \times 10^{10}$ kgs (82) (total)	Fertilizers; manufacture of nitric acid, hydrazine hydrate, caprolactam, acrylonitriles, hydrogen cyanide, urethane, acrylonitrile and sodium carbonate; refrigerant; nitriding of steel; condensation catalyst; synthetic fibers; dyeing; neutralizing agent in petroleum industry; latex preservative; sulfite cooking liquors; fuel cells; rocket fuel; yeast nutrient; developing diazo films; explosives; solvent; cleaning and bleaching; cotton defoliant
Benzene [ $\text{C}_6\text{H}_6$ ]	$3.5 \times 10^9$ kgs (82) (total)	Ethylbenzene (for styrene monomer); dodecylbenzene (for detergents); cyclohexane (for nylon); phenol; nitrobenzene (for aniline); maleic anhydride; chlorobenzene; diphenyl; benzene hexachloride; benzene sulfonic acid; anthraquinone; cumene; solvent; antiknock gasoline
Carbon dioxide [ $\text{CO}_2$ ]	$3.4 \times 10^9$ kgs (82) (total)	Refrigeration; carbonated beverages; aerosol propellant; chemical intermediate; low temperature testing; fire extinguishing; inert atmospheres; municipal waste treatment; medicine; enrichment of air in greenhouses; fracturing and acidizing oil wells; mining; miscellaneous pressure source; hardening of foundry molds and cores; shielding gas for welding; cloud seeding, moderator in some nuclear reactors; immobilization for humane animal killings; special lasers; blowing agent
Dichlorodifluoromethane [see Freon 12]		
1,2-Dichloroethane [ $\text{ClCH}_2\text{CH}_2\text{Cl}$ ]	$4.5 \times 10^9$ kgs (82) (total)	Vinyl chloride intermediate (Wulff process); solvent; lead scavenger in antiknock gasoline; paint, varnish, and finish removers; metal degreasing; soaps and scouring compounds; wetting and penetrating agents; organic synthesis of trichloroethylene, perchloroethylene and methyl chloroform; ore flotation

(Continued)

TABLE B-3 (Continued)

<u>Blowing Agent/Foam Modifier</u>	<u>Consumption†</u>	<u>Use</u>
<u>PHYSICAL BLOWING AGENTS (Continued)</u>		
Dichloromethane [see Methylene Chloride]		
Ethyl alcohol [C <sub>2</sub> H <sub>5</sub> OH]	4.5 x 10 <sup>9</sup> kgs (82) (total)	Solvent for resins, fats, oils, fatty acids, hydrocarbons, alkali hydroxides; extractive medium; manufacture of intermediates, organic derivatives (especially acetaldehyde), dyes, synthetic drugs, esters, elastomers, detergents, cleaning solutions, surface coatings, cosmetics, pharmaceuticals, explosives, antifreeze; beverages; antisepsis; medicine; gasoline additive; yeast growth medium
Freon 11 [Trichlorofluoromethane]	1.2 x 10 <sup>8</sup> kgs (75) (total)	Refrigerant; propellant; blowing agent; cleaning compound; fire extinguishers; monomer for resins
Freon 11A		
Freon 11B [Trichlorofluoromethane]		
Freon 12 [Dichlorodifluoromethane]	1.8 x 10 <sup>8</sup> kgs (75) (total)	Propellant; degreaser; monomer for resins; refrigerant and air conditioner; blowing agent; low temperature solvent; leak detecting agent; freezing of foods by direct contact; chilling cocktail glasses
Freon 22		
Freon 113 [1,1,2-trichlorotrifluoroethane], [Cl <sub>2</sub> CFCClF <sub>2</sub> ]	>4.5 x 10 <sup>2</sup> kgs (75) (total)	Refrigerant; solvent for photographic film and magnetic tape; cleaning agent for plastics and electronic equipment; intermediate for fluoropolymers; fire extinguishers; blowing agent; dry cleaning solvent; to make chlorotrifluoroethylene
Freon 114 [Dichlorotetrafluoroethane], [Cl <sub>2</sub> CFCF <sub>3</sub> ]	1.8 x 10 <sup>3</sup> kgs (79) (total)	Solvent; fire extinguishers; refrigerant and air conditioner; aerosol propellants; blowing agent; dielectric fluid; monomer for resins
Freon HE [Blend of Freon 11]		
n-Heptane [CH <sub>3</sub> (CH <sub>2</sub> ) <sub>5</sub> CH <sub>3</sub> ]		Standard for octane rating determinations; anesthetic; solvent; organic synthesis; preparation of laboratory reagents
n-Hexane [CH <sub>3</sub> (CH <sub>2</sub> ) <sub>4</sub> CH <sub>3</sub> ]	1.8 x 10 <sup>8</sup> kgs (79) (total)	Solvent, especially for vegetable oils, low temperature thermometers; calibrations; polymerization reaction medium; paint diluent; alcohol denaturant; determination of refractive index of materials

(Continued)

TABLE B-3 (Continued)

<u>Blowing Agent/Foam Modifier</u>	<u>Consumption†</u>	<u>Use</u>
<u>PHYSICAL BLOWING AGENTS (Continued)</u>		
Isopentane [2-methylbutane], [(CH <sub>3</sub> ) <sub>2</sub> CHCH <sub>2</sub> CH <sub>3</sub> ]	7.3 x 10 <sup>8</sup> kgs (72) (total)	Solvent; manufacture of chlorinated and alcohol derivatives; blowing agent for polystyrene; antiknock gasoline additive
Isopropyl alcohol [CH <sub>3</sub> CH(OH)CH <sub>3</sub> ]	5.9 x 10 <sup>8</sup> kgs (82) (total)	Manufacture of acetone and its derivatives; manufacture of glycerol and isopropyl acetate; solvent for essential and other oils, alkaloids, gums, resins, shellacs, etc.; latent solvent for cellulose derivatives; coatings solvent; deicing agent for liquid fuels; pharmaceuticals; perfumes; lacquers; extraction processes; dehydrating agent; preservative; quick drying inks; antiseptic; coupling agent in oil emulsions
Isopropyl ether	3.6 x 10 <sup>6</sup> kgs (75) (total)	Solvent for animal, vegetable, mineral oils, waxes, and resins; extraction of acetic acid from aqueous solutions; solvent for dyes in presence of small amounts of alcohol; paint and varnish removers; spotting compositions; rubber cements
K-11 [See Freon 11]		
Methylene chloride [CH <sub>2</sub> Cl <sub>2</sub> ]	2.3 x 10 <sup>8</sup> kgs (75) (total)	Solvent for photographic film, synthetic fibers and cellulose acetate; paint removers; propellant for aerosol sprays; sol- vent degreasing; plastics processing; blowing agent in foams; solvent extraction; refrigerant; fire extinguishers
Nitrogen [N <sub>2</sub> ]	1.6 x 10 <sup>10</sup> kgs (82) (total)	Production of ammonia, acrylonitrile, cyanamide, cyanides, nitrides; inert gas for purging, blanketing and exerting pressure; electric and electronic industries; in-transit food refrigeration and freeze drying; pressurizing liquid propel- lants; quick-freezing foods; chilling in aluminum foundries; bright annealing of steel; cryogenic preservation; inert pressuring and blanketing gas in missiles; food antioxidant; source of pressure in oil wells; inflating tires
n-Pentane [CH <sub>3</sub> (CH <sub>2</sub> ) <sub>3</sub> CH <sub>3</sub> ]	3.3 x 10 <sup>7</sup> kgs (79) (total)	Artificial ice manufacture; low temperature thermometers; solvent extraction processes; blowing agent in plastics; pesticide; propellant; refrigerant; fuel; cleaning and degreasing
Perchloroethylene [Cl <sub>2</sub> C:CCl <sub>2</sub> ]		Dry cleaning solvent; vapor-degreasing solvent; drying agent for metals and certain other solids; vermifuge; heat trans- fer medium; manufacture of fluorocarbons

(Continued)



TABLE B-3 (Continued)

<u>Blowing Agent/Foam Modifier</u>	<u>Consumption†</u>	<u>Use</u>
<u>PHYSICAL BLOWING AGENTS (Continued)</u>		
Toluene [C <sub>6</sub> H <sub>5</sub> CH <sub>3</sub> ]	2.3 x 10 <sup>10</sup> kgs (82) (total)	Aviation gasoline and high octane blending stock; benzene, phenol, and caprolactam; solvent for paints and coatings, gums, resins, most oils, rubber, vinyl organosols; diluent and thinner in nitrocellulose lacquers; adhesive solvent in plastic toys and model airplanes; chemicals (benzoic acid, benzyl and benzoyl derivatives, saccharin, medicines, dyes, perfumes); source of toluene diisocyanates; explosives (TNT); toluene sulfonates; scintillation counter
Tetrachloromethane [Carbon tetrachloride], [CCl <sub>4</sub> ]	3.2 x 10 <sup>8</sup> kgs (79) (total)	Refrigerants and propellants, especially the chlorofluorohydrocarbons; metal degreasing; agricultural fumigant; chlorinating organic compounds; production of semiconductors; solvents
Trichloroethylene	2.0 x 10 <sup>8</sup> kgs (75) (total)	Metal degreasing; extraction solvent for oils, fats, waxes; solvent dyeing; dry cleaning; refrigerant and heat exchange liquid; fumigant; cleaning and drying electronic parts; diluent in paint and adhesives; textile processing; chemical intermediate; aerospace operations (flushing liquid oxygen); pharmaceuticals
Trichlorofluoromethane [see Freon 11]		
Trichloromethane [Chloroform], [CHCl <sub>3</sub> ]	1.6 x 10 <sup>8</sup> kgs (79) (total)	Fluorocarbon refrigerants and propellants; fluorocarbon plastics; solvent; analytical chemistry; fumigant; insecticides
1,1,2-Trichlorotrifluoroethane [see Freon 113]		
Water [H <sub>2</sub> O]		
<u>CHEMICAL BLOWING AGENTS</u>		
Ammonium bicarbonate [NH <sub>4</sub> HCO <sub>3</sub> ]		Production of ammonium salts; dyes; leavening agent for cookies, crackers, cream puff doughs; fire extinguishing compounds; pharmaceuticals; degreasing textiles; blowing agent for foam rubber; boiler scale removal; compost treatment; ceramics; fertilizer; tanning; smelling salts
Ammonium carbonate [(NH <sub>4</sub> )HCO <sub>3</sub> ·NH <sub>2</sub> COONH <sub>4</sub> ]		Ammonium salts; medicine (expectorant); baking powders; smelling salts; fire extinguishing compounds; pharmaceuticals; textiles (mordant); fermentation accelerator in wine manufacture; organic chemicals; ceramics; washing wool

(Continued)

TABLE B-3 (Continued)

<u>Blowing Agent/Foam Modifier</u>	<u>Consumption†</u>	<u>Use</u>
<b>CHEMICAL BLOWING AGENTS (Continued)</b>		
1,1'-Azobiscyclohexanecarbonitrile		
Azobisformamide [Azodicarbonamide], [ABFA], [AZ], [H <sub>2</sub> NCON:NCONH <sub>2</sub> ]	8.2 x 10 <sup>6</sup> kgs (82) (in plastics)	Blowing agent for plastics and rubbers; maturing agent for flours; food additive
Azobisformamide, nonplateout		
Azobis(isobutyronitrile) [AZDN]		Catalyst for vinyl polymerizations and for curing unsaturated polyester resins; blowing agent for plastics
Barium azodicarboxylate		
Benzene disulfonyl dihydrazide		
Benzene sulfonyl hydrazide [BSH]		
1,3-Bis(o-xenyl)triazene		
2-Butylazo-2-hydroxy-5-methylhexane [Lucel 7-Azo]		
2-Butylazo-2-methoxy-5-methylpentane [Lucel 135]		
Celogen CB [Proprietary hydrazide]		
Celogen HT-500 [Modified hydrazine derivative]		
Celogen HT-550 [Hydrazine derivative]		
Celogen XP-100 [Sulfonyl hydrazide type]		
Citric acid [HOC(CH <sub>2</sub> CO <sub>2</sub> H) <sub>2</sub> CO <sub>2</sub> H]		
Diazoaminobenzene [1,3-Diphenyl- triazene]		Organic synthesis; dyes; insecticide
N,N'-di-t-butylazobisformamide		

(Continued)

TABLE B-3 (Continued)

<u>Blowing Agent/Foam Modifier</u>	<u>Consumption†</u>	<u>Use</u>
<u>CHEMICAL BLOWING AGENTS (Continued)</u>		
N,N'-di-n-decylazobisformamide		
N,N'-Dinitroso-N,N'-dimethylterephthalamide [N,N'-dimethyl-N,N'-dinitrosoterephthalamide], [NTA]		
Dinitrosopentamethylenetetramine	>4.5 x 10 <sup>2</sup> kgs (79) (total)	Blowing agent for rubber and plastics
Diphenylsulfon-3,3'-disulfonyl hydrazide		
N,N'-Diphenylazobisformamide		
Ethylene carbonate [OC(CH <sub>2</sub> ) <sub>2</sub> ]		Solvent for many polymers and resins; solvent extraction; synthesis of pharmaceuticals, rubber chemicals, textile finishing agents
Expandex 150 [5-phenyltetrazole analog]		
Expandex 175 [5-phenyltetrazole analog]		
Ficel AF-100		
KemTec 350		
KemTec 500		
N-Nitroguanidine		High explosives, especially flashless propellant powder; chemical intermediate
Nitropore ATA		
N-Nitrourea		Explosives
Oxamic acid [NH <sub>2</sub> COCOOH]		
p,p'-Oxybis(benzene sulfonyl hydrazide) [OBSSH]	4.5 x 10 <sup>5</sup> kgs (82) (in plastics)	Blowing agent for sponge rubber and expanded plastics

(Continued)

TABLE B-3 (Continued)

<u>Blowing Agent/Foam Modifier</u>	<u>Consumption†</u>	<u>Use</u>
<u>CHEMICAL BLOWING AGENTS (Continued)</u>		
p,p'-Oxybis(benzene sulfonyl semicarbazide) [OBSC]		
5-Phenyl tetrazine		
5-Phenyl tetrazole		
Potassium borohydride [KBH <sub>4</sub> ]		Source of hydrogen; reducing agent for aldehydes, ketones and acid chlorides; foaming agent for plastics
Salicylaldehyde hydrazone		
Silicon oxyhydride		
Sodium bicarbonate [NaHCO <sub>3</sub> ]		Manufacture of effervescent salts and beverages, artificial mineral water, baking powder; other sodium salts; pharmaceuticals; sponge rubber; gold and platinum plating; treating wool and silk; fire extinguishers; ceramics; prevention of timber mold; laboratory reagent; antacid; mouthwash; skin ointment; cleaning compound
Sodium borohydride [NaBH <sub>4</sub> ]		Source of hydrogen, diborane, and other borohydrides; reduces aldehydes, ketones, and acid chlorides; bleaching wood pulp; blowing agent for plastics; precipitation of mercury from waste effluent; decolorizer for plasticizers; recycling of gold and platinum group metals; inorganic and organometallic reductions; organic synthesis
3,3'-Sulfonbis(benzene sulfonyl hydrazide)		
p-Toluene sulfonyl hydrazine		
p-Toluene sulfonyl semicarbazide [TSSC]		Blowing agent
Trihydrazine triazine [THT], [Cyanuric trihydrazide]		

(Continued)

TABLE B-3 (Continued)

<u>Blowing Agent/Foam Modifier</u>	<u>Consumption†</u>	<u>Use</u>
<u>BLOWING AGENT CATALYSTS</u>		
Actafoam P2		
Actafoam R-3		
Actafoam R-5		
Actafoam R-10		
Actafoam R-34		
BIK [urea (surface treated)]		Urea: Fertilizer; animal feed; plastics; chemical intermediate; stabilizer in explosives; medicine; adhesives; separation of hydrocarbons (as urea adducts); sulfamic acid production; flameproofing agents; viscosity modifier for starch and casein-based paper coatings; reported helpful in treating sickle-cell anemia
Interstab ABC 1		
Interstab ABC 2		
Interstab ABC 6		
Interstab ABC 7		
Interstab ABC 18		
Interstab ABC 50		
Nuostab V-1530 [Zinc-based activator]		
RIA		
Zinc oxide		Diffusing pigment; accelerator; activator; reinforcing agent; ointments; pigment and mold-growth inhibitor in paints; ceramics; floor tile; glass; zinc salts; feed additive; dietary supplement; seed treatment; cosmetics; semiconductor; photoconductor; dental cement; flame retardant; antiseptic

(Continued)

TABLE B-3 (Continued)

<u>Blowing Agent/Foam Modifier</u>	<u>Consumption†</u>	<u>Use</u>
<u>SURFACTANTS</u>		
<u>SILICONES</u>		
Dabco [silicone, tetraethylene-diamine]		
Dimethylsilicone oil		
Dow 190 [silicone-glycol]		
Dow 192 [silicone-glycol]		
Dow 193 [silicone]		
Dow 194 [silicone-glycol]		
Dow 195 [silicone-glycol]		
Dow 197 [silicone-glycol]		
Dow 1250 [silicone-glycol]		
Dow 1251 [silicone-glycol]		
Dow 1252 [silicone-glycol]		
Dow 1253 [silicone-glycol]		
Dow 1254 [silicone-glycol]		
Dow 1312 [silicone-glycol]		
Dow F-11630 [silicone-glycol]		
G. E. SS-4255 [silicone]		
Tegostab B 3640 [silicone]		
Tegostab B 4113 [silicone]		
Union Carbide L-520 [silicone]		
Union Carbide L-532 [silicone]		

(Continued)

TABLE B-3 (Continued)

<u>Blowing Agent/Foam Modifier</u>	<u>Consumption†</u>	<u>Use</u>
<u>SILICONES (Continued)</u>		
Union Carbide L-540 [silicone]		
Union Carbide L-546 [silicone]		
Union Carbide L-548 [silicone]		
Union Carbide L-550 [silicone]		
Union Carbide L-562 [silicone]		
Union Carbide L-5302		
Union Carbide L-5303		
Union Carbide L-5305		
Union Carbide L-5307		
Union Carbide L-5340		
Union Carbide L-5350		
Union Carbide L-5410		
Union Carbide L-5420		
Union Carbide L-5430		
Union Carbide L-5612		
Union Carbide L-5710		
Union Carbide L-5720		
Union Carbide L-6202		
Union Carbide LC-5613		
Union Carbide Y-6402		
Union Carbide Y-6454		

(Continued)

TABLE B-3 (Continued)

<u>Blowing Agent/Foam Modifier</u>	<u>Consumption†</u>	<u>Use</u>
<u>SURFACTANTS</u>		
<u>MISCELLANEOUS</u>		
Air Prod LK-221 [organic amine]		
Air Prod LK-322 [all organic]		
Air Prod LK-443		
Empicol LZ [sodium alkyl sulfate]		
Ethylan TC [amine ethylene oxide]		
Ethylan TCO [fatty amine oxide]		
Interwet 212 [non-ionic ester]		
Zonyl FSA [fluorosurfactant]		
Zonyl FSB [fluorosurfactant]		
Zonyl FSC [fluorosurfactant]		
Zonyl FSJ [fluorosurfactant]		
Zonyl FSN [fluorosurfactant]		
Zonyl FSP		
<u>NUCLEATING AGENTS</u>		
Adipic Acid		Manufacture of nylon and polyurethane foams; preparation of esters for use as plasticizers and lubricants; food additive; adhesives
Benzoic Acid		Sodium and butyl benzoates; plasticizers; benzoyl chloride; alkyd resins; food preservative; seasoning tobacco; flavors; perfumes; dentrifices; medicine
Calcium carbonate [CaCO <sub>3</sub> ]	2.5 x 10 <sup>9</sup> kgs (81) (in plastics)	Source of lime; neutralizing agent; filler and extender in rubber, plastics, and paints; opacifying agent in paper; fortification of bread; putty; tooth powders; antacid; white-wash; Portland cement; SO <sub>2</sub> removal from stack gases; metallurgical flux; analytical chemistry; CO <sub>2</sub> generation

(Continued)



TABLE B-3 (Continued)

<u>Blowing Agent/Foam Modifier</u>	<u>Consumption†</u>	<u>Use</u>
<u>NUCLEATING AGENTS (Continued)</u>		
Silica [ $\text{SiO}_2$ ]	$8.2 \times 10^7$ lbs (80) (in plastics)	Manufacture of glass, water glass, ceramics; abrasives; water filtration; component of hydraulic cements; source of ferro-silicon and elemental silicon; filler in cosmetics, pharmaceuticals, paper, insecticides; rubber reinforcing agent; anticaking agent for foods; flatting agent in paints; thermal insulator
Sodium silicofluoride [ $\text{Na}_2\text{SiF}_6$ ]		Fluoridation of drinking water; laundry sours; opalescent glass; vitreous enamel frits; metallurgy of aluminum and beryllium; insecticide and rodenticides; chemical intermediate; glue, leather, and wood preservative
Talc	$1.5 \times 10^8$ kgs (82) (in plastics)	Ceramics; cosmetics and pharmaceuticals; filler and pigment in rubber, paints, soap, putty, plaster, oilcloth; adherent; dusting agent; lubricant; paper; slate pencils and crayons; electrical insulation; insecticide diluent; refractories; filtration

†Annual Consumption is presented parenthetically for the most recent year available.

TABLE B-4. CATALYSTS FOR THERMOPLASTICS POLYMERIZATION  
CONSUMPTION AND OTHER USES

Catalyst	Consumption†	Use
Acetic Acid [CH <sub>3</sub> COOH]	1.3 x 10 <sup>9</sup> kgs (82) (total)	Manufacture of acetic anhydride, cellulose acetate, vinyl acetate monomer, acetic esters, and chloroacetic acid; production of plastics, rubbers, pharmaceuticals, dyes, insecticides, photographic chemicals; food additive; latex coagulant; oil well acidizer; textile printing
Acetic Anhydride [(CH <sub>3</sub> CO) <sub>2</sub> O]	5.0 x 10 <sup>8</sup> kgs (82) (total)	Cellulose acetate fibers and plastics; vinyl acetate; dehydrating and acetylating agent in production of pharmaceuticals, dyes, perfumes, explosives; aspirin; esterifying agent for food starch
N-Acetylcaprolactam		
Acetyl perchlorate		
Aluminum Chloride [AlCl <sub>3</sub> ]		Ethylbenzene catalyst; dyestuff intermediate; detergent alkylate; ethyl chloride; pharmaceuticals and organics; butyl rubber; petroleum refining; hydrocarbon resins; nucleating agent for titanium dioxide pigments
Aluminum isopropoxide [Al(OC <sub>3</sub> H <sub>7</sub> ) <sub>3</sub> ]		Dehydrating agent; catalyst; waterproofing textiles
Aluminum oxide	4.5 x 10 <sup>9</sup> kgs (75) (total)	Production of aluminum; manufacture of abrasives, refractories, ceramics, electrical insulators, catalyst and catalyst supports; paper; spark plugs; crucibles and laboratory ware; absorbing gases and water vapors; chromatographic analysis; fluxes; light bulbs; artificial gems; heat resistant fibers; desiccant; abrasive; electrical insulation; dental cements; artificial gems; chromatography
ε-Aminocaprolactam		
Ammonium hexafluorotitanate [(NH <sub>4</sub> ) <sub>2</sub> TiF <sub>6</sub> ]		
Antimony trifluoride		Procelain; pottery; dyeing; fluorinating agent
Antimony trioxide [Sb <sub>2</sub> O <sub>3</sub> ]		Flame proofing textiles, paper, plastics; paint pigments; ceramic opacifier; catalyst; intermediate; staining iron and copper; phosphors; mordant; glass decolorizer

(Continued)

TABLE B-4 (Continued)

<u>Catalyst</u>	<u>Consumption†</u>	<u>Use</u>
Benzil [C <sub>6</sub> H <sub>5</sub> CO·COC <sub>6</sub> H <sub>5</sub> ]		Organic synthesis; insecticide
Benzophenone [(C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> CO]		Organic synthesis; odor fixative; derivatives are used as UV absorbers; flavoring; soap fragrance; pharmaceuticals; polymerization inhibitor for styrene
Biacetal		Carrier of aroma for butter, vinegar, coffee and other foods; synthetic flavoring substance and adjunctive
Bis(cyclopentadienyl) titanium chloride		
Bis(triphenylsilyl) chromate [[(C <sub>6</sub> H <sub>5</sub> ) <sub>3</sub> SiO] <sub>2</sub> CrO <sub>2</sub> ]		
Boric Acid [H <sub>3</sub> BO <sub>3</sub> ]		Heat resistant glass; glass fibers; porcelain enamels; boron chemicals; metallurgy; fireproofing compositions; fungus control; ointment and eyewash; nickel electroplating
Boron trifluoride		Catalyst in organic synthesis; instruments for measuring neutron intensity; silver soldering fluxes; gas brazing
Boron trifluoride dibutyl-etherate		
Boron trifluoride etherate		
Butyl lithium		Polymerization of isoprene and butadiene; intermediate in preparation of lithium hydride; rocket fuel component; metalating agent
Butyl zinc		
Cadmium acetate [Cd(OOCCH <sub>3</sub> ) <sub>2</sub> ]		Ceramics (glazes); manufacture of acetates; assistant in dyeing and printing textiles; laboratory reagent
Calcium acetate [Ca(CH <sub>3</sub> COO) <sub>2</sub> ]		Manufacture of acetone, acetic acid, acetates; mordant in dyeing and printing textiles; stabilizer in resins; additive in calcium soap; lubricants; food additive; catalyst manufacture; medicine

(Continued)

TABLE B-4 (Continued)

<u>Catalyst</u>	<u>Consumption†</u>	<u>Use</u>
Carbon dioxide [CO <sub>2</sub> ]	3.4 x 10 <sup>9</sup> kgs (82) (total)	Refrigerant; carbonated beverages; manufacture of carbonates; fire prevention and extinction; inert gas blanketing of reactors; propellant for aerosols; antiseptic in bacteriology and frozen food industry; treatment of carbon monoxide poisoning; shielding-arc welding; in greenhouses to increase growth rate; manufacture of drugs and white lead; textile and leather industry; processing and preserving food; production of urea, sodium carbonate, methanol, carbonic acid, inorganic carbonates, petroleum, and hydrocarbons; oil well stimulation; livestock slaughtering; municipal water treatment; as fertilizer
p-Chlorophenyl diazonium hexafluoroarsenate		
p-Chlorophenyl diazonium hexaphosphate		
Chromocene [(C <sub>5</sub> H <sub>5</sub> ) <sub>2</sub> Cr]		
Chromic Acid [CrO <sub>3</sub> ]		Chromates; oxidizing agents; catalysts; chromium plating, process engraving; intermediate; medicine; anodizing; ceramic glazes; colored glaze; metal cleaning; inks; tanning; paints; textile mordant
Chromyl chloride [CrO <sub>2</sub> Cl <sub>2</sub> ]		Organic oxidation and chlorination; solvent for chromic anhydride; chromium complexes and dyes
Cobalt acetate [CO(C <sub>2</sub> H <sub>3</sub> O <sub>2</sub> ) <sub>2</sub> ]		Sympathetic inks; paint and varnish dryers; catalyst; anodizing; mineral supplement in feed additives; foam stabilizer
Cobalt on charcoal		
Copper (I) chloride [CuCl]		Catalyst; preservative and fungicide; desulfurizing agent; decolorizing agent in petroleum industry; absorbent for carbon monoxide
Copper (II) chloride [CuCl <sub>2</sub> ]		Isomerization and cracking catalyst; mordant in dyeing and printing fabrics; sympathetic ink; disinfectant; pyrotechnics; wood preservation; fungicides; metallurgy; deodorizing and desulfurizing petroleum distillates; photography; water purification; feed additive

(Continued)

TABLE B-4 (Continued)

<u>Catalyst</u>	<u>Consumption†</u>	<u>Use</u>
Cyanuric chloride [C <sub>3</sub> N <sub>3</sub> Cl <sub>3</sub> ]		Chemical synthesis; dyestuffs; herbicides; optical brighteners
Dibutyl aluminum chloride [Al(C <sub>4</sub> H <sub>9</sub> ) <sub>2</sub> Cl]		
Diethyl aluminum chloride [(C <sub>2</sub> H <sub>5</sub> ) <sub>2</sub> AlCl]		Polyolefin catalyst; intermediate in production of organometallics
Diethyl ethoxy aluminum [AlEt <sub>2</sub> OEt]		
Diethyl zinc [ZnEt <sub>2</sub> ]		Organic synthesis; catalyst for polymerization of olefins; high energy aircraft and missile fuel; production of ethyl mercuric chloride
Di-(2-methyl borneal) chromate		
Di(triphenylsilyl) chromate		
Ethyl aluminum sesquichloride [(C <sub>2</sub> H <sub>5</sub> ) <sub>3</sub> Al <sub>2</sub> Cl <sub>3</sub> ]	>9.1 x 10 <sup>2</sup> kgs (75) (total)	Catalyst for olefin polymerization; aromatic hydrogenation; intermediate
Ethyl magnesium bromide		Grignard-type reactions
Ferric acetyl acetonate [Fe(OC(CH <sub>3</sub> ):CHC(O)CH <sub>3</sub> ) <sub>3</sub> ]		Moderating and combustion catalyst; solid fuel catalyst; bonding agent; curing accelerator; intermediate
Germanium dioxide [GeO <sub>2</sub> ]		Special glass mixtures; phosphors; transistors and diodes
Iodine		Dyes (aniline dyes, phthalein dyes); catalyst; iodides; iodates; pharmaceuticals; process engraving and lithography; special soaps; analytical reagent; iodized salt; medicine; in special lubricants for titanium and stainless steel parts
Lead acetate [Pb(C <sub>2</sub> H <sub>3</sub> O <sub>2</sub> ) <sub>2</sub> ]		Medicine; lead salts; dyeing of textiles; waterproofing; varnishes; lead dryers; chrome pigments; gold cyanidation process; insecticide; antifouling paints; analytical reagent
Lead dioxide [PbO <sub>2</sub> ]		Oxidizing agent; electrodes; lead-acid storage batteries; curing agent for polysulfide elastomers; textiles (dyeing); matches; explosives; analytical reagent

(Continued)

TABLE B-4 (Continued)

<u>Catalyst</u>	<u>Consumption†</u>	<u>Use</u>
Lead oxide [PbO]	1.2 x 10 <sup>8</sup> kgs (75) (total)	Storage batteries; ceramic cements and fluxes; pottery and glazes; glass; chromium pigments; oil refining; dryer for varnishes, paints, enamels, ink, linoleum; insecticides; metal cement; acid-resisting compositions; match-head compositions; rubber accelerator; chemical intermediate; ointments; plasters; coloring sulfur-containing substances; artificial tortoise shell and horn
Lithium acetate [LiC <sub>2</sub> H <sub>3</sub> O <sub>2</sub> ]		
Lithium s-butoxide		
Lithium carbonate [Li <sub>2</sub> CO <sub>3</sub> ]		Ceramic and porcelain glazes; pharmaceuticals; catalyst; other lithium compounds; coating for arc welding electrodes; nucleonics; luminescent paints, varnishes and dyes; glass ceramics; aluminum production
Lithium hydride [LiH]		Desiccant; source of hydrogen; condensing agent in organic synthesis; preparation of lithium amide and double hydrides; nuclear shielding material; reducing agent; manufacture of electronic tubes; ceramics
Magnesium		Alloys for structural parts, die-cast auto parts, missiles, space vehicles; powder for pyrotechnics and flash photography; production of iron, nickel, zinc, etc.; magnesium compounds and Grignard synthesis; cathodic protection; reducing agent; precision instruments; optical mirrors, dry and wet batteries.
Magnesium acetate [Mg(OOCCCH <sub>3</sub> ) <sub>2</sub> ]		Dye fixative in textile printing; medicine; deodorant; disinfectant; antiseptic
Magnesium dichloride [MgCl <sub>2</sub> ]		Source of magnesium metal; disinfectants; fire extinguishers; fireproofing wood; magnesium oxychloride cement; refrigerating brines; ceramics; cooling drilling tools; textiles; paper manufacture; road dust-laying compounds; floor sweeping compounds; flocculating agent; catalyst

(Continued)

TABLE B-4 (Continued)

<u>Catalyst</u>	<u>Consumption†</u>	<u>Use</u>
Magnesium hydroxide [Mg(OH) <sub>2</sub> ]		Intermediate for obtaining magnesium metal; sugar refining; medicine; residual fuel oil additive; sulfite pulp; uranium processing; dentifrices; in foods as alkali, drying agent, color retention agent; frozen desserts
Magnesium hydroxychloride [Mg(OH)Cl]		
Magnesium oxide [MgO]		Refractories; polycrystalline ceramic for aircraft windshields; electrical insulation; cosmetics; inorganic rubber accelerator; oxychloride and oxy-sulfate cements; paper manufacture; fertilizers; removal of sulfur dioxide from stack gases; adsorption and catalysis; semiconductors; pharmaceuticals; food and feed additive
Magnesium sulfate [MgSO <sub>4</sub> ]		Fireproofing; textiles; mineral waters; catalyst carrier; ceramics; fertilizers; paper sizing; cosmetic lotions; dietary supplement; medicine
Manganese acetate [Mn(C <sub>2</sub> H <sub>3</sub> O <sub>2</sub> ) <sub>2</sub> ]		Textile dyeing; oxidation catalyst; paint and varnish dryer; fertilizers; food packaging; feed additive
Manganese dioxide		Oxidizing agent; depolarizer in dry cell batteries; pyrotechnics, matches, etc.; catalyst; laboratory reagent; scavenger and decolorizer; textile dyeing
Molybdenum trioxide [MoO <sub>3</sub> ]		Source of molybdenum compounds; agriculture; analytical chemistry; manufacture of metallic molybdenum; corrosion inhibitor; ceramic glazes; enamels; pigments; catalyst in petroleum industry; medicine
Nickel on charcoal		
Palladium [Pd]		Alloys for electrical relays and switching systems in telecommunications equipment; catalyst for petroleum; metallizing ceramics; "white gold" jewelry; resistant wires; hydrogen valves; aircraft spark plugs; protective coatings

(Continued)

TABLE B-4 (Continued)

<u>Catalyst</u>	<u>Consumption†</u>	<u>Use</u>
Perchloric acid		Medicine; analytical chemistry; catalyst; manufacture of various esters; ingredient of the electrolytic bath in the deposition of lead; electro-polishing; explosives
Phenyl isocyanate [C <sub>6</sub> H <sub>5</sub> NCO]		Reagent for identifying alcohols and amines; intermediate
Phenyl-N-phenyl benzimidooether		
Phosphoric acid [H <sub>3</sub> PO <sub>4</sub> ]	7.8 x 10 <sup>9</sup> kgs (82) (total)	Fertilizers; soaps and detergents; inorganic phosphates; pickling and rust-proofing metals; pharmaceuticals; sugar refining; gelatin manufacture; water treatment; animal feeds; electro-polishing; gasoline additive; conversion coatings for metals; dyeing; yeast; soil stabilizer; waxes and polishes; binder for ceramics; activated carbon; in foods and carbonated beverages; laboratory reagent; source of uranium
Potassium carbonate [K <sub>2</sub> CO <sub>3</sub> ]		Special glasses (optical and color TV tubes); potassium silicate; dehydrating agent; pigments; printing inks; laboratory reagent; soft soaps; raw wool washing; general purpose food additive
Potassium ferrocyanide [K <sub>3</sub> Fe(CN) <sub>6</sub> ]		Medicine; potassium cyanide and ferricyanide; dry colors; tempering steel; dyeing; explosives; process engraving and lithography; laboratory reagent
Potassium triphenyl methoxide		
Pyridine [N(CH) <sub>4</sub> CH]		Synthesis of vitamins and drugs; solvent; water-proofing; rubber chemicals; denaturant for alcohol and antifreeze mixtures; dyeing assistant for textiles; fungicides
Sodium acetate		Dye and color intermediate; pharmaceuticals; cinnamic acid; soaps; photography; purification of glucose; meat preservation; medicine; electroplating; tanning; dehydrating agent; buffer in foods; laboratory reagent
Sodium caprolactam		

(Continued)



TABLE B-4 (Continued)

<u>Catalyst</u>	<u>Consumption†</u>	<u>Use</u>
Sodium carbonate [ $\text{Na}_2\text{CO}_3$ ]	$7.2 \times 10^9$ kgs (82) (total)	Medicine; photography; cleaning and boiler compounds; pH-control of water; food additive
Sodium hydride [NaH]		Condensing or alkylating agent; descaling metals; reducing agent and reduction catalyst
Sodium hydroxide [NaOH]	$8.4 \times 10^9$ kgs (82) (total)	Chemical manufacture; rayon and cellophane; petroleum refining; pulp and paper; aluminum; detergents; soap; textile processing; vegetable oil refining; reclaiming rubber; regenerating ion exchange resins; organic fusions; peeling of fruits and vegetables; laboratory reagent; etching and electroplating
Sodium hypophosphite [ $\text{NaH}_2\text{PO}_2$ ]		Medicine; reducing agent in electroless nickel plating of plastics and metals; laboratory reagent
Sodium methoxide	$5.0 \times 10^6$ kgs (75) (total)	Catalyst in condensation reactions; catalyst for treatment of edible fats and oils; intermediate for pharmaceuticals; preparation of sodium cellulose; analytical reagent; ester-alcohol interchange
Stannic chloride		Electroconductive and electroluminescent coatings; textiles; perfume stabilization; manufacture of fuchsin; color lakes; ceramics; bleaching agent for sugar; stabilizer for certain resins; manufacture of blue print and other sensitized papers; other tin salts; bacteria and fungi control in soaps
Sulfuric acid [ $\text{H}_2\text{SO}_4$ ] [ $\text{SO}_3$ in $\text{H}_2\text{O}$ ]	$2.9 \times 10^{10}$ kgs (82) (total)	Fertilizers; chemicals; inorganic pigments; petroleum refining; etchant; alkylation catalyst; electroplating baths; iron and steel; rayon and film; industrial explosives; laboratory reagent; nonferrous metallurgy
Tetraallyl zirconium [ $\text{Zr}(\text{allyl})_4$ ]		
Tetrabenzyl titanium [ $\text{Ti}(\text{C}_6\text{H}_5)_4$ ]		
Tetrabenzyl zirconium [ $\text{Zr}(\text{C}_6\text{H}_5)_4$ ]		

(Continued)

TABLE B-4 (Continued)

<u>Catalyst</u>	<u>Consumption†</u>	<u>Use</u>
Tetrabutyl zirconate [Zr(OC <sub>4</sub> H <sub>9</sub> ) <sub>4</sub> ]		Condensation catalyst and crosslinking agent
Tetrabutyl titanium [TiBu <sub>4</sub> ]		
Tetraethyl titanium [Ti(OC <sub>2</sub> H <sub>5</sub> ) <sub>4</sub> ]		
N,N,N',N'-Tetramethylethylene- diamine [(CH <sub>3</sub> ) <sub>2</sub> NCH <sub>2</sub> CH <sub>2</sub> N (CH <sub>3</sub> ) <sub>2</sub> ]		Preparation of epoxy curing agents; polyurethane formation; corrosion inhibitor; textile finishing agents; intermediate for quaternary ammonium compounds
Tetramethylguanidine [(CH <sub>3</sub> ) <sub>2</sub> NC(NH)N(CH <sub>3</sub> ) <sub>2</sub> ]		
Thiocarboximide		
Titanium dichloride [TiCl <sub>2</sub> ]		
Titanium dichloride diiso- propylate [TiCl <sub>2</sub> (OPr) <sub>2</sub> ]		
Titanium dioxide [TiO <sub>2</sub> ]	2.0 x 10 <sup>8</sup> kgs (82) (in plastics)	White pigment; opacifying agent; cosmetics; radio- active decontamination of skin; floor coverings; glassware and ceramics; enamel frits; delustering synthetic fibers; printing inks; welding rods; source of titanium metal; synthetic sunscreens; dusting powder
Titanium isopropylate [Ti(OC <sub>3</sub> H <sub>7</sub> ) <sub>4</sub> ]		Ester exchange reactions; adhesion of paints, rub- ber and plastic to metals; condensation catalyst; flue gas sorbent; controlled release pesticide
Titanium tetrachloride [TiCl <sub>4</sub> ]		For titanium and titanium salts; mordant dye; irri- descent effects in glass; smoke screen; titanium pigments; polymerization catalyst
Titanium trichloride [TiCl <sub>3</sub> ]		Reducing agent; organic synthesis; cocatalysts for polyolefin polymerization; organometallic synthesis involving titanium; laundry stripping agent
Triallyl hafnium bromide		
Triallyl titanium bromide [Ti(allyl) <sub>3</sub> Br]		

(Continued)

TABLE B-4 (Continued)

<u>Catalyst</u>	<u>Consumption†</u>	<u>Use</u>
Triallyl zirconium bromide		
Tributyl aluminum [(CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> ) <sub>3</sub> Al]		Production of organotin compounds
Tricyclohexyl aluminum [Al(C <sub>6</sub> H <sub>13</sub> ) <sub>3</sub> ]		
Triethyl aluminum [(C <sub>2</sub> H <sub>5</sub> ) <sub>3</sub> Al]		Catalyst intermediate for polymerization of olefins; pyrophoric fuels; production of alpha-olefins and long chain alcohols; gas plating of aluminas
Triethylamine [(C <sub>2</sub> H <sub>5</sub> ) <sub>3</sub> N]		Catalytic solvent in chemical synthesis; accelerator for rubbers; wetting, penetrating and water-proofing agents of quaternary ammonium types; curing and hardening polymers; corrosion inhibitor; propellant
Triethylbenzyl ammonium chloride		
Triethylsulfonium iodide		
Triisobutyl aluminum [((CH <sub>3</sub> ) <sub>2</sub> CHCH <sub>2</sub> ) <sub>3</sub> Al]		Polyolefin catalyst; manufacture of primary alcohols and olefins; pyrophoric fuels
Triphenylphosphine		Synthesis of organic compounds, phosphonium salts, and other phosphorus compounds
Vanadium oxytrichloride [VOCl <sub>3</sub> ]		Catalyst in olefin polymerization; organovanadium synthesis
Vanadium trioxybutylate [VO(OC <sub>4</sub> H <sub>9</sub> ) <sub>3</sub> ]		
Vanadium tetrachloride [VCl <sub>4</sub> ]		Preparation of vanadium trichloride, vanadium dichloride, and organovanadium compounds
Vanadium trichloride [VCl <sub>3</sub> ]		Preparation of vanadium dichloride and organovanadium compounds
Zinc acetate [Zn(C <sub>2</sub> H <sub>3</sub> O <sub>2</sub> ) <sub>2</sub> ]		Medicine; preserving wood; textile dyeing; zinc chromate; laboratory reagent; feed additive; cross-linking agent for polymers; ingredient in dietary supplement

(Continued)

TABLE B-4 (Continued)

<u>Catalyst</u>	<u>Consumption†</u>	<u>Use</u>
Zinc chloride [ZnCl <sub>2</sub> ]		Galvanizing iron; catalyst; dehydrating and condensing agent in organic synthesis; wood preservative; soldering fluxes, burnishing and polishing compounds for steel; electroplating; antiseptic and deodorant preparations; textiles; adhesives; dental cements; glass etching; petroleum refining; parchment; dentrifices; embalming and taxidermist's fluids; medicine; dyestuffs, pigments; antistatic; feed additive; denaturant for alcohol; dietary supplement
Zinc formate [Zn(CHO <sub>2</sub> ) <sub>2</sub> ]		Catalyst for production of methanol; water proofing agent; textiles; antiseptic
Zinc oxide [ZnO]		Accelerator, activator, pigment and reinforcing agent for rubber; ointments; pigments and mold-growth inhibitor in paints; ceramics; floor tile; glass; zinc salts; feed additive; dietary supplement; seed treatment; cosmetics; semiconductor in electronic devices; photoconductor; piezoelectric devices; dental cement; flame retardant; antiseptic
<u>SUPPORTS</u>		
SiO <sub>2</sub>		Manufacture of glass, water glass, ceramics; abrasives; water filtration; component of hydraulic cements; source of ferrosilicon and elemental silicon; filler in cosmetics, pharmaceuticals, paper, insecticides; rubber reinforcing agent; anticaking agent for foods; flattening agent in paints; thermal insulator
Al <sub>2</sub> O <sub>3</sub>		See Catalysts
MgO		See Catalysts
MgOHCl		See Catalysts
MgCl <sub>2</sub>		See Catalysts
Mg(OH) <sub>2</sub>		See Catalysts
TiO <sub>2</sub>		See Catalysts

(Continued)

TABLE B-4 (Continued)

<u>Catalyst</u>	<u>Consumption†</u>	<u>Use</u>
<u>SUPPORTS (Continued)</u>		
TiCl <sub>3</sub>		See Catalysts
CaO		Refractory; flux in steel manufacture; pulp and paper; manufacture of calcium carbide; SO <sub>2</sub> removal of stack gases; sewage treatment; poultry feeds; neutralization of acid waste effluents; insecticides and fungicides; dehairing of hides; food processing; sugar refining
Ca <sub>5</sub> (PO <sub>4</sub> ) <sub>3</sub> OH		
Mg(OEt) <sub>2</sub>		
<u>NEUTRALIZERS</u>		
Calcium oxide		See Catalysts
Calcium stearate		Water repellent; flattening agent in paints; lubricant in making tablets; emulsions; cements; wax crayons; stabilizer for vinyl resins; anticaking agent in foods; cosmetics
n-Heptane [CH <sub>3</sub> (CH <sub>2</sub> ) <sub>5</sub> CH <sub>3</sub> ]		Standard for octane rating determinations; anesthetic; solvent; organic synthesis; preparation of laboratory reagents
Hydrochloric acid [HCl]		Acidizing of petroleum wells; chemical intermediate; ore reduction; food processing; pickling and metal cleaning; industrial acidizing; general cleaning; alcohol denaturant
Isopropyl alcohol [(CH <sub>3</sub> ) <sub>2</sub> CHOH]		Manufacture of acetone and its derivatives; manufacture of glycerol and isopropyl acetate; solvent for essential and other oils, alkaloids, gums, resins, etc.; latent solvent for cellulose derivatives; coatings solvent; deicing agent for liquid fuels; pharmaceuticals; perfumes; lacquers; extraction processes; dehydrating agent; preservative

(Continued)

TABLE B-4 (Continued)

<u>Catalyst</u>	<u>Consumption†</u>	<u>Use</u>
<u>NEUTRALIZERS</u> (Continued)		
Methanol		Manufacture of formaldehyde and dimethyl terephthalate; chemical synthesis; aviation fuel, automotive antifreeze; solvent for nitrocellulose, ethylcellulose, polyvinyl butyral, shellac, rosin, manila resin, dyes; denaturant for ethyl alcohol; dehydrator for natural gas; fuel for utility plants; feedstock for manufacture of synthetic proteins by continuous fermentation
Phosphoric Acid		See Catalysts
n-Propanol [ $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ ]	$3.8 \times 10^7$ kgs (72) (total)	Organic synthesis and chemical intermediate; solvent for waxes, vegetable oils, natural and synthetic resins, cellulose esters and ethers; polishing compositions; brake fluids; solvent degreasing; antiseptic; pharmaceuticals; lacquers and dopes; cosmetics; component of brake fluid; antiseptic agent; dental lotions; synthetic flavor
Triphenyl phosphate		Fire-retarding agent; plasticizer
Water (as steam)		

†Annual Consumption is presented parenthetically for the most recent year available.

TABLE B-5. COLORANTS  
CONSUMPTION AND OTHER USES

<u>Colorant</u>	<u>Color Index</u>	<u>Consumption†</u>	<u>Use</u>
<u>INORGANIC PIGMENTS</u>			
<u>WHITE</u>			
Aluminum Silicate [Al <sub>2</sub> (SiO <sub>3</sub> ) <sub>3</sub> ]			Extender for thermoset polyesters; acts as a reinforcer as well
Barium Sulfate [BaSO <sub>4</sub> ] [Blanc fixe]	Fig. White 22, 77102 Fig. White 21, 77115		Diffusing pigment for acrylics; weighing mud in oil drilling; paper coating; filler and delustrant; base for lake colors; X-ray photography; battery plate expanders
Calcium Silicate [CaSiO <sub>3</sub> ] [Wollastonite]			Polyethylene, vinyls, and thermoset resins; absorbent; antacid; adhesives; filler for paper; cosmetics; food additive (anticaking agent)
Lithopone [28% ZnS and 72% BaSO <sub>4</sub> ]	Fig. White 5, 77115		White pigment for paints, rubber, paper and leather
Titanium dioxide [TiO <sub>2</sub> ]	Fig. White 6, 77891	2.0 x 10 <sup>8</sup> kgs (82) (in plastics)	53% in paints, varnishes, lacquers; 21% in paper; 10% in plastics; 3% in elastomers; 2.5% in ceramics; 2% in floor covering; 2% in printing inks; 1% in coated fabrics and textiles; 1% in roofing granules; 4.5% for other pigments
Wollastonite [see Calcium Silicate]			Ceramics; paint extender; welding rod coatings; rubber filler; silica gels; paper coating; filler in plastics, cements, and wallboard; mineral wool; soil conditioner
Zinc oxide [ZnO]	Fig. White 4, 77947		Diffusing pigment; accelerator; activator; reinforcing agent; ointments; pigment and mold-growth inhibitor in paints; ceramics; floor tile; glass; zinc salts; feed additive; dietary supplement; seed treatment; cosmetics; semiconductor; photoconductor

(Continued)

TABLE B-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Consumption†</u>	<u>Use</u>
<u>WHITE (Continued)</u>			
Zinc Sulfide [ZnS]	Pig. White 7, 77957		Diffusing pigment; white and opaque glass; base for color lakes; rubbers; dyeing; phosphor in X-ray and television screens; luminous watch faces; fungicides
<u>BLACK</u>			
Bone Black [C+Ca <sub>3</sub> (PO <sub>4</sub> ) <sub>2</sub> ]	Pig. Black 9, 77267		
Ceramic Black	Pig. Black 26, 77494 Pig. Black 28, 77428		
Iron Oxide [FeO·Fe <sub>2</sub> O <sub>3</sub> ]	Pig. Black 11, 77499		Pigment; polishing compound; metallurgy; medicine; magnetic inks; coatings for magnetic tape
Copper Chromite Black [Cu(CrO <sub>2</sub> ) <sub>2</sub> ]			
Cobalt Black [CoO]			Paint, enamel, and ceramic pigment; other cobalt salts; catalyst; feed additive
<u>BLUE, GREEN</u>			
Barium Manganate [BaMnO <sub>4</sub> ] [Manganese green]			Paint pigment
Cassel Green [MnO]			
Chrome Cobalt-Alumina (turquoise) [CrCoAl oxides]	Pig. Blue 36, 77343		
Chrome Green (green) [PbCrO <sub>4</sub> ·PbSO <sub>4</sub> ·FeNH <sub>4</sub> Fe(CN) <sub>6</sub> ]	Pig. Green 15, 77510, 77600		Paints, enamels, lacquers, printing inks, paper coating, staining and plastics such as thermoset polyesters and polyethylene leaf bags
Chromium Oxide (dull green) [Cr <sub>2</sub> O <sub>3</sub> ]	Pig. Green 17, 77288, 77289		Metallurgy; green paint pigment; ceramics; catalyst in organic synthesis; green granules in asphalt roofing; component of refractory brick

(Continued)



TABLE B-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Consumption†</u>	<u>Use</u>
<u>BLUE, GREEN (Continued)</u>			
Cobalt Aluminate (blue) $[\text{CoO} \cdot \text{Al}_2\text{O}_3]$	Fig. Blue 28, 77346		Artist's color, paints, printing inks, lacquers
Cobalt Chrome Green	Fig. Green 26		Rubber, paper, plastics, printing inks, lacquers, enamels
Hydrated Chrome Oxide (green) $[\text{Cr}_2\text{O}_3 \cdot 2\text{H}_2\text{O}]$	Fig. Green 18, 77289		
Iron Blue (blue) [Prussian Blue] [Milor and Chinese Blue] $[\text{FeNH}_4\text{Fe}(\text{CN})_6]$ or $[\text{FeNH}_4\text{Fe}(\text{CN})_6 \cdot \text{FeKFe}(\text{CN})_6]$	Fig. Blue 27, 77510 77520		Paints; printing inks; plastics; cosmetics (eye shadow); artist colors; laundry blue; paper dyeing; fertilizer ingredient; baked enamel finishes for autos and appliances; industrial finishes
Manganese (blue) $[\text{BaMnO}_4 \cdot \text{BaSO}_4]$	Fig. Blue 33, 77112		Cement
Myrtle Green $[\text{CrCoAl oxides}]$			
Shamrock $[\text{CoTiZnNiAl oxides}]$			
Titanium Pigments (blue) $[\text{TiO}_2 \text{ with } \text{CaO} \cdot \text{Al}_2\text{O}_3]$			
Titanium Pigments (green)	Fig. Green 50, 77377		
Titanium Pigments (light green) $[\text{TiO}_2 \text{ with Ni and Co}]$	Fig. Green 50, 77377		
Ultramarine Blue (blue) $[\text{NaAlSi}_3\text{O}_8]$ [Complex aluminum sulfo-silicate produced by heating Ultramarine Green in presence of sulfur]	Fig. Blue 29, 77007		Intensifies whiteness of white enamel, rubber compounds, laundered clothing, etc.
Ultramarine Green (green) [Approximately $\text{Na}_7\text{Al}_6\text{Si}_6\text{O}_{24}\text{S}_3$ ]	77013		

(Continued)

TABLE B-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Consumption†</u>	<u>Use</u>
<u>VIOLET</u>			
Cobalt Lithium Phosphate [CoLiPO <sub>4</sub> ]	Fig. Violet 14, 77360 Fig. Violet 47, 77363 Fig. Violet 48, 77352		Ceramics, glass, artists' color, rubber, plastics, paper
Cobalt Phosphate [Co <sub>3</sub> (PO <sub>4</sub> ) <sub>2</sub> ]	Fig. Violet 14		Cobalt pigments; coloring glass, painting porcelain; animal feed supplement
Manganese Violet [MnHP <sub>2</sub> O <sub>7</sub> ·NH <sub>3</sub> ] [Mineral Violet]	Fig. Violet 16, 77742		Paints and crayons
Ultramarine Violet [Complex aluminum sulfosilicate]	Fig. Violet 5		
Ultramarine Pink [Complex aluminum sulfosilicate produced by heating Ultramarine Green at 200-250°C for 4 days in the presence of ammonium chloride]	Fig. Violet 15, 77007		Distemper and paints
<u>RED, RED-ORANGE</u>			
Cadmium Mercury [maroon, red, orange] [CdS and HgS]	Fig. Red 113, 77201 Fig. Orange 23, 77201		Paints, enamels, printing inks, plastics, rubber, paper, textiles printing
Cadmium Sulfoselenide (maroon, red, orange) [CdSe and CdS]	Fig. Red 108, 77196, 77202		Pigment for paints, plastics, enamels, lacquers; semiconductor
Cadmium Sulfide (orange) [CdS]	Fig. Orange 20, 77106, 77196, 77198, 77199		Pigments and inks; ceramic glazes; pyrotechnics; phosphors; fluorescent screens; scintillation counters; rectifiers; photoconductors in xerography; transistors; photovoltaic cells; solar cells
Chrome-tin (pink)			
Chrome Orange [PbCrO <sub>4</sub> ·PbO]	Fig. Orange 21, 77601		Paints, enamels, inks, lacquers, paper, rubber, plastics, artist's colors
Copper Maroon [CuK <sub>2</sub> Fe(CN) <sub>6</sub> ]	Fig. Red 121, 77320		Rubber, paper, plastics, printing inks, lacquers, enamels

(Continued)

TABLE B-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Consumption†</u>	<u>Use</u>
<u>RED, RED-ORANGE (Continued)</u>			
Hematite [Fe <sub>2</sub> O <sub>3</sub> ]	See Iron Oxide		Iron ore; rouge; paint pigment
Iron Oxide (maroon, red, light red) [Fe <sub>2</sub> O <sub>3</sub> ]	Fig. Red 101, 77419 Fig. Red 102, 77419		Marine paints and metal primers; polishing compounds; pigment in rubber and plastic; theatrical rouge; grease paints
Mercuric Sulfide [HgS]			Medicine; pigment
Molybdate Orange [PbCrO <sub>4</sub> .PbO. PbMoO <sub>4</sub> ]	Fig. Orange 21, 77601 Fig. Red 104, 77605		See Chrome Orange. Pigment for printing inks, paints, and plastics
Molybdate Orange (coated)	Same as Molybdate Orange		Paints, plastics, lacquers, printing inks, emulsion paints, rubber
Red Ochre (natural) [Fe <sub>2</sub> O <sub>3</sub> ]	Fig. Red 101, 77491 Fig. Red 102, 77491		See Iron Oxide
Red Lead (synthetic) [Pb <sub>3</sub> O <sub>4</sub> ]	Fig. Red 105, 77578		Jointing paints, protective paints
Ultramarine Red [Complex aluminum sulfosilicate produced by heating Ultramarine Green at 70-200°C for 4 days in presence of HCl or by reaction with gaseous HNO <sub>3</sub> at higher temperature]	Fig. Red 5, 12490		
<u>YELLOW</u>			
Burnt Umber (natural) [Fe <sub>2</sub> O <sub>3</sub> .H <sub>2</sub> O]	See Iron Oxide Fig. Yellow 42, 77492 Fig. Yellow 43, 77492		See Iron Oxide
Cadmium Sulfide (yellow) [CdS and ZnS] [Cadmium Yellow]	Fig. Yellow 37, 77117, 77199		Pigment for paints, plastics, lacquers, paper and inks; ceramic glazes; pyrotechnics; phosphors; fluorescent screens; scintillation counters; rectifiers, photoconductors; transistors; photovoltaic cells; solar cells
Ceramic Buff [Yellow buff] [Sb, Ti, Cr oxides]			

(Continued)

TABLE B-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Consumption†</u>	<u>Use</u>
<u>YELLOW</u> (Continued)			
Chrome Yellow [PbCrO <sub>4</sub> ]	Fig. Yellow 34, 77603, 77600		Pigment for paints, inks, rubbers and plastics
Chrome Yellow (heat resistant) [PbCrO <sub>4</sub> ], coated	Fig. Yellow 34		Pigment for rubbers and plastics and occasionally inks and paper
Iron oxide (yellow) [Fe <sub>2</sub> O <sub>3</sub> ·xH <sub>2</sub> O]	Fig. Yellow 42, 77492		Paints; rubber products; plastics and cement
Lead Chromate	See Chrome Yellow		Pigment for paints, rubbers, plastics, ceramic coatings
Lead Molybdate			Analytical chemistry; pigments
Ocher [Fe <sub>2</sub> O <sub>3</sub> ·H <sub>2</sub> O]	Fig. Yellow 43 See below		Paint pigments; cosmetics; theatrical make-up
Sienna [Fe <sub>2</sub> O <sub>3</sub> ]	Fig. Yellow 43		See Ocher
Titanium Pigment (light yellow) [Nickel titanate] [NiO·TiO <sub>2</sub> ] (buff) [Ni, Sb, Ti oxides] [Fe, Zn, Ti oxides] and [Fe, Cr, Ti, Sb, Zn oxides]	Fig. Yellow 53, 77788		Paints and printing inks
Zinc Chromate (yellow) [ZnCrO <sub>4</sub> (complex)]	Fig. Yellow 36, 77955		Artist's color; varnishes; pigment in rust-resistant primer and automotive paints; corrosion resistant additive to epoxy laminate
<u>BROWN</u>			
Iron Oxide (buff, brown) [(FeO) <sub>x</sub> ·(Fe <sub>2</sub> O <sub>3</sub> ) <sub>y</sub> ]	Fig. Brown 6, 77491, 77492, 77499 Fig. Brown 7, 77491		Pigment for paints, enamels, lacquers, plastics, rubbers
Limonite [hematite brown]	Fig. Brown 6, 77491 Fig. Brown 7, 77491		See Iron Oxide
Ocher [Fe <sub>2</sub> O <sub>3</sub> ]			Paint pigments; cosmetics; theatrical makeup

(Continued)

TABLE B-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Consumption†</u>	<u>Use</u>
<u>BROWN (Continued)</u>			
Sienna (natural) [Fe <sub>2</sub> O <sub>3</sub> ]			Colorant in oil paints, stains, pastels, etc.
Titanium Pigments (brown) [TiO <sub>2</sub> with up to 10% Fe] [rutile]	Fig. Brown 24		Paints, inks, plastics
Umber [Fe <sub>2</sub> O <sub>3</sub> with silica, alumina, manganese oxides and lime]	Fig. Brown 43		Paint pigment; lithographic ink; wall-paper pigment; artist's color
<u>ORGANIC PIGMENTS</u>			
<u>BLACK</u>			
Aniline Black	Fig. Black 1, 50440		Colorant, largely for cotton and textiles
Bone Black [85% Ca <sub>3</sub> (PO <sub>4</sub> ) <sub>2</sub> and CaCO <sub>3</sub> with 12-23% C]	Fig. Black 9, 77267		Manufacturing activated carbon; decolorizing agent and filtering medium; cementation reagent; adsorptive medium in gas masks; paint and varnish pigment; clarifying shellac; water purification
Carbon Black (furnace black) [C]	Fig. Black 7, 77266		Reinforcing agent, pigment for cements, ceramic ware, mortar, inks, linoleum, surface coatings, crayons, polishes, carbon paper, soap, etc.; in insulating compositions; liquid-air explosives; matches; fertilizers; furnace lutes; lubricating compositions; carbon brushes
Carbon Black (lamp carbon black) [C]	Fig. Black 6, 77266		See Channel Black and Furnace Black
Channel Black [C]			Reinforcing agent for rubber tires, belt covers and other abrasion-resistant rubber products; colorant for plastics; inks, carbon paper, typewriter ribbon; paint; nucleating agent in weather modification; expanders for battery plates
Thermal Black			See Furnace Black

(Continued)

TABLE B-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Consumption†</u>	<u>Use</u>
<u>BROWN</u>			
Azoic Brown [Monoazo]	Fig. Brown 25, 12510 Fig. Brown 32		Plastics (PVC)
Disazo Brown	Fig. Brown 23		Oil paints, printing inks, plastics
<u>BLUE, GREEN</u>			
Alumina Lake [Monoazo]	Acid Blue 4, 73015		
Cromophtal Blue A3R	Fig. Blue 60, see Indanthrone		
Cromophtal Green GF			
Dianisidene Blue [Disazo]	Fig. Blue 25		Rubber, plastics, textile printing, occasionally inks, emulsion paints
FD&C Blue 1 Aluminum Lake (food blue 2) [Ethyl(4-p-(ethyl(m-sulfobenzyl) amino)- (o-sulfo-phenyl)benzylidene) -2,5-cyclohexadien-1-ylidene)(m-sul- fobenzyl)hydroxide ammonium inner salt, sodium salt]	42090:2		
FD&C Blue 2 Aluminum Lake (food blue 1) [indigoid]	Fig. Blue 63, 73013		Cosmetics
Indanthrone Blue-Red Shade [Anthraquinone]	Fig. Blue 64, 68925		Textiles
Indanthrone [6,15-dihydro-5,9,14,18- anthrazine tetrone]	Fig. Blue 22, 69810		Pigment in paints and enamels
[Cromophtal Blue A3R] [Anthraquinone]	Fig. Blue 60, 69800		Paints, plastics, printing inks
Nickel-Azo Yellow (greenish yellow) [metal complex of p-chloroaniline coupled to 2,4-dihydroxyquinoline]	Fig. Green 10, 12755		Plastics, lacquers, inks
Oracet Blue 2R			

(Continued)

TABLE B-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Consumption†</u>	<u>Use</u>
<u>BLUE, GREEN (Continued)</u>			
Phthalocyanine (blue)			Decorative enamels; automotive finishes; linoleum plastics; roofing granules; printing inks; wallpaper; rubber goods
red shade	Fig. Blue 15, 76160, 74160		
green shade	Fig. Blue 15:3, 74160, 76160	4.0 x 10 <sup>6</sup> kgs (79)	
metal free	Fig. Blue 16, 74100		Paints, inks, distempers, paper coating, plastics
Phthalocyanine (green)	Fig. Green 7, 74260, 74160	1.5 x 10 <sup>3</sup> kgs (79)	100% as a pigment
Phthalocyanine Green, brominated	Fig. Green 36, 74265		Paints, inks, plastics, rubber, lacquer, leather, textile printing
Pigment Green B (dark green) [Nitroso]	Fig. Green 8, 1006		Very small application in plastics; emulsion paints, distempers, wallpaper, paper coating, leathercloth, bookcloth, cement
PTA PMA Toners (blue, green) [triphenyl-methane, phosphotungstomolybdic acid]	Fig. Blue 1, 42595 Fig. Green 2, 42040	3.9 x 10 <sup>4</sup> kgs (79) 8.2 x 10 <sup>3</sup> kgs (79)	Printing inks, paints, enamels, plastics, paper coating, carbon papers, typewriter ribbons
<u>VIOLET</u>			
Alizarine Maroon (maroon) [Anthraquinone]	Fig. Violet 5, 58055		Manufacture of aluminum salt
Benzimidazolone Violet [Monoazo]	Fig. Violet 32, 12517 See Monoazo Red		Plastics, printing inks, stove enamels, paints
Carbazole Dioxazine Violet	Fig. Violet 23, 51319 Fig. Violet 25, 51319	1.5 x 10 <sup>5</sup> kgs (79)	Oil paints, emulsion paints, plastics, rubber, ink, textile painting, emulsion paints
Isoviolanthrone Violet [Anthraquinone] [Vat pigment]	Fig. Violet 33 Fig. Violet 31 Vat Violet 9, 60005		
Methyl Violet	Fig. Violet 3, 42535	9.0 x 10 <sup>4</sup> kgs (79)	Medicine; acid-base indicator; denaturant for alcohol; biological stain; pigments; dye for textiles

(Continued)

TABLE B-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Consumption†</u>	<u>Use</u>
<u>VIOLET (Continued)</u>			
Monoazo Red, blue shade [Benzimidazolone violet]	Fig. Violet 32, 12517 Fig. Red 83, 58000		Plastics, printing inks, stove enamels, paints
Oracet Violet 2R			
P T M A Toners [Phosphotungstomo- lybdic acid salt of basic dye] [Xanthene]	Fig. Violet 2, 45175		
Perrindo Violet [Anthraquinone]	Fig. Violet 29, 71129		PVC pigment
Quinacridone Red (yellow shade)	Fig. Violet 19, 16500, 46500	$7.1 \times 10^5$ kgs (79)	Plastics, textile emulsion inks
Quinacridone (violet-maroon)	Fig. Violet 19, 16500, 46500	$7.1 \times 10^5$ kgs (79)	Plastics, textile emulsion inks
Thioindigo Violet	Fig. Violet 36, 73385		Textiles
<u>RED</u>			
Alizarine Red B Lake	Fig. Red 83, 58000 See Madder Lake		
Alumina Lake [phthalein]	Fig. Red 172, 43439:1		Cosmetics
Anthraquinone Red	Fig. Red 177		Plastics, paints
Orange RK	Fig. Red 168, 59300 See Vat Orange		Paints, printing inks, plastics
Anthraquinone Red	Fig. Red 194, 71100 See Vat Red		Plastics, lacquers
Azo Condensate Red	Fig. Red 242		
Ba Lithol (medium red)	Fig. Red 49, 15630 See Lithol Red	$2.9 \times 10^6$ kgs (79)	Printing inks, rubber, enamels

(Continued)



TABLE B-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Consumption†</u>	<u>Use</u>
<u>RED (Continued)</u>			
Benzimidazolone Reds	Fig. Red 171, 12521 See Monoazo		PVC, inks, lacquers
[Permanent Red HPT]	Fig. Red 175, 12513 See Monoazo		Paints, lacquers, plastics
[Monoazo]	Fig. Red 176, 12516 See Monoazo		Plastics, lacquers, inks
[Permanent Carmine]	Fig. Red 185, 12516 See Monoazo		Plastics, lacquers, tinplate ink
B.O.N. Rubine (Na Salt) (Ca Salt)	Fig. Red 52, 15860 Fig. Red 200, 15867		Base for salts of heavy metal inks, paints, plastics
B.O.N. Maroon [Monoazo] [Sodium salt of acid dye]	Fig. Red 63, 15880	6.7 x 10 <sup>5</sup> kgs (79)	Base for heavy metal salts
Chlorinated Para (light red) [1(-2-chloro-4-Nitrophenyl)azo] 2-Naphthol] [Monoazo]	Fig. Red 4, 12085 Fig. Red 6		Paints, lacquers, plastics, rubber
Cromophtal Scarlet R [Azo]	Fig. Red 166		Plastics, paints, printing inks
Cromophtal Red BR [Disazo] [Disazo Condensation Red]	Fig. Red 144		Enamels, lacquers, plastics, leathercloth
Cromophtal Red 3B [Anthraquinone]	Fig. Red 177 See Anthraquinone Red		Plastics, paints
Cromophtal Red G [Disazo]	Fig. Red 220		
Cromophtal Red CR [Disazo]	Fig. Red 139		Plastics
Cromophtal Red 2RS			
Cromophtal Rubine B			
Dianisidine (medium red)	Fig. Red 41, 21200		Plastics, occasionally printing inks
Disazo Condensation Red	Fig. Red 144 See Cromophtal Red BR		Enamels, lacquers, plastics

(Continued)

TABLE B-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Consumption†</u>	<u>Use</u>
<b>RED (Continued)</b>			
Disazo Reds	Fig. Red 146 Fig. Red 166 Fig. Red 214 Fig. Red 220 Fig. Red 221		Paints, lacquers, printing inks
Dichlorobenzidene Red	See Pyrazolone Red		
FD&C Red 3 Aluminum Lake (food red 14) [2',4',5',7' Tetra-bromo-4,5,6,7-tetrachloro fluorescein, disodium salt]	45430		
FD&C Red 40 Aluminum Lake	16035		
Helio Bordeaux (maroon)	Fig. Red 54, 14830		Printing inks, paints, plastics, paper coating, wall paper printing, bookcloth
Irgazin Red 2BLT [Isoindolinone Red]	Fig. Red 180		Paints
Lake Red C (light red) [5-chloro-2-((2-Hydroxy-1-Naphtha-1-enyl)Azo)4-methylbenzene-sulfonic acid, barium salt]	Fig. Red 53:1, 15585:1	1.9 x 10 <sup>6</sup> kgs (79)	Printing inks, plastics, stove finishes, foil inks, paper coloring, cosmetics
Lithol Red (Ba of acid dye) [Monoazo]	Fig. Red 49, 15630	2.9 x 10 <sup>6</sup> kgs (79)	Manufacture of metal lakes
Lithol Rubine (Na salt of acid dye) (bluish red) [Monazo]	Fig. Red 57, 15850	2.1 x 10 <sup>6</sup> kgs (79)	Manufacture of metal salts for use as pigments
Lithol Rubine, Sr [Monoazo]	Fig. Red 52, 15850		Manufacture of metal salts for pigments
Madder Lake (alizarine red) [1,2-dihydroxy-anthraquinone]	Fig. Red 83, 58000		Paints, plastics, printing inks, lacquers, emulsion paints
Monoazo Red (blue and yellow shade reds)	Fig. Red 187 Fig. Red 188, 12467 Fig. Red 246 Fig. Red 247 Fig. Red 175, 12513 Fig. Red 171, 12521		Plastics, lacquers, inks Plastics, lacquers, inks Paints, lacquers, plastics  Paints, lacquers, plastics Plastics, ink, lacquers

(Continued)

TABLE B-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Consumption†</u>	<u>Use</u>
<u>RED (Continued)</u>			
Monoazo Red (blue shade red)	Fig. Red 176, 12515 Fig. Red 185, 12516		Plastics, lacquers, inks Plastics, stoving lacquer, inks
Na, Ca Lithols (light red-maroon)	Fig. Red 49, 15630	Ca: $6.6 \times 10^6$ kgs (79) Ba: $2.9 \times 10^6$ kgs (79)	Manufacture of metal lakes for rubber, printing inks and enamels
Naphthol Red (blue shade red Ba salt)	Fig. Red 151		Plastics
Naphthol Red (blue shade red Ca salt)	Fig. Red 68, 15525		
Naphthol Red (bluish red)	Fig. Red 150 Fig. Red 210		
Naphthol Red (bordeaux shade)	Fig. Red 14, 12380		Oil paints, plastics, rubber, printing inks, paper, emulsion paints
Naphthol Red (dark red)	Fig. Red 23, 12355	$1.5 \times 10^5$ kgs (79)	Paints, inks, plastics, textiles, lacquers, paper
Naphthol Red (light red)	Fig. Red 17, 12390 Fig. Red 22, 12315	$4.1 \times 10^4$ kgs (79) $4.2 \times 10^4$ kgs (79)	Inks, rubber, plastics, emulsion paints, paints and enamels
Naphthol Red (medium red)	Fig. Red 170 Fig. Red 210 Fig. Red 7, 12420		Inks, lacquers Paints, inks, emulsion paints, distempers, plastics, cosmetics
Naphthol Red (yellow shade)	Fig. Red 9, 12460		Printing inks, paints, paper
Naphthol Red (yellow shade red Ca salt)	Fig. Red 68, 15525		Printing inks, plastics
Oracet Red 3B			
Para Red (medium to deep red)	Fig. Red 1, 12070		Paints, printing inks, rubber, paper, plastics, paper coating
Permanent Carmine HF4C	Fig. Red 185 See Monoazo		Plastics, lacquers, inks

(Continued)

TABLE B-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Consumption†</u>	<u>Use</u>
<u>REDS (Continued)</u>			
Permanent Red HFT	Fig. Red 175 See Monoazo Red		Paints, lacquers, plastics
Permanent Red BL	Fig. Red 149 See Perylene Scarlet		Plastics
Permanent Red HPM	Fig. Red 171 See Monoazo		Plastics, inks, lacquers
Permanent Red 2B-Ba Salt (light red)	Fig. Red 48:1, 15865:1	3.0 x 10 <sup>5</sup> kgs (79)	Printing inks, paints, plastics, lacquers, rubber, paper, leathercloth, cosmetics, textiles
Permanent Red 2B-Ca Salt (medium red)	Fig. Red 48:2, 15865	8.1 x 10 <sup>5</sup> kgs (79)	Plastics, lacquers, inks
Perinone Red FTG	Vat Red 15		
Perinone Red [Anthraquinone]	Fig. Red 194, 71100 See Vat Red		Plastics
Perylene, nitrogen free	Fig. Red 175		Paints, lacquers, plastics
Perylene Vermillion	Fig. Red 123, 71145, 71140		Plastics, textile printing
Perylene Maroon	Fig. Red 179, 71130		Paints, inks, plastics
Perylene	Fig. Red 224		
Perylene Scarlet	Fig. Red 149, 71137		Plastics
Perylene Medium Red	Fig. Red 190, 71140		Plastics, inks, plastics
Pigment Scarlet 3B Lake (bluish red) [Mordant Red 9 and Al <sub>2</sub> (OH) <sub>3</sub> ] [Monoazo]	Fig. Red 60, 16105		Manufacture of metal salts
Pigment Scarlet-Ba Salt [Monoazo]	Fig. Red 60:1, 16105:1 See Fig. Scarlet 3B		Printing inks, lacquers, plastics, rub- ber, textile printing, emulsion paints

(Continued)

TABLE B-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Consumption†</u>	<u>Use</u>
<u>RED (Continued)</u>			
Pyranthrone Orange	Fig. Red 197, 59710		
Pyrazolone (medium red) [Disazo]	Fig. Red 38, 21120	7.5 x 10 <sup>4</sup> kgs (79)	Rubber and plastics, occasionally printing inks, lacquers, emulsion paints, textile printing
Pyrazolone Red (yellow shade) [Disazo]	Fig. Red 37, 21205		Rubber and plastics
Quinacridone Magenta [Quindo Magenta]	Fig. Red 122, 73915 Fig. Red 202	9.8 x 10 <sup>4</sup> kgs (79)	Plastics, inks, textile printing
R.K. Anthranthrone [Anthraquinone]	Fig. Red 168 See Vat Orange		Paints, inks, plastics
Red Lake R (light red)	Fig. Red 64		
Thioindigo Red	Fig. Red 86, 73375 Fig. Red 88, 73312 Fig. Red 198, 73390		Inks, plastics, textile printing Paints, inks, plastics, rubber Paints, inks, plastics
Thioindigo Maroon	Not assigned, 73390		
Thioindigo Pink	Fig. Red 181, 73360		Paints, inks, plastics
Thioindigoid	Fig. Red 131, 73360		
Toluidine Maroon (light red) [Monoazo]	Fig. Red 3, 12120	6.8 x 10 <sup>5</sup> kgs (79)	Paints, printing inks, emulsion paints, distempers, plastics, rubber, textile printing
[Substituted amines coupled to naphthol]	Fig. Red 13, 12395		Oil and emulsion paints, plastics, lacquers, printing inks, textile printing, rubber, paper
Vat Orange [Anthraquinone]	Fig. Red 168, 59300		Paints, inks, plastics
Vat Pink	Fig. Red 181, 73360 See Thioindigo Pink		Paints, inks, plastics
Vat Red (medium red)	Fig. Red 194, 71100		Plastics

(Continued)

TABLE B-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Consumption†</u>	<u>Use</u>
<u>ORANGE</u>			
Anthanthrone Orange (brominated)	Fig. Orange 168, 59300		
Anthramide Orange [vat pigment]	Vat Orange 15, 69025	7.1 x 10 <sup>2</sup> kgs (79)	Textiles, paper, paint, inks, plastics
Benzidine Orange	Fig. Orange 13, 21110 See Diarylide Orange		Paints and printing inks, rubber, plas- tics, paper, leathercloth
Benzimidazolone Orange	Fig. Orange 36, 11780 See Monoazo Orange		Paints, plastics, printing inks
Brominated Pyranthrone	Vat Orange 14, 59710		Textiles (mainly)
Cromophtal Orange 4R			
Dianisidine Orange	Fig. Orange 16, 21160	3.3 x 10 <sup>5</sup> kgs (79)	Printing inks, rubber, plastics, paper, textiles
Dianisidine Orange GG	Fig. Orange 14		Rubber
Diarylide Orange	Fig. Orange 13, 21110	1.6 x 10 <sup>5</sup> kgs (79)	
Diarylide Orange RL	Fig. Orange 34	4.3 x 10 <sup>4</sup> kgs (79)	Printing inks, paints, plastics, rubber, wallpaper, textile printing
Dinitroaniline Orange [Monoazo] [1-((2,4-Dinitrophenyl)Azo)-2- Naphthol]	Fig. Orange 5	4.1 x 10 <sup>5</sup> kgs (79)	Paints, printing inks, emulsion paints, enamels and lacquers, paper, wax, rubber, plastics
Disazo Orange 4R	Fig. Orange 31		Plastics
GR Perinone Orange [vat pigment] [Anthraquinone]	Fig. Orange 43, 71105 Vat Orange 7, 71105		Paints, printing inks, plastics
Homolog-Red Lake C (yellowish red)	Fig. Orange 46, 15602		Printing inks, plastics, rubber, paint
Indofast Double Scarlet	Vat Orange 4, 59710		
Irgazin Orange RLT			
Isoindolinone Orange	Fig. Orange 61 Fig. Orange 42		Paints

(Continued)

TABLE B-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Consumption†</u>	<u>Use</u>
<u>ORANGE</u> (Continued)			
Modified Azo Orange			
Monoazo Red (Orange)	Fig. Orange 38, 77878		
Monoazo Orange [C <sub>17</sub> H <sub>3</sub> N <sub>6</sub> O <sub>5</sub> Cl]	Fig. Orange 36, 11780 Fig. Orange 60 Fig. Orange 62		Paints, plastics, printing inks
Orange RK	Vat Orange 3, 59300		Textiles, paints, inks, plastics
Perinone Orange GR [Anthraquinone]	Vat Orange 7, 71105 Fig. Orange 43 See GR Perinone Orange		Textiles, paints, inks, plastics
Pyranthrone Orange [Vat Pigment]	Vat Orange 9, 59700 Fig. Orange 40		Textiles (main use)
Pyrazolone Orange [Disazo]	Fig. Orange 13, 21110 See Diarylide Orange		See Diarylide Orange
Tolyl Orange	Fig. Orange 30		
Quinacridone Gold	Fig. Orange 48		
<u>YELLOW</u>			
β-Amino Anthraquinone (yellow)			
Anthrapyrimidine (yellow) [Anthraquinone]	Fig. Yellow 108, 68420 Vat Yellow 20, 68420		Paints, printing inks, vinyl plastics, synthetic fibers, textiles
Anthrapyrimidine (yellow, medium yellow)	Fig. Yellow 108		
Anthraquinone Yellow			
Azo Yellow	Dis. Yellow 3, 11855	1.5 x 10 <sup>6</sup> kgs (79)	

(Continued)

TABLE B-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Consumption†</u>	<u>Use</u>
<u>YELLOW (Continued)</u>			
Azoic Yellow (light yellow)	Fig. Yellow 81, 21127 Fig. Yellow 113, 21126 Fig. Yellow 16, 20040		Paints, lacquers and printing inks, emulsion paints and distempers, plastic, PVC
Azoic Yellow (medium yellow)	Fig. Yellow 120, 11783		Used chiefly in PVC, also polyethylene and polystyrene
Azoic Yellow, specialty (light yellow)	Fig. Yellow 151 Fig. Yellow 154		
Azomethine Yellow [Irgazin yellow 5GLT]	Fig. Yellow 129		
Benzidine Yellow [Disazo] [2,2'-((3,3'-Di-chloro-4,4'-bi-phenylene)diazo)bis-acetoacetanilide]	Fig. Yellow 12, 21090 See Diarylide Yellow Anilide	5.9 x 10 <sup>6</sup> kgs (79)	Printing inks and lacquers, rubber, PVC, paper, and textile printing
Benzidine Yellow HR			
Benzidine Yellow AAMX [Disazo]	Fig. Yellow 13 See Diarylide Yellow Xylidide	2.2 x 10 <sup>5</sup> kgs (79)	Rubber and plastics, printing ink, paint, distempers
Benzidine Yellow AAOA	Fig. Yellow 17 See Diarylide Yellow Anisidine	4.9 x 10 <sup>5</sup> kgs (79)	Printing inks of high transparency
Benzidine Yellow AAOT	Fig. Yellow 14 See Diarylide Yellow Ortho Toluidide	1.9 x 10 <sup>6</sup> kgs (79)	Rubber and plastics, printing inks; occasionally paints and paper
Cromophtal Yellow 3G (yellow) [Disazo Condensation Yellow]	Fig. Yellow 93		Plastics, paints and printing inks
Cromophtal Yellow 6G [Disazo]	Fig. Yellow 94		Plastics, paints, printing inks, stove enamels and lacquers
Cromophtal Yellow GR [Disazo]	Fig. Yellow 95		Plastics, paints, printing inks, stove enamels and lacquers
Diarylide Yellow	Fig. Yellow 106		

(Continued)



TABLE B-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Consumption†</u>	<u>Use</u>
<u>YELLOW (Continued)</u>			
Diarylide Yellow AAMX (light transparent)	Fig. Yellow 127		
Diarylide Yellow MCG	Fig. Yellow 16, 20040 See Azoic Yellow		Lacquers, printing inks and plastics
Diarylide Yellow Anilide (light yellow) [Diarylide Yellow AAA]	Fig. Yellow 12, 21090		See Benzidine Yellow
Diarylide Yellow Anisidide (light yellow) [Diarylide Yellow AAOA]	Fig. Yellow 17, 21105		See Benzidine Yellow AAOA
Diarylide Yellow, HR (medium yellow)	Fig. Yellow 83, 21108, 21118		Mainly printing inks, occasionally paints and lacquers
Diarylide Yellow Ortho Toluidide (yellow)	Fig. Yellow 14, 21095		See Benzidine Yellow AAOA
Diarylide Yellow Xylidide (light yellow)	Fig. Yellow 13, 21100		See Benzidine Yellow AAMX
Disazo Yellows (other)	Fig. Yellow 155 Fig. Yellow 128		
FD&C Yellow #5 Aluminum Lake (food yellow 4) [Monoazo Aluminum Salt]	Fig. Yellow 100, 19140:1		Cosmetics
FD&C Yellow #6 Aluminum Lake (food yellow 3) [Monoazo Aluminum Salt]	Fig. Yellow 104, 15985:1		Cosmetics
Flavanthrone (yellow) [Anthraquinone]	Fig. Yellow 24, 70600		Paints, printing inks, plastics
Hansa Yellow 10G (primrose, light medium yellow)	Fig. Yellow 3, 11710		Paints, printing inks, emulsion paints, distempers, lacquers, rubbers, textiles, leather finishes, plastics
Hansa Yellow R	Fig. Yellow 10, 12710		Printing inks, emulsion paints and distempers, paper coating, resins

(Continued)

TABLE B-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Consumption†</u>	<u>Use</u>
<u>YELLOW (Continued)</u>			
Hansa Yellow 4R	Fig. Yellow 60, 12702		Paints, lacquers, printing inks, stains, plastics, rubbers, paper, synthetic fibers
Hansa Yellow G [Monoazo]	Fig. Yellow 1, 11680, 11860	1.8 x 10 <sup>5</sup> kgs (79)	Paints, printing inks, emulsion paints, distempers, lacquers, rubbers, textiles, leather finishes, plastics
Irgazin Yellow 5GLT	Fig. Yellow 129 See Azomethine Yellow		
Irgazin Yellow 2GRT	Fig. Yellow 109 See Isoindolinone Yellow		
Irgazin Yellow 2RLT, 3RLT (isoindolinone)	Fig. Yellow 110 See Isoindolinone Yellow		Paints
Isoindoline Yellow	Fig. Yellow 139		Paints
Isoindolinone Yellow [Irgazin Yellow 2GRT]	Fig. Yellow 109		
Isoindolinone Yellow [Irgazin Yellow 2RLT, 3RLT]	Fig. Yellow 110		
Modified Azo (light yellow)			
Monoazo Yellow (light yellow) [Permanent Yellow FGL]	Fig. Yellow 97, 11797, 11767		Printing inks, stove lacquers
Permanent Yellow FGL	Fig. Yellow 97 See Monoazo Yellow		
Permanent Yellow HR	Fig. Yellow 83 See Diarylide Yellow HR		Mainly printing inks, some use in paints and lacquers
Permanent Yellow H2G	Fig. Yellow 120 See Azoic Yellow		Plastics

(Continued)

TABLE B-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Consumption†</u>	<u>Use</u>
<u>YELLOW (Continued)</u>			
Permanent Yellow H10GH [Disazo]	Fig. Yellow 113 See Azoic Yellow		
Quinophtalone Yellow	Fig. Yellow 138		
Sandorin Yellow GGL [Isoindolinone]	Fig. Yellow 109		Paints
Palitol Yellow 1090	Fig. Yellow 138 See Quinophtalone Yellow		
<u>DYES (SOLUBLE)</u>			
Acetate (wide color range)			
Acid Chrome and Direct (wide color range)			
Basic Dyes (wide color range)			
Anthraquinone (yellow-red, green, blue, brown)			
<u>BROWN-BLACK</u>			
Azo Dyes [4-(1-Naphthylazo) m-phenylene-diamine]	Sol. Brown 1, 11285		Solvents, fats, oils, waxes, inks, lacquers
[2,3-dihydro-2,2-dimethyl-6-((4 (phenylazo)-1-Naphthyl)azo)- perimidine]	Sol. Black 3		Solvents, inks, lacquers, oils, fats, waxes
	Sol. Brown 11		Polishes, waxes, inks, oil stains, lacquers, varnishes, plastics
Azo Metal Complex Dyes	Sol. Black 27 Sol. Black 28		Lacquers, wood stains, plastics Lacquers
Nigrosine	Sol. Black 5, 50415		Solvents, varnishes, lacquers, wood stains, leather, printing inks, rubber, plastics
Induline			

(Continued)

TABLE B-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Consumption†</u>	<u>Use</u>
<u>YELLOW</u>			
Anthraquinone Yellow Dyes	Dis. Yellow 64		
Monoazo Dyes	Sol. Yellow 2, 11020		Lacquers, varnishes, waxes, oil stains, styrene plastics
[N,N-dimethyl-p-phenylazo aniline]	Sol. Yellow 16, 12700		Shoe cream, polishes, candles, plastics
	Sol. Yellow 56, 11021		Hydrocarbons, shoe polishes
[1-phenylazo)-2-naphthol]	Sol. Yellow 14, 12055	1.6 x 10 <sup>5</sup> kgs (79)	Oils and waxes
Disazo Dyes (Disazo)	Sol. Yellow 30, 21240		Inks, hydrocarbons and solvents, polishes, candles, plastics
	Sol. Yellow 71		Hydrocarbons and solvents
	Sol. Yellow 72		Hydrocarbons and solvents
	Sol. Yellow 29		Inks, stains, lacquers, waxes
	Dis. Yellow 23		
Azo [N-(4((2-Hydroxy-5-methyl phenyl) azo)phenyl) acetamide]	Dis. Yellow 3		
	Dis. Yellow 34		
Azo Metal Complex Dyes	Sol. Yellow 65		Solvents
	Sol. Yellow 79		Solvents, lacquers, plastics, wood stain
	Sol. Yellow 81		
	Sol. Yellow 82		Solvents, varnishes
	Sol. Yellow 48		Varnishes, inks
	Sol. Yellow 89		Plastics
	Sol. Yellow 95		
Brilliant Sulfofavin (2,3-dihydro-6-amino-1,3-dioxo-2-p-tolyl)-1H Benz-(de)iso-quinoline-5-sulfonic acid, monosodium salt]	Acid Yellow 7		Textiles, leather, paper, melamine and urea resins
Metanil Yellow	Acid Yellow 36	7.3 x 10 <sup>4</sup> kgs (79)	Textiles, paper, soaps, drugs, biological stains, indicator, cosmetics, lacquers, leather
Monomethine	Sol. Yellow 93		Plastics
Palacet Yellow SF7861	Dis. Yellow 13, 58900		

(Continued)

TABLE B-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Consumption†</u>	<u>Use</u>
<u>YELLOW (Continued)</u>			
Palacet Yellow SF7862	Dis. Yellow 116		
Quinoline Yellow	Sol. Yellow 33, 47000		Lacquers, plastics, cosmetics, solvents
<u>ORANGE</u>			
Anthraquinone Dyes Perinone [Turn Signal Color]	Sol. Orange 60		Plastics
Azo Dyes [1-(2,4-xylylazo)- 2-naphthol]	Sol. Orange 1, 11920 Sol. Orange 7		Oils, waxes, fats, plastics Oils, fats, waxes, solvents, plastics
Azo Metal Complex Dyes	Sol. Orange 54  Sol. Orange 56  Sol. Orange 59		Solvents, lacquers, plastics, wood stains Solvents, lacquers, plastics, wood stains Lacquers
Xanthene Dyes	Sol. Orange 63		Plastics
<u>RED</u>			
Anthraquinone Reds Perinone	Sol. Red 135 Sol. Red 195		Plastics
[Taillight Red]	Sol. Red 111, 60505		Plastics
Amaplast Rubinol R	Sol. Red 52, 68210		Plastics
Azo Dyes Disazo	Sol. Red 1, 12150 Sol. Red 27, 26125 Sol. Red 23, 26100		Solvents, plastics Oils, fats, waxes, cosmetics Oils, fats, waxes, plastics, cosmetics
[1-((4-(phenylazo) phenyl)azo)-2- naphthalenol]	Sol. Red 24, 26105		Solvents, floor polishes, plastics, lacquers, varnishes, indicator
[1-((4(o-tolylazo)-o-tolyl)azo)-2- naphthol]	Sol. Red 3, 12010		Oils, fats, waxes, wood stains, moulding powder
[N-ethyl-1-((p-(phenylazo)phenyl)- azo)-2-naphthylamine]	Sol. Red 19 Sol. Red 22  Sol. Red 40  Sol. Red 26		Solvents, inks, candles, oils, plastics Oils, fats, waxes, solvents, inks, lacquers Inks, oil stains, candles, gasoline, lacquers, plastics Oils, fats, waxes, plastics

(Continued)

TABLE B-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Consumption</u> †	<u>Use</u>
<u>RED (Continued)</u>			
Azo Metal Complex Dyes	Sol. Red 118 Sol. Red 119 Sol. Red 122  Sol. Red 125		Lacquers, wood stains, plastics Lacquers, wood stains, plastics Solvents  Solvents, inks, lacquers
Congo Red [Sodium diphenyl- bis-alpha-naphthalamine sulfonate]			Dye; medicine; indicator; biological stain
Palacet Pink SF-7867 [1,5-Diamino- anthraquinone]	Dis. Red 4, 60755 Dis. Red 11, 62015		
Palacet Red SF-7874	Dis. Red 60	8.0 x 10 <sup>5</sup> kgs (79)	
Rhodamine B Base	Sol. Red 49, 45170B		Solvents, inks, carbon paper, plastics
Vat Red	Vat Red 1, 73360		Textiles
Xanthene [o-(6-(ethylamino)- 3(ethylimino)-2,7-dimethyl-3H-xan- thene-9-yl)-Benzoic acid, ethyl ester, monohydrochloride]	Acid Red 52 Basic Red 1		Textiles, leather, paper Textiles, paper, inks, crayons, leather
<u>VIOLET</u>			
Anthraquinone [1-Hydroxy-4-(p- Toluidino)anthraquinone]	Dis. Violet 31 Sol. Violet 13, 60721 Sol. Violet 14, 61705		Solvents, petrol, plastics, cosmetics Oils, waxes, petrol, plastics, wood stains
Carbazole Dioxazine	Sol. Violet 23, 51319		Solvents, lacquers
Palacet Red Violet SF-7868 [1,4 Diaminoanthraquinone]	Dis. Violet 1, 61100	2.3 x 10 <sup>4</sup> kgs (79)	
Palacet Violet SF-7870	Dis. Violet 4, 61105		
Palacet Blue SF-7872	Sol. Violet 13, 60725 See Anthraquinone dye		

(Continued)

TABLE B-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Consumption†</u>	<u>Use</u>
<u>VIOLET (Continued)</u>			
Rhodamine B [Xanthene] [9-(o-Carboxyphenyl)-6-(Diethylamino)-3H-Xanthen-3-ylidene]diethyl ammonium chloride]	Basic Violet 10		Textiles, paper, inks, crayons, distempers, leather, wood stain
<u>BLUE AND GREEN</u>			
Anthraquinone	Sol. Blue 56 Sol. Blue 58  Sol. Blue 59		Solvents, inks Solvents, oils, fats, waxes, petroleum products, plastics, lacquers Solvents, oils, fats, waxes, petroleum products, plastics, lacquers
(Alizarine)	Sol. Green 3, 61565 Sol. Green 28		Solvents, oils, fats, waxes, petrol, wood stains, soap, plastics, inks
Amaplast Blue RJK [Anthraquinone]	Sol. Blue 16		Solvents, oils, fats, waxes, plastics
Amaplast Bordeaux BPS			
Azo Dyes	Sol. Blue 35		Solvents, oils, fats, waxes, lacquers
Azo Metal Complex Dyes	Sol. Blue 67 Sol. Blue 53		Lacquers, enamels, inks, plastics Solvents, inks, lacquers, plastics
Phthalocyanine	Sol. Blue 70		Solvents, plastics, lacquers, wood stains
Palacet Blue SF-7871 [1-((2-Hydroxyethyl)amino)-4-(methylamino) anthraquinone]	Dis. Blue 3	5.7 x 10 <sup>5</sup> kgs (79)	
Thermoplast Brilliant Yellow 10G [Anthraquinone]	Sol. Green 5, 59075		Solvents
Triphenylmethane Dye	Victoria Blue B		
Unspecified	Sol. Blue 3, 61505		Solvents, oils, fats, waxes, textiles
Xanthene Dyes	Sol. Green 4		Solvents, fats, oils, waxes

(Continued)

TABLE B-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Consumption†</u>	<u>Use</u>
<u>FLUORESCENTS</u>			
Bisazoles			
Vinylenebisbenzoxazoles			
Coumarins MDAC [4-methyl-7-diethylamino coumarin] [3 phenyl-7 amino coumarins]			Optical bleach for textiles; paper, label, book cover coatings; plastics, resins, varnishes, lacquers; invisible marking agent
Stilbenes Derivatives of stilbene-naphthotriazole (4-naphtho-triazolylstilbene)			
Fluorescent (dyed organic glass particles, full color range)			
Fluorescent			
(Pure dye, assorted color range)			
(Sulfides)			
<u>PHOSPHORESCENT</u>			
[zinc sulfide]			Pigment for glass; base color for lakes; rubbers and plastics; dyeing (hydrosulfite process); ingredient in lithopone; phosphor in X-ray and television screens; luminous watch faces; fungicide
[zinc cadmium sulfide or calcium strontium sulfide]			Fluorescent pigment; depilatory; luminous paints; source of hydrogen sulfide; manufacture of strontium chemicals
<u>PEARLESCENTS</u>			
Bismuth Coated Mica (pearly luster)			
Bismuth Coated Talc (pearly luster)			

(Continued)



TABLE B-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Consumption†</u>	<u>Use</u>
<u>PEARLESCENTS</u> (Continued)			
Bismuthoxychloride (pearly luster) [BiOCl]			Medicine; cosmetics; pigment
Lead Carbonate I (brilliant pearl) [xPbCO <sub>3</sub> .yPb(OH) <sub>2</sub> ]			Industrial paint pigment
Lead Carbonate II (opaque pearl) [xPbCO <sub>3</sub> .yPb(OH) <sub>2</sub> ]			
Metallic Oxide Brown-FDA (high heat stable) [x-Ferric oxide crystallized from a borox melt] and other compositions			
Metallic Oxide Browns (high heat stable)			
Titanium Dioxide/Mica Composite (pearly luster)			Plastics pigment
Titanium Dioxide/Mica/Inorganic Pigment			Plastics pigment
<u>METALLICS</u>			
Aluminum; Plastic Grades (silver)	Fig. Metal 1, 77000, 77001		Powder: Paints and protective coatings; rocket fuel; incendiary mixtures; catalyst; foamed concrete; vacuum metallizing and coating; plastics Flakes: Insulation of liquid fuels; plastics
Bronze; Plastic Grades (red gold to yellow gold) [pale gold bronze (92% Cu, 6% Sn, 2% Al)] [rich pale gold bronze (90% Cu, 9.25% Zn, 0.75% Al)] [rich gold bronze (77% Cu, 22% Zn, 1% Al)] [green gold bronze (68.75% Cu, 31% Zn, 0.25% Al)]	Fig. Metal 2, 77400		Paint; cosmetics; fine arts; plastics

(Continued)

TABLE B-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Consumption†</u>	<u>Use</u>
<u>METALLICS</u> (Continued)			
Copper; Plastic Grades (coppery red)			Powder: Insecticides; catalysts; antifouling paints; plastics Flakes: Insulation for liquid fuels; plastics

†Annual Consumption is presented parenthetically for the most recent year available.

TABLE B-6. COUPLING AGENTS  
CONSUMPTION AND OTHER USES

<u>Coupling Agents</u>	<u>Consumption†</u>	<u>Use</u>
<u>SILANES</u>		
N-β-Aminoethylaminomethylphenylethyltrimethoxysilane		
N-β-Aminoethyl-γ-aminopropyltrimethoxysilane		
Aminophenyltriethoxysilane		
γ-Aminopropyltriethoxysilane		
Amyltrimethoxysilane		
Bis(β-Hydroxyethyl)-γ-aminopropyltriethoxysilane		
γ-Chloroisobutyltriethoxysilane		
Chloromethylphenylethyltrimethoxysilane		
γ-Chloropropyltrimethoxysilane		
β-Cyclohexylethyltrimethoxysilane		
β-(3,4-Epoxy cyclohexyl)ethyltrimethoxysilane		
γ-Glycidoxypropyltrimethoxysilane		Coupling agent
γ-Mercaptopropyltrimethoxysilane		Coupling agent for glass-resin, metal-resin, and resin-resin bonds; formulation of adhesives having built-in primer systems
γ-Methacryloxypropyltrimethoxysilane		
Methylphenyltrimethoxysilane		
Methoxyphenyltrimethoxysilane		
Octyltriethoxysilane		
Phenyltriethoxysilane		
Sulfonyl azide silane (proprietary)		

(Continued)

TABLE B-6 (Continued)

<u>Coupling Agents</u>	<u>Consumption†</u>	<u>Use</u>
<u>SILANES (Continued)</u>		
γ-Ureidopropyltriethoxysilane		
Vinylbenzyl cationic silane		
Vinylbenzylpropyltrimethoxysilane		
Vinyltriethoxysilane		
Vinyltrimethoxysilane		
Vinyl-tris-(2-methoxyethoxy)silane		
<u>TITANATES</u>		
Acrylamino pyrophosphate titanate [KR-262A]		
Acrylojunctional organotitanate pyrophosphate [KR-238A]		
4-Aminobenzenesulfonyl dodecylbenzene- sulfonyl ethylene titanate [KR-226S]		
4-Aminobenzoyl, isostearyl ethylene titanate [KR-237BS]		
Di(butyl, methyl pyrophosphato) ethylene titanate [KR-262S]		
Di(butyl, methyl pyrophosphato) ethylene titanate mono(dioctyl, hydrogen phosphate) [KR-262ES]		
Di(butyl, methyl pyrophosphato) isopropyl titanate di(dioctyl, hydrogen) phosphite [KR-62ES]		
Di(dioctyl phosphato)ethylene titanate [KR-212]		
Di(dioctyl pyrophosphato) ethylene titanate [KR-238S]		

(Continued)

TABLE B-6 (Continued)

<u>Coupling Agents</u>	<u>Consumption†</u>	<u>Use</u>
<u>TITANATES (Continued)</u>		
Diisostearylethylene titanate [KR-201]		
Dodecylbenzenesulfonyl (4-aminobenzene sulfonyl), ethylene titanate [KR-226S]		
Ethylene, di(dioctyl)pyrophosphato titanate [KR-238J]		
Ethylene, di(dioctyl pyrophosphato) titanate dimethylamino-1-butanol adduct		
Isopropyl, 4-aminobenzenesulfonyl, di(dodecylbenzenesulfonyl) titanate [KR-26S]		
Isopropyl (di-4-aminobenzoyl)isostearoyl titanate [KR-37BS]		
Isopropyl diacryl isostearoyl titanate [KR-11]		
Isopropyl diisostearoyl acryl titanate [KR-10]		
Isopropyl diisostearoyl methacryl titanate [KR-6]		
Isopropyl, dimethacryl, isostearoyl titanate [KR-7]		
Isopropyl di(methyl, butyl pyrophosphate) titanate [KR-62S]		
Isopropyl isostearoyl diacryl titanate [KR-11]		
Isopropyl methacryl diisostearoyl titanate [KR-6]		
Isopropyl octyl, butyl pyrophosphate titanate [KR-58DS]		

(Continued)

TABLE B-6 (Continued)

<u>Coupling Agents</u>	<u>Consumption†</u>	<u>Use</u>
<u>TITANATES</u> (Continued)		
Isopropyl, triacryl titanate [KR-39BS], [KR-39CS]		
Isopropyl tri(2-aminobenzoyl) titanate [KR-52S]		
Isopropyl triaminoethylethylamino titanate [XKR-44U]		
Isopropyl tri(butyl, octyl pyrophosphato) titanate di(dioctyl, hydrogen) phosphate [KR-58FS]		
Isopropyl tricumylphenyl titanate [KR-34BS], [KR-34S]		
Isopropyl, tri(dioctyl phosphato)titanate [KR-12]		
Isopropyl tri(dioctyl pyrophosphato) titanate [KR-38S]		
Isopropyl, tridodecylbenzenesulfonyl titanate [KR-9S]		
Isopropyl, tri(N-ethylaminoethylamino) titanate [KR-44]		
Isopropyl triisostearoyl titanate [KR-15], [KR-TTS]		Coupling agent; antistatic agent
Isopropyl tri(3-mercaptopropionyl) titanate [KR-66S]		
Isopropyl trimethacryl titanate [KR-33BS], [KR-33CS]		
Isopropyl triricinoyl titanate [TTR-27]		
Isopropyl tri(tetraethylenetriamine) titanate [KR-63S]		

(Continued)

TABLE B-6 (Continued)

<u>Coupling Agents</u>	<u>Consumption†</u>	<u>Use</u>
<b>TITANATES (Continued)</b>		
Oxoethylene di(butyl, octyl pyrophosphato) titanate dimethylamino-1-butanol adduct [KR-158D]		
Oxoethylene di(dioctyl pyrophosphato) titanate dimethylamino-1-butanol adduct [KR-138D]		
Oxoethylene di(dioctyl) pyrophosphato titanate di(dimethylaminopropyl methacrylamide) [KR-138J]		
Oxoethylene di(dioctyl)pyrophosphate titanate triethylamine complex [KR-138T]		
Proprietary [KR-9T]		
Proprietary [KR-238T]		
Pyrophosphato titanium ammonium methacrylate [KR-238M]		
Tetra(2,2-diallyloxymethyl-1-butoxy)titanium di(ditridecyl)phosphite [KR-55]		
Tetraisopropyl, di(dioctyl phosphito) titanate [KR-41B]		
Tetraisopropyl di(tridecyl phosphito) titanate [KR-36C]		
Tetraoctyloxytitanium di(dilauryl phosphite) titanate [KR-46B]		
Tetraoctyloxytitanium di(ditridecyl phosphite) [KR-46B]		
Titanium acrylate isostearate oxyacetate [KR-110S]		
Titanium 4-aminobenzoate, isostearate, oxyacetate [KR-137BS]		

(Continued)

TABLE B-6 (Continued)

<u>Coupling Agents</u>	<u>Consumption +</u>	<u>Use</u>
<u>TITANATES (Continued)</u>		
Titanium 4-aminobenzene sulfonate, dodecylbenzenesulfonate, oxyacetate [KR-126S]		
Titanium diacrylate, oxyacetate [KR-139BS], [KR-139CS]		
Titanium di(butyl, octyl pyrophosphate) di(dioctyl, hydrogen phosphite) oxyace- tate [KR-158FS]		
Titanium di(butyl, octyl pyrophosphate) oxyacetate [KR-158DS]		
Titanium di(cumylphenolate) oxyacetate [KR-134BS], [KR-134CS]		
Titanium di(dioctyl phosphate) oxyacetate [KR-112S]		
Titanium di(dioctyl pyrophosphate) oxyacetate [KR-138S]		
Titanium dimethacrylate, oxyacetate [KR-133BS], [KR-133CS]		
Titanium isostearate methacrylate oxyacetate [KR-106], [KR-106S]		
Titanium (IV) bismethacrylate, oxoethylene diolato [KR-133DS]		
Titanium (IV) bis(methyl, butyl) pyro- phosphato, ethylenediol bis 3-N-dimethyl- amino isobutanol [KR-262D]		
Titanium (IV) trisacrylate methoxydigly- colato [KKR-39DS]		
Titanium (IV) tris methacrylate methoxy- glycolato [KKR-33DS]		

(Continued)



TABLE B-6 (Continued)

<u>Coupling Agents</u>	<u>Consumption†</u>	<u>Use</u>
<u>TITANATES (Continued)</u>		
Tri(butyl, octyl pyrophosphato) iso-propyl titanate mono(dioctyl, hydrogen phosphite) [KR-58FS], [KR-58S]		
Tris(dioctyl)pyrophosphato, isopropyl titanate		
<u>ESTERS</u>		
Calcium stearate		Water repellant; flatting agent in paints; lubricant in making tablets; emulsions; cements; wax crayons; stabilizer for vinyl resins; anticaking agent in foods; cosmetics
Stearic acid		Chemicals, especially stearates and stearate dryers; lubricants; soaps; pharmaceuticals and cosmetics; accelerator activator, dispersing agent and softener in rubber compounds; shoe and metal polishes; coatings; food packaging
<u>PROPRIETARY ESTERS</u>		
Anti-Terra U-80 [Unsaturated acid ester neutralized with polyaminoamine; electroneutral]		
Surfaid-90 (fatty acid ester)		
VP-109 [Unsaturated fatty acid, anionic]		
VP-900 [Polymeric ester, anionic]		
VP-905 [Polymeric esters, unsaturated, combination of anionic and cationic]		
W-900 [Low molecular weight polymeric salt]		
W-905 [Low and medium molecular weight polymeric salt and anionic polymeric salt]		
W-910 [Medium molecular weight fatty acid based anionic]		

(Continued)

TABLE B-6 (Continued)

<u>Coupling Agents</u>	<u>Consumption†</u>	<u>Use</u>
<u>PROPRIETARY ESTERS (Continued)</u>		
W-980 [Medium molecular weight unsaturated acid ester neutralized with polyamino amine]		
W-960 [Medium molecular weight unsaturated acid ester]		
<u>MISCELLANEOUS PROPRIETARY</u>		
<u>PROPRIETARY ORGANOSILICONS</u>		
Union Carbide Y-9578		
Union Carbide Y-9602		
Union Carbide Y-7676		
Union Carbide Y-9674		
Union Carbide Y-4935		
Union Carbide Y-9682		
<u>CHLORINATED PARAFFINS</u>		
Chlorez 700 [Chlorinated paraffins, 70% Cl]		
Chlorez 720 [Chlorinated paraffins, 70+% Cl]		
Chlorez 760 [Chlorinated paraffins, 70+% Cl]		
<u>CHROME-CONTAINING</u>		
Methacrylate chromic		

†Annual Consumption is presented parenthetically for the most recent year available.

TABLE B-7. CURING AGENTS AND CATALYSTS FOR THERMOSETTING RESINS  
CONSUMPTION AND OTHER USES

<u>Chemical</u>	<u>Consumption†</u>	<u>Use</u>
<u>AMINES</u>		
Alkanolamine [See Ethanolamine, Triethanolamine]		
m-Aminobenzylamine		
p-Aminobenzylaminoaniline		
N-Aminoethylethanolamine		Textile finishing compounds; resins; rubber products; insecticides; certain medicinals
N-Aminoethyl piperazine		Epoxy curing agent; intermediate for pharmaceuticals; anthelmintics; surface active agents; synthetic fibers
Benzyl dimethylamine		Intermediate, especially for quaternary ammonium compounds; dehydrohalogenating catalyst; corrosion inhibitor; acid neutralizer
Bis(dimethylaminoethyl) ether		
Bis(hexamethylene)triamine		
4-Chloroorthophenylene diamine		
N-Cocmorpholine		
Cyclohexylpropylene diamine		
Diallyltetrahydriodipyridyl		
Diaminocyclohexane		
Diaminodiphenyl methane		Determination of tungsten and sulfates; polymer and dye intermediate; corrosion inhibitor; epoxy resin hardening agent; isocyanate resins; polyamides
Diaminodiphenyl sulfone [DDS] [Sulfonyl dianiline]		Curing agent for epoxy resins; medicine
3,5(Diaminomethyl) aniline		
2,6-Diaminopyridine		

(Continued)

TABLE B-7 (Continued)

<u>Chemical</u>	<u>Consumption†</u>	<u>Use</u>
<b>AMINES (Continued)</b>		
Dicyanodiamine		
Diethanolamine		Liquid detergents for emulsion paints; cutting oils; shampoos; cleaners and polishes; textile specialties; absorbent for acid gases; chemical intermediate for resins, plasticizers, etc.; solubilizing 2,4-D
Diethylamine		Rubber chemicals; textile specialties; selective solvent; dyes; flotation agents; resins; pesticides; polymerization inhibitors; pharmaceuticals; petroleum chemicals; electroplating; corrosion inhibitors
Diethylaminoethanol		Water soluble salts; fatty acid derivatives; textile softeners; pharmaceuticals; antirust compositions; emulsifying agents in acid media; derivatives containing tertiary amine groups; curing agent for resins
Diethylaminopropylamine [DEAPA]		Curing agent for epoxy resins; intermediate
Diethylenetriamine [DETA]		Solvent for sulfur, acid gases, various resins, dyes; saponification agent for acidic materials; fuel component
Dimethylamine		Acid gas absorbent; solvent; antioxidants; manufacturing of dimethylformamide and dimethylacetamide; dyes; flotation agent; gasoline stabilizers; pharmaceuticals; textile chemicals; rubber accelerators; electroplating; dehairing agent; missile fuels; pesticide propellant; rocket propellants; surfactants
Dimethylaminoethanol		
Dimethylaminoethyl piperazine		
Dimethylaminomethyl phenol		Antioxidants; stabilizers; catalysts; intermediates
N,N-Dimethylaminopropylamine		Curing agent for epoxy resins; organic intermediate
1,1'(3(Dimethylamino)propyl) imino bis(2-propanol)		

(Continued)

TABLE B-7 (Continued)

<u>Chemical</u>	<u>Consumption†</u>	<u>Use</u>
<u>AMINES</u> (Continued)		
Dimethylaminopyridine		
N,N-Dimethylbenzylamine		
Dimethylcyclohexylamine		Catalyst for polyurethane foams; intermediate for rubber accelerators; treatment of textiles
Dimethylethanolamine		Intermediate in the synthesis of dyestuffs, textile auxiliaries, pharmaceuticals and corrosion inhibitors; medicine; curing for epoxy, amine and polyamide resins; emulsifier
N,N-Dimethylhexadecylamine		
N,N-Dimethylpiperazine		Curing agent for polyurethane foams; intermediate for cationic surface active agents
Di(morpholinoethyl)ether		
Ethyl-diethanolamine		Solvent; detergents
N-Ethylenediamine		Fungicides; manufacture of chelating agents; dimethylolethylene-urea resins; chemical intermediate
N-Ethylmorpholine		Intermediate for dyestuffs, pharmaceuticals, rubber accelerators and emulsifying agents; solvent for dyes, resins oils; catalyst for polyurethane foams
Glycidylether polyamine adducts		
Heptamethylisobiguamide		
Hexamethylenediamine		Formation of Nylon 6/6
Hexamethylenetetramine		Catalyst for phenol-formaldehyde and resorcinol-formaldehyde resins; ingredient in rubber-to-textile adhesives; protein modifier; organic synthesis; pharmaceuticals; ingredient in high explosive cyclonite; fuel tablets
N-(β-Hydroxyethyl)piperazine		Intermediate for pharmaceuticals, anthelmintics, surface active agents and synthetic fibers
N(2-Hydroxypropyl)ethylenediamine		

(Continued)

TABLE B-7 (Continued)

<u>Chemical</u>	<u>Consumption†</u>	<u>Use</u>
<u>AMINES (Continued)</u>		
3,3'-Iminobispropylamine		Intermediate for soaps, dyestuffs, rubber chemicals, emulsifying agents, petroleum specialties, insecticides, and pharmaceuticals
Menthane diamine		Curing agent for epoxy resins; chemical intermediate
N-Methoxyethylmorpholine		
α-Methylbenzyl dimethylamine		Polymerization catalyst
p,p'-Methylenedianiline [p,p'-diaminodi-phenylmethane]		Determination of tungsten and sulfates; polymer and dye intermediate; corrosion inhibitor; epoxy resin hardening agent; isocyanate resins; polyamides
N-Methylmorpholine		Catalyst for polyurethane foams; extraction solvent; stabilizing agent for chlorinated hydrocarbons; self-polishing waxes; oil emulsions; corrosion inhibitor; pharmaceuticals
Methylpiperzine		Intermediate for pharmaceuticals, surface agents, synthetic fibers
Monomethylamine [Methylamine]		Intermediate for accelerators, dyes, pharmaceuticals, insecticides, fungicides, surface active agents; tanning; dyeing of acetate textiles; fuel additive; polymerization inhibitor; component of paint removers; solvent; photographic developer; rocket propellant
Monoethanolamine [2-Aminoethanol]		Scrubbing acid gases; nonionic detergents for dry cleaning, wool treatment, emulsion paints, polishes, agricultural sprays; chemical intermediates; pharmaceuticals; corrosion inhibitor; rubber accelerator
Monoethylamine		Dye intermediates; solvent extraction; petroleum refining; stabilizer for rubber latex; detergents; organic synthesis
Olefin oxide-polyamine adduct		
Pentaethylenehexamine		

(Continued)

TABLE B-7 (Continued)

<u>Chemical</u>	<u>Consumption†</u>	<u>Use</u>
<u>AMINES (Continued)</u>		
m-Phenylenediamine		Dyestuff manufacture; detection of nitrous acid; textile developing agent; laboratory reagent
Piperidine		Solvent and intermediate; curing agent for rubber and epoxy resins; catalyst for condensation reactions; ingredient in oils and fuels; complexing agent
Polyoxyalkylenepolyamine		
Pyridine		Synthesis of vitamins and drugs; solvent; water-proofing; rubber chemicals; denaturant for alcohol and antifreeze mixtures; dyeing assistant in textiles; fungicide
Pyrrolidine		Intermediate in pharmaceuticals, fungicides, insecticides, rubber accelerators; citrus decay control; curing agent for epoxy resins; inhibitor
Quinuclidine		
Silicone amine		
Tetraethylenepentamine		Solvent for sulfur, acid gases, various resins and dyes; saponifying agent for acidic materials; manufacture of synthetic rubber; dispersant in motor oils; intermediate for oil additives
N-Tetramethylethylenediamine		Preparation of epoxy curing agents; polyurethane formation; corrosion inhibitor; textile finishing agents; intermediate for quaternary ammonium compounds
N-Tetramethyl-1,3-butanediamine		Catalyst for polyurethane foams and epoxy resins; high energy fuels
Tetramethylguanidine		
Triaminomethylbenzene		
Tri(dimethylaminomethyl) phenol		Antioxidants, acid neutralizers, stabilizers and catalysts for epoxy and polyurethane resins
Triethanolamine borate		
Triethylamine		Catalytic solvent in chemical synthesis; accelerator activators for rubber; wetting, penetrating and waterproofing agents of quaternary ammonium types; curing and hardening of polymers; corrosion inhibitor; propellant

(Continued)

TABLE B-7 (Continued)

<u>Chemical</u>	<u>Consumption†</u>	<u>Use</u>
<u>AMINES</u> (Continued)		
Triethylenediamine		Catalyst for polyurethane
Triethylenetetramine		Detergents and softening agents; synthesis of dye-stuffs, pharmaceuticals and rubber accelerators
1,2,4-Trimethylpiperazine		Polymerization catalyst
2,4,6-Tris(dimethylaminoethyl)phenol		
2,4,6-Tris(dimethylaminomethyl)phenol		
1,3,5-Tris((N,N-dimethyl-3-amino)propyl)-5-hexahydro-triazine		
m-Xylenediamine		
<u>AMINE OXIDES</u>		
Dimethyldodecylamine-N-oxide		
Pyridine-N-oxide		Intermediate
Trimethylamine-N-oxide		
<u>AMIDES</u>		
1,1-Dimethylurea		
1,3-Dimethylurea		Intermediate in synthesis of drugs
1,3-Diphenylurea [carbanilide]		Organic synthesis
1-Methylurea		
1-Phenylurea		
Urea [carbamide]		Fertilizer; animal feed; plastics; chemical intermediate; stabilizer in explosives; medicine; adhesives; separation of hydrocarbons; sulfamic acid production; flame-proofing agent; viscosity modifier for starch or casein-based paper coatings; reported helpful in treating sickle cell anemia

(Continued)



TABLE B-7 (Continued)

<u>Chemical</u>	<u>Consumption†</u>	<u>Use</u>
<u>IMIDAZOLES</u>		
Benzimidazole		
1-N-Butylimidazole		
1-N-Cyclohexylimidazole		
2-Ethyl-4-methylimidazole		Curing epoxy resins
N-Propylimidazole		
<u>METAL COMPOUNDS</u>		
<u>ANTIMONY</u>		
Antimony pentachloride		Analysis of alkaloids and cesium; dyeing; intermediates; as a chlorine carrier in organic chlorinations
Antimony trichloride		Antimony salts; bronzing iron; mordant; manufacturing lakes; chlorinating agent in organic synthesis; pharmaceuticals; fireproofing textiles
<u>CALCIUM</u>		
Calcium acetate		Manufacture of acetone, acetic acid, acetates; mordant in dyeing and printing of textiles; stabilizer in resins; additive to calcium soap lubricants; food additive, as antimold agent in bakery goods, in sausage casings; catalyst manufacture; medicine
Calcium carbonate		Source of lime; neutralizing agent; filler and extender in rubber, plastics, paints; opacifying agent in paper; fortification of bread; putty; tooth powders; antacid; whitewash; Portland cement; SO <sub>2</sub> removal from stack gases; metallurgical flux; analytical chemistry; CO <sub>2</sub> generation (laboratory)
Calcium naphthenate		Waterproofing compositions; adhesives; dryers; wood fillers; grafting waxes; cements; varnishes; color lakes

(Continued)

TABLE B-7 (Continued)

<u>Chemical</u>	<u>Consumption†</u>	<u>Use</u>
<u>CALCIUM</u> (Continued)		
Tricalcium phosphate [Calcium phosphate, tribasic]		Ceramics; calcium acid phosphate; phosphorus and phosphoric acid; polishing powder; cattle foods; clarifying sugar syrups; medicine; mordant; fertilizers; dentifrices; stabilizer for plastics; in meat tenderizers; in foods as anticaking agent, buffer, nutrient supplement; can remove strontium-90 from milk
<u>CHROMIUM</u>		
Chromium (III) triacetyl acetate		Reduction of detonation of nitromethane
Chromium (III) tri-2-acetylcyclohexanoate		
Chromium (III) tri(dibenzoylmethane)		
Chromium (III) tri(1,3-Diphenyl-1,3-pentanedioate)		
Chromium (III) tri(1,3-diphenyl-1,3-propanedioate)		
Chromium (III) tri-2-ethylhexanoate		
Chromium (III) tri(1-phenyl-1,3-butane-dione)		
Chromium (III) tripicolinoate		
<u>COBALT</u>		
Cobalt benzoate		
Cobalt 2-ethylhexoate [Cobalt octoate]		Paint dryer; whitener; catalyst
Cobalt naphthenate [Indefinite]		Paint and varnish dryer; bonding rubber to steel and other metals

(Continued)

TABLE B-7 (Continued)

<u>Chemical</u>	<u>Consumption†</u>	<u>Use</u>
<u>LEAD</u>		
Lead benzoate		
Lead 2-ethylhexoate		
Lead naphthenate		Paint and varnish dryer; wood preservative; insecticide; catalyst for reaction between unsaturated fatty acids and sulfates in air; lube oil additive
Lead oleate		Varnishes; lacquers; paint dryer; high pressure lubricants
Litharge, sublimed		Storage batteries; ceramic cements and fluxes; pottery and glazes; glass; chromium pigments; oil refining; varnishes, paint, enamels, ink, linoleum; insecticides; cement; acid-resisting compositions; other lead compounds; rubber accelerator
<u>MANGANESE</u>		
Manganese 2-ethylhexoate [Manganese octoate]		Primarily as a dryer for paints, enamels, varnishes and printing inks
Manganese linoresinate		
Manganese naphthenate {Indefinite}		Paint and varnish dryer
<u>PHOSPHORUS</u>		
Hexamethylphosphoric triamide {Hempa}		Ultraviolet inhibitor in polyvinyl chloride; chemosterilant for insects; promoting stereospecific reactions; specialty solvent
Tri-n-butylphosphine		Polymerization crosslinking catalyst; inorganic intermediate; fuels
Tributyldecylphosphonium iodide		
Trioctylphosphine oxide		Reagent for extraction of metals from aqueous and nonaqueous solution, including fissionable actinide elements
Triphenyl phosphine oxide		

(Continued)

TABLE B-7 (Continued)

<u>Chemical</u>	<u>Consumption†</u>	<u>Use</u>
<u>TIN</u>		
Dibutyltindiacetate		Stabilizer for chlorinated organics; catalyst for condensation reactions
Dibutyltindilaurate		Stabilizer for vinyl resins, lacquers, elastomers; catalyst for polyurethane
Dibutyltindioctoate [Dibutyltindi-2-ethylhexoate]		Catalyst for silicone curing; polyether foams
Dibutyltinbis(isooctylmaleate		
Dibutyltinbis(isooctylmercapto- acetate		
Dibutyltinbis(laurylmercaptide		Antioxidant and metal cleaning agent
Dimethyltinbis(isooctylmaleate		
Dimethyltin isooctylmercapto- acetate		
Dimethyltinbis(laurylmercaptide		
Stannous chloride		Reducing agent in manufacture of chemicals, intermediates, dyes, polymers, phosphors; manufacture of lakes; textiles (reducing agent in dyeing, discharge to printing); tin galvanizing; reagent in analytical chemistry; medicine; silvering mirrors; revivification of yeast sown in must; antisludging agent for lubricating oils; food preservative; stabilizer for perfume in soaps
Stannous octoate [Stannous-2-ethylhexoate]		Polymerization catalyst for urethane foams; lubricant; addition agent; stabilizer for transformer oils
Stannous oleate		Polymerization catalyst; inhibitor

(Continued)

TABLE B-7 (Continued)

<u>Chemical</u>	<u>Consumption†</u>	<u>Use</u>
<u>ZINC</u>		
Zinc acetate		Medicine; preserving woods; textile dyeing (mordant and resist); zinc chromate; laboratory reagent; feed additive; crosslinking agent for polymers; ingredient in dietary supplements
Zinc-2-ethylhexoate [Zinc octoate]		Catalyst
Zinc naphthenate		Dryer and wetting agent in paints, varnishes, and resins; insecticide, fungicide and mildew preservative; wood preservative; waterproofing textiles; insulating materials
Zinc oxide [ZnO]		Accelerator, activator, pigment and reinforcing agent in rubber; ointments; pigment and mold growth inhibitor in paints; ceramics; floor tile; glass; zinc salts; feed additive; dietary supplement; seed treatment; cosmetics; semiconductor in electronic devices; photoconductor in copy machines and color photography; piezoelectric devices
<u>ZIRCONIUM</u>		
Zirconium 2-ethylhexoate		
Zirconium naphthenate		Ceramic enamels and glazes; lubricants; paints and varnishes
Zirconium toluene		
<u>MISCELLANEOUS METAL COMPOUNDS</u>		
Aluminum isopropoxide		Dehydrating agent; catalyst; waterproofing textiles
Aluminum-sec-butoxide		Ester exchange catalyst; defoamer ingredient; hydrophobic agent intermediate
Barium carbonate		Treatment of brines in chlorine-alkali cells to remove sulfates; rodenticide; barium salts; ceramic flux; optical glass; case hardening baths; ferrites; in radiation-resistant glass for color television tubes
Cerium naphthenate		

(Continued)

TABLE B-7 (Continued)

<u>Chemical</u>	<u>Consumption†</u>	<u>Use</u>
<u>MISCELLANEOUS METAL COMPOUNDS</u> (Continued)		
Lanthanum naphthanate		
Lithium acetate		
Magnesium acetate		Dye fixative in textile printing; medicine; deodorant, disinfectant and antiseptic
Magnesium Oxide		Refractories, especially steel furnace linings; polycrystalline ceramic for aircraft windshields; electrical insulation; pharmaceuticals and cosmetics; inorganic rubber accelerator; oxychloride and oxysulfate cements; paper manufacture; fertilizers; removal of sulfur dioxide from stack gases, adsorption and catalysis; semiconductors; food and feed additive
Monopotassium glycoxide		
Potassium acetate		Dehydrating agent; textile conditioner; reagent in analytical chemistry; medicine; acetone; cacodylic derivatives; crystal glass; laboratory reagent
Potassium octoate		
Potassium oleate		Textile soaps; emulsifying agent
Sodium propionate		Fungicide; mold preventive; food preservative
Strontium carbonate		Catalyst; in radiation-resistant glass for color television tubes; ceramic ferrites; pyrotechnics
Tri-n-butylarsine		
<u>MISCELLANEOUS</u>		
Aminodiboron		
Benzyltrimethylammonium chloride		Solvent for cellulose; gelling inhibitor for polyester resins; intermediate
Cresylic acid		Phosphate esters; phenolic resins; wire enamel solvent; plasticizers; gasoline additives; laminates; coating for magnet wire for small electrical motors; disinfectants; metal cleaning compounds; phenolic resins; flotation agents; surfactants; chemical intermediates; oil additives; solvent refining of lubricating oils; scouring compounds; pesticides

(Continued)

TABLE B-7 (Continued)

<u>Chemical</u>	<u>Consumption†</u>	<u>Use</u>
<u>MISCELLANEOUS (Continued)</u>		
Dicyandiamide		Polymerization of cyanamide in the presence of bases
Dimethyldilauryl ammonium chloride		
β-Hydroxyethyltrimethyl ammonium hydroxide		
Paraformaldehyde		Fungicides, bacteriacides and disinfectants; adhesives; hardener and waterproofing agent for gelatin
Tetrahydroxydiboron		
Tetrapropylammonium chloride		
Trimethylboroxine		
Trioxane		Organic synthesis; disinfectant; nonluminous, odorless fuel
<u>ACIDS</u>		
Acetic acid	1.3 x 10 <sup>9</sup> kgs (82) (total)	Manufacture of acetic anhydride, cellulose acetate and vinyl acetate monomer, acetic esters, and chloroacetic acid; production of plastics, rubber, pharmaceuticals, dyes, insecticides, photographic chemicals, etc.; food additive; latex coagulant; oil well acidizer; textile printing
Ammonium chloride		Dry batteries; mordant in dyes and printing; soldering flux; manufacture of various ammonia compounds; fertilizer; pickling agent in zinc coating and tinning; electroplating; washing powders; snow treatment; resin and adhesive in urea-formaldehyde; medicine; food industry
Ammonium fluoride		Fluorides; analytical chemistry; antiseptic in brewing; etching glass; textile mordant; wood preservation
Boric acid		Heat resistant glass; glass fibers; porcelain enamels; boron chemicals; metallurgy; fireproofing compositions for textile products such as cotton batting in mattresses; fungus control on citrus fruits; ointment and eye wash; nickel electroplating

(Continued)

TABLE B-7 (Continued)

<u>Chemical</u>	<u>Consumption†</u>	<u>Use</u>
<u>ACIDS (Continued)</u>		
Boron trifluoride		Catalyst in organic synthesis; instruments for measuring neutron intensity; silver soldering fluxes; gas brazing
Carbon dioxide	3.4 x 10 <sup>9</sup> kgs (82) (total)	Refrigeration; carbonated beverages; aerosol propellant; chemical intermediate; low temperature testing; fire extinguishing; inert atmospheres; municipal waste treatment; medicine; enrichment of air in greenhouses; fracturing and acidizing oil wells; mining; miscellaneous pressure source; hardening of foundry molds and cores; shielding gas for welding; cloud seeding, moderator in some nuclear reactors; immobilization for humane animal killings; special lasers; blowing agent
Cinnamic acid		Medicine; perfumes; intermediate
N-Cyclohexyl sulfamate		
Hydrochloric acid	2.3 x 10 <sup>9</sup> kgs (82) (total)	Acidizing of petroleum wells; chemical intermediate; ore reduction for tin and tantalum; food processing; pickling and metal cleaning; industrial acidizing; general cleaning; alcohol denaturant; laboratory reagent; production of chlorides; manufacture of phosphoric acid; starch modifier; production of vinyl chloride
Oxalic acid		Automobile radiator cleanser; general metal and equipment cleaning; purifying agent and intermediate for many compounds; leather tanning; catalyst; laboratory reagent; stripping agent for permanent press resins; bleaching of textiles; rare-earth processing
Phosphogypsum		
Phosphoric acid	7.7 x 10 <sup>9</sup> kgs (82) (total)	Fertilizers; soaps and detergents; inorganic phosphates; pickling and rust-proofing metals; pharmaceuticals; sugar refining; gelatin manufacture; water treatment; animal feeds; electro-polishing; gasoline additive; conversion coating for metals; catalyst for ethanol manufacture; lakes in cotton dyeing; yeasts; soil stabilizers; waxes and polishes; binder for ceramics; activated carbon; in foods and carbonated beverages as acidulant and sequestrant; laboratory reagent; source of uranium (experimental); intermediate; catalyst for making ethylene; flavoring for soft drinks

(Continued)



TABLE B-7 (Continued)

<u>Chemical</u>	<u>Consumption†</u>	<u>Use</u>
<u>ACIDS (Continued)</u>		
Phthalic anhydride		Alkyd resins; plasticizers; hardener for resins; polyesters; synthesis of phenolphthalein and other phthaleins, many other dyes; chlorinated products; pharmaceutical intermediates; insecticides; diethyl phthalate; dimethyl phthalate; laboratory reagent
Succinic anhydride		Manufacture of chemicals, pharmaceuticals, esters; hardener for resins
Sulfuric acid	2.9 x 10 <sup>10</sup> kgs (82) (total)	Fertilizers; chemicals; inorganic pigments; petroleum refining; manufacture of titanium dioxide, ammonium sulfate, dyestuffs, other acids, paper, and glue; etchant; alkylation catalyst; electroplating baths; iron and steel; rayon and film; industrial explosives; laboratory reagent; nonferrous metallurgy; dehydrating agent for ethers and esters; gas drying; obtaining glucose from hydrolysis of cellulose
p-Toluenesulfonic acid		Dyes; organic synthesis; organic catalyst
Thioglycolic acid		
<u>BASES</u>		
Ammonia	1.4 x 10 <sup>10</sup> kgs (82) (total)	Fertilizers; manufacture of nitric acid, hydrazine hydrate, caprolactam, acrylonitrile, hydrogen cyanide, urethane, acrylonitrile and sodium carbonate; refrigerant; nitriding of steel; condensation catalyst; synthetic fibers; dyeing; neutralizing agent in petroleum industry; latex preservative; sulfite cooking liquors; fuel cells; rocket fuel; yeast nutrient; developing diazo films; explosives; solvent; cleaning and bleaching; cotton defoliant
Barium hydroxide		Manufacture of oil and grease additives; barium soaps and chemicals; refining of beet sugar; alkalinizing agent in water softening; sulfate removal agent in treatment of water and brine; boiler scale removal; dehairing agent; catalyst in manufacture of phenol-formaldehyde resins; insecticide and fungicide; sulfate controlling agent in ceramics; purifying agent for caustic soda; steel carbonizing agent; glass

(Continued)

TABLE B-7 (Continued)

<u>Chemical</u>	<u>Consumption†</u>	<u>Use</u>
<u>BASES (Continued)</u>		
Calcium hydroxide		Mortar; plasters; cements; calcium salts; causticizing soda; hydrogen; depilatory; unhairing of hides; lime paints; medicine; agriculture; ammonia recovery in gas manufacture; disinfectant; water softening; purification of sugar juices; accelerator for low-grade rubber compounds; water paints; soil stabilizer; petrochemicals; food additive
Lime		See Calcium Hydroxide
Lithium carbonate		Ceramic and porcelain glazes; pharmaceuticals; catalyst; other lithium compounds; coating for arc welding electrodes; nucleonics; luminescent paints, varnishes and dyes; glass ceramics; aluminum production
Lithium hydroxide		Storage battery electrolyte; carbon dioxide absorbent in space vehicles; lubricating greases; ceramics
Magnesium hydroxide		Intermediate for obtaining magnesium metal; sugar refining; medicine; residual fuel oil additive; sulfite pulp; uranium processing; dentrifices; in foods as alkali, drying agent, color retention agent; frozen desserts
Monosodium phosphate		Medicine; baking powder; nutrient solutions; yeast foods; buffer and sequestrant in foods; laboratory reagent
Potassium hydroxide	1.9 x 10 <sup>8</sup> kgs (75) (total)	Soap manufacture; bleaching; manufacture of potassium carbonate and tetrapotassium pyrophosphate; electrolyte in alkaline storage batteries and some fuel cells; absorbent for carbon dioxide and hydrogen sulfide; dyestuffs; liquid fertilizers; food additive; herbicides; electroplating; inks; analytical chemistry
Sodium aluminate		Mordant; zeolites; water purification; sizing paper; manufacture of milk-glass, soap and cleaning compounds

(Continued)

TABLE B-7 (Continued)

<u>Chemical</u>	<u>Consumption†</u>	<u>Use</u>
<u>BASES (Continued)</u>		
Sodium bicarbonate		Manufacture of effervescent salts and beverages, artificial mineral water, baking powder; other sodium salts; pharmaceuticals; sponge rubber; gold and platinum plating; treating wool and silk; fire extinguishers; ceramics; prevention of timber mold; laboratory reagent; antacid; mouthwash; skin ointment; cleaning compound
Sodium hydroxide	8.2 x 10 <sup>9</sup> kgs (82) (total)	Chemical manufacture; rayon and cellophane; petroleum refining; pulp and paper; aluminum; detergents; soaps; textile processing; vegetable oil refining; reclaiming rubber; regenerating ion exchange resins; organic fusions; peeling of fruits and vegetables in food industry; laboratory reagent; etching and electroplating; precipitation of alkaloids; neutralizing acids; deshorning calves; explosives and dyestuffs; electrolytic extraction of zinc
Strontium hydroxide		Extraction of sugar from beet sugar molasses; lubricant soaps and greases; stabilizer for plastics; glass; adhesives
<u>CATALYST NEUTRALIZERS</u>		
<u>Amines</u>		
Phosphorous pentoxide [phosphoric anhydride]		Preparation of phosphorus oxychloride and metaphosphoric acid; acrylate esters; surfactants; dehydrating agent; organic synthesis; medicine; sugar refining; laboratory reagent; fire extinguishing; special glasses
Sodium hydroxide [See Bases]		See Bases
Tricalcium phosphate		See Metal Compounds
Triethanolamine		Fatty acid soaps used in dry cleaning, cosmetics, household detergents, and emulsions; wool scouring; textile antifume agent and water repellent; dispersion agent; corrosion inhibitor; softening agent, humectant and plasticizer; insecticide; chelating agent; rubber accelerator

(Continued)

TABLE B-7 (Continued)

<u>Chemical</u>	<u>Consumption†</u>	<u>Use</u>
<u>RESIN STABILIZERS</u>		
2-Amino-2-methyl-1-propanol		Emulsifying agent for oils, fats and waxes; absorbent for acidic gases; chemical synthesis
Dimethylaminoethanol		Intermediate in the synthesis of dyestuffs, textile auxiliaries, pharmaceuticals and corrosion inhibitors; curing epoxy, amine and polyamide resins; emulsifier
m-Phenylenediamine [See Amines]		See Amines
Triethylamine [See Amines]		See Amines

†Annual Consumption is presented parenthetically for the most recent year available.

TABLE B-8. FILLERS AND REINFORCERS FOR PLASTICS  
CONSUMPTION AND OTHER USES

<u>Filler</u>	<u>Consumption†</u>	<u>Use</u>
<u>INORGANIC EXTENDERS</u>		
Alumina, hydrated [Al <sub>2</sub> O <sub>3</sub> ·3H <sub>2</sub> O]	2.7 x 10 <sup>8</sup> kgs (80)	Glass, ceramics, iron-free aluminum and aluminum salts; manufacture of activated alumina; base for organic lakes; flame retardant; rubber reinforcing agent; paper coating; filler; cosmetics
Aluminum, powder [Al]		Paints; protective coating; rocket fuel; ingredient of incendiary mixtures; catalyst; foamed concrete; vacuum metalizing and coating
Aluminum hydroxide [See Alumina, hydrated]		
Aluminum oxide [Al <sub>2</sub> O <sub>3</sub> ] [Emery], [Sapphire]		Production of aluminum; manufacture of abrasives, refractories, ceramics, electrical insulators, catalyst and catalyst supports; paper; spark plugs; crucibles and laboratory ware; absorbing gases and water vapors; chromatographic analysis; fluxes; light bulbs; artificial gems; heat resistant fibers
Aluminum silicate [See Clay]		
Antimony trioxide		Flame proofing textiles, paper, plastics; paint pigments; ceramic opacifier; catalyst; intermediate; staining iron and copper; phosphors; mordant; glass decolorizer
Barium carbonate, precipitated [BaCO <sub>3</sub> ], [Witherite]		Treatment of brines in chlorine-alkali cells to remove sulfates; rodenticide; barium salts; ceramic flux; optical glass; case-hardening baths; ferrites; in radiation resistant glass for color television tubes
Barium ferrite		
Barium titanate [BaTiO <sub>3</sub> ]		
Barium sulfate [BaSO <sub>4</sub> ]		Weighting mud in oil drilling; paper coatings; paints; filler and delustrant for textiles, rubber, linoleum, oilcloth, plastics and lithographic ink; base for lake colors; X-ray photography; opaque medium for gastrointestinal radiography; in battery plate expanders
Barytes		
Blanc fixe [barium sulfate, precipitated]		
Barium sulfide		Dehairing hides; fireproofing agent; barium salts; generating pure hydrogen sulfide for analytical purposes

(Continued)

TABLE B-8 (Continued)

<u>Filler</u>	<u>Consumption†</u>	<u>Use</u>
<u>INORGANIC EXTENDERS</u> (Continued)		
Bentonite clay	2.5 x 10 <sup>9</sup> kgs (75) (total)	Oil-well drilling fluids; cement slurries for oil-well casings; bonding agent in foundry sands and pelletizing of iron ores; sealant for canal walls; thickener in lubricating greases and fireproofing compositions; cosmetics; decolorizing agent; filler in ceramics, refractories, paper coatings; asphalt modifier; polishes and abrasives; food additive; catalyst support; absorbent; manufacture of animal feed; pet litter absorbent
Beryllium oxide [BeO]		Electron tubes; resistor cores; windows in klystron tubes; transistor mountings; high-temperature reactor systems; additive to glass, ceramics and plastics; preparation of beryllium compounds
Bronze [1-10% Sn in Cu]		Paint; cosmetics
Cadmium sulfide [CdS]		Pigments and inks; ceramic glazes; pyrotechnics; phosphors; fluorescent screens; scintillation counters; rectifiers; photoconductor in xerography; transistors; photovoltaic cells; solar cells
Calcium carbonate [CaCO <sub>3</sub> ]	2.5 x 10 <sup>9</sup> kgs (81)	Source of lime; neutralizing agent; filler and extender in rubber, plastics, and paints; opacifying agent in paper; fortification of bread; putty; tooth powders; antacid; whitewash; Portland cement; SO <sub>2</sub> removal from stack gases; metallurgical flux; analytical chemistry; CO <sub>2</sub> generation
Calcium fluoride [CaF <sub>2</sub> ]		Source of fluorine and its compounds; flux in open hearth steel furnaces and in metal smelting; in ceramics; for synthetic cryolite; in carbon electrodes; emery wheels; electric arc welders; certain cements; dentrifices; phosphor; paint pigment; catalyst in wood preservatives; optical equipment
Calcium hydroxide [lime] [Ca(OH) <sub>2</sub> ]		Mortar; plasters; cements; calcium salts; causticized soda; hydrogen; depilatory; unhairing of hides; lime paints; medicine; agriculture; ammonia recovery in gas manufacture; disinfectant; water softening; purification of sugar juices; accelerator for low grade rubber compounds; water paints; soil stabilizers; petrochemicals; food additive as buffer and neutralizing agent
Calcium silicate, precipitated [CaSiO <sub>3</sub> ]		Adsorbent; antacid; adhesives; filler for paper and paper coatings; cosmetics; food additive (anticaking agent)

(Continued)

TABLE B-8 (Continued)

<u>Filler</u>	<u>Consumption†</u>	<u>Use</u>
<u>INORGANIC EXTENDERS</u> (Continued)		
Calcium sulfate [CaSO <sub>4</sub> ]		Portland cement retarder; tile and plaster; source of sulfur and sulfuric acid; polishing powders; paints; paper; dyeing and calico printing; metallurgy (reduction of zinc minerals); drying industrial gases, solids and many organic liquids; nutrient supplement; in granulated form as soil conditioner; quick-setting cements, molds, and surgical casts; wallboard
Clay [Kaolin], [Aluminum silicate] [Al <sub>2</sub> O <sub>3</sub> ·2SiO <sub>2</sub> ·2H <sub>2</sub> O] Calcined	1.5 x 10 <sup>8</sup> kgs (81)	Ceramic products; refractories; colloidal suspensions; oil-well drilling fluids; filler for rubber and plastics products; films; paper coatings; decolorizing oils; temporary molds; filtration; carrier in insecticidal sprays; catalyst support; cosmetics; cement; source of alumina
Copper, powdered [Cu]		Electrical wiring; switches, plumbing, heating, roofing, building construction; chemical and pharmaceutical machinery; alloys; electroplated protective coatings and undercoats for nickel, chromium, zinc, etc.; cooking utensils, corrosion resistant piping; insecticides; catalysts; antifouling paints; thermal and electrical composites
Emery [See Aluminum Oxide]		
Feldspar [Potassium aluminosilicate] [KAlSi <sub>3</sub> O <sub>8</sub> ]		Pottery, enamel, and ceramic ware; glass; soaps; abrasive; bond for abrasive wheels; cements and concretes; insulating compositions; fertilizer; poultry grit; tarred roofing materials
Glass	1.4 x 10 <sup>7</sup> kgs (81) (does not include fibers)	Windows; structural building blocks; chemical reaction equipment; pumps and piping; vacuum tubes; light bulbs; glass fibers; yarns and fabrics; containers; optical equipment; minute glass spheres with partial vacuum interior and treated exterior are available for compounding with resins for use in deep sea floats, potting compounds and other composites
Graphite		Pencils; crucibles; retorts; foundry facings; molds; lubricants; paints and coatings; boiler compounds; powder glazing; electrotyping; monochromator in X-ray diffraction
Iron, powder [Fe]		Powder metallurgy products; magnets; high frequency cores; auto parts; catalyst for ammonia synthesis
Iron oxide [Fe <sub>2</sub> O <sub>3</sub> ]		Metallurgy; gas purification; paint and rubber pigment; component of thermite; polishing compounds; mordant; laboratory reagent; catalyst; feed additive; medicine; electronic pigments for TV; permanent magnets; memory core for computers; magnetic tapes

(Continued)

TABLE B-8 (Continued)

<u>Filler</u>	<u>Consumption†</u>	<u>Use</u>
<u>INORGANIC EXTENDERS</u> (Continued)		
Kieselguhr [See Diatomaceous Earth]		
Kryolite [Sodium Fluoroaluminat		
Lead, powder [Pb]		Storage batteries; tetraethyl lead; radiation shielding; cable covering; ammunition; sheet and pipe; solder and fusible alloys; type metal; vibration damping in heavy construction; foil; numerous alloys
Lead oxide [PbO]	1.2 x 10 <sup>8</sup> kgs (75) (total)	Chemical intermediate; ointments; plasters; glazing pottery; glass flux; dryer for varnishes; pigment for rubber; storage battery plates; rubber activator; insecticides; metal cement; coloring sulfur-containing substances; artificial tortoise shell and horn
Lithium aluminum silicate		
Lithopone [72% BaSO <sub>4</sub> + 28% ZnS]		See Barium Sulfate and Zinc Sulfide
Magnesium carbonate, precipitated [MgCO <sub>3</sub> ]		Magnesium salts; heat insulation and refractory; rubber reinforcing agent; inks; glass; pharmaceuticals, dentrifices and cosmetics; free-running table salts; mineral waters; filtering medium; in foods as alkali, drying agent, color retention agent, anticaking agent and carrier
Magnesium hydroxide	8.6 x 10 <sup>7</sup> kgs (74) (total)	Intermediate for obtaining magnesium metal, magnesium carbonate and magnesium chloride; sugar refining; medicine; residual fuel oil additive; sulfite pulp; uranium processing; dentifices; in foods as alkali, drying agent, color retention agent; frozen desserts; neutralization of acids
Magnesium oxide		Refractories; polycrystalline ceramic for aircraft windshields; electrical insulation; pharmaceuticals and cosmetics; inorganic rubber accelerator; oxychloride and oxysulfate cements; paper manufacture; fertilizers; removal of sulfur dioxide from stack gases; adsorption and catalysis; semiconductors; pharmaceuticals; feed and food additives
Magnesium silicate, precipitated [3MgSiO <sub>3</sub> ·5H <sub>2</sub> O]		Rubber filler; ceramics; glass; refractories; adsorbent for crude oil spills; manufacture of permanently dry resins and resinous compositions; paints, varnishes and paper (filler); animal and vegetable oil bleaching agent; odor absorbent; filter medium; catalyst and catalyst carrier; anticaking agent in foods
Magnetite [Ferrous-ferric Oxide], [See Iron Oxide]		

(Continued)



TABLE B-8 (Continued)

<u>Filler</u>	<u>Consumption†</u>	<u>Use</u>
<u>INORGANIC EXTENDERS</u> (Continued)		
Mica [Potassium Aluminum Silicate]	$4.5 \times 10^5$ kgs (80)	Electrical equipment; vacuum tubes; incandescent lamps; dusting agent; lubricant; windows in high temperature equipment; filler in exterior paints; cosmetics; glass and ceramic flux; roofing; rubber; mold release agent; specialty paper for insulation and filtration; wallpaper and wallboard joint cement; oil-well drilling muds
Molybdenum disulfide	$5.0 \times 10^8$ kgs (72) (total)	Lubricant in greases, oil dispersions, resin-bound films, dry powders, etc.; hydrogenation catalyst; microprobe analysis of soil erosion aerosols
Nepheline [(Na,K)(Al,Si) <sub>2</sub> O <sub>4</sub> ]		Ceramic and glass manufacture; enamels; source of potash and aluminum
Nickel, powder		Alloys; electroplated protective coatings; electroformed coatings; alkaline storage battery; fuel cell electrodes; ceramics; catalyst for fuel gas and vegetable oil production
Perlite [See Silica]	$1.0 \times 10^7$ kgs (80)	
Pumice [67-75% SiO <sub>2</sub> + 10-20% Al <sub>2</sub> O <sub>3</sub> ]		Concrete aggregate; heat and sound insulation; filtration; finishing glass and plastics; road construction; scouring preparations; paint fillers; absorbents; support for catalysts; dental abrasive; adherent for uncured rubber products
Pyrophyllite [Al <sub>2</sub> Si <sub>4</sub> O <sub>10</sub> (OH)]		
Rottenstone		
Silica	$8.2 \times 10^7$ kgs (80)	Manufacture of glass, water glass, ceramics; abrasives; water filtration; component of hydraulic cements; source of ferrosilicon and elemental silicon; filler in cosmetics, pharmaceuticals, paper, insecticides; rubber reinforcing agent; anticaking agent for foods; flattening agent in paints; thermal insulator
Diatomaceous Earth		Filtration, clarifying and decolorizing; insulation; absorbent; mild abrasive; drilling mud thickener; extender in paints, rubber and plastics products; ceramics; paper coating; anticaking agent in fertilizers; asphalt compositions; chromatography
Fumed		Thickener, thixotropic and reinforcing agent in inks, resins, rubber, paints, cosmetics, etc.

(Continued)

TABLE B-8 (Continued)

<u>Filler</u>	<u>Consumption†</u>	<u>Use</u>
<u>INORGANIC EXTENDERS</u> (Continued)		
Silica (Continued)		
Fused		Ablative material in rocket engines, spacecraft, etc.
Silica gel		Dehumidifying and dehydrating agent; air conditioning; drying of compressed air and other gases and liquids; recovery of natural gasoline from natural gas; bleaching of petroleum oils; catalyst and catalyst carrier; chromatography; anticaking agent in cosmetics and pharmaceuticals; in waxes to prevent slipping
Silicon carbide [SiC]	1.2 x 10 <sup>8</sup> kgs (75) (total crude)	Abrasive for cutting and grinding metals; grinding wheels; refractory in nonferrous metallurgy, ceramic industry and boiler furnaces; composite tubes for steam forming operations; semiconductor; structural component of nuclear reactors
Slate flour		Filler in rubber and paint; abrasive
Sodium aluminum hydroxycarbonate [Dawsonite]		
Sodium aluminosilicate		Anticaking agent in food preparations; dentrifice
Sodium aluminum fluoride		
Steel, stainless		Construction; ship hulls; auto bodies; machinery and machine parts; cables; abrasive; chemical equipment; belts for tire reinforcement
Talc [magnesium silicate] [Mg <sub>3</sub> Si <sub>4</sub> O <sub>10</sub> (OH) <sub>2</sub> ]	1.5 x 10 <sup>8</sup> kgs (82) (in plastics)	Ceramics; cosmetics and pharmaceuticals; filler in rubber, paints, soap, putty, plaster, oilcloth; adherent; dusting agent; lubricant; paper; slate pencils and crayons; electrical insulation; refractories; fireproofing wood
Titanium dioxide, Rutile, Anatase	2.0 x 10 <sup>8</sup> kgs (82) (in plastics)	53% in paints, varnishes, lacquers; 21% in paper; 10% in plastics; 3% in elastomers; 2.5% in ceramics; 2% in floor covering; 2% in printing inks; 1% in coated fabrics and textiles; 1% in roofing granules; 4.5% for other pigments
Zinc, powder		Alloys; galvanizing iron and other metals; electroplating; metal spraying; automotive parts; electrical fuses, anodes; dry cell batteries; fungicides; nutrition; roofing and gutters; engraver's plates; cable wrappings; organ pipes

(Continued)

TABLE B-8 (Continued)

<u>Filler</u>	<u>Consumption†</u>	<u>Use</u>
<u>INORGANIC EXTENDERS</u> (Continued)		
Zinc oxide [ZnO]		Diffusing pigment; accelerator; activator; reinforcing agent; ointments; pigment and mold-growth inhibitor in paints; ceramics; floor tile; glass; zinc salts; feed additive; dietary supplement; seed treatment; cosmetics; semiconductor; photoconductor
Zinc sulfide [ZnS]		Diffusing pigment; white and opaque glass; base for color lakes; rubbers; dyeing; phosphor in X-ray and television screens; luminous watch faces; fungicides
Zirconia [ZrO <sub>2</sub> ]		Production of piezoelectric crystals; high frequency induction coils; colored ceramics glazes; special glasses; source of zirconium metal; heat resistant fibers; odor absorbent; to cure dermatitis caused by poison ivy; refractory furnace linings, crucibles, etc.; solid electrolyte for batteries
Zirconium silicate		Source of zirconia, metallic zirconium and hafnium; abrasives; refractories; enamels; refractory procelain
<u>ORGANIC EXTENDERS</u>		
<u>NATURAL</u>		
Bagasse [From Sugar Cane]		Paper; insulating board in construction; medium for growth of nutritive bacteria; animal feeds; manufacture of furfural
Bark, ground		
Carbon black	5.4 x 10 <sup>7</sup> kgs (80)	Pigment; reinforcing agent; pigment for cements, ceramic ware, mortar, inks, linoleum, surface coatings, crayons, polishes, carbon paper, soap, etc.; in insulating compositions; liquid-air explosives; matches; fertilizers; furnace lutes; lubricating compositions; carbon brushes
Cherrystone flour		
Carbon hollow spheres [See Fly Ash]		Cement additive for oil-field well casings; adsorbent for oil spills (silicone coated); filler in plastics; source of germanium
Casein		Cheese making; plastic items; paper coatings; water-dispersed paints for interior use; adhesives, especially for wood laminates; textile sizing; foods and feeds; textile fibers

(Continued)

TABLE B-8 (Continued)

<u>Filler</u>	<u>Consumption†</u>	<u>Use</u>
<b>NATURAL EXTENDERS (Continued)</b>		
Coconut-shell flour		
Coffee, ground		
Cellulose, hydrated		In the manufacture of paper, vulcanized fiber, mercerized cotton, viscose rayon
Cellulose, oxidized		Surgery and medicine; ion exchange medium; thickening agent
Cork dust	4.0 x 10 <sup>6</sup> kgs (80)	
Fly Ash [C], [Soot]		See Carbon Spheres
Gilsonite	8.2-9.1 x 10 <sup>7</sup> kgs (79) (total)	Acid, alkali and waterproof coating; black varnishes, lacquers, baking enamels and japans; wire insulation compounds; linoleum and floor tile; paving; insulation; diluent in low-grade rubber compounds; a possible source of gasoline, fuel oil and metallurgical coke; raw material for explosives and nuclear graphite industries; dark photographic inks
Keratin [ground feathers]		
Lignin, processed		Component of groundwood paper (newsprint); stabilization of asphalt emulsions; ceramic binder and deflocculant; dye leveler and dispersant; drilling fluid additive; precipitation of proteins; extender for phenolic plastics; special molded products; vanillin; source of a component of battery expanders
Peanut shells, ground	1.2 x 10 <sup>7</sup> kgs (80) (all shell flours)	
Pecan shell flour	1.2 x 10 <sup>7</sup> kgs (80) (all shell flours)	
Petroleum coke		Reduction of iron ore in blast furnaces; source of synthetic gas; refractory furnace linings in electrolytic reduction of aluminum and other high-temperature service; for electrodes in electrolytic reduction of alumina to aluminum; electrothermal production of phosphorus, silicon carbide and calcium carbide
Rice hull ash	1.2 x 10 <sup>7</sup> kgs (80) (all shell flours)	

(Continued)

TABLE B-8 (Continued)

<u>Filler</u>	<u>Consumption†</u>	<u>Use</u>
<u>NATURAL EXTENDERS</u> (Continued)		
Rubber, natural [Gutta Percha]		Tires; hoses; conveyor belt covers; footwear; specialized mechanical products; drug sundries; foam rubber; electric insulation; cements; adhesives
Saw dust		
Soybean meal	1.2 x 10 <sup>7</sup> kgs (80) (all shell flours)	Animal feeds; abrasives; medium for bacitracin production
Starch		Adhesive; machine-coated paper; textile filler and sizing agent; beater additive in papermaking; gelling agent and thickener in foods; oil-well drilling fluids; filler in baking powders; fabric stiffener in laundering; urea-formaldehyde resin adhesive for particleboard and fiberboard; explosives; dextrin; chelating and sequestering agent in foods; indicator in analytical chemistry; anticaking agent in sugar; face powders; abherent and mold release agent; polymer base
Walnut-shell flour	1.2 x 10 <sup>7</sup> kgs (80) (all shell flours)	
<u>SYNTHETIC EXTENDERS</u>		
Acrylic		See Organic Fibers, see also IPPEU Chapters 10 and 10a
Cellophane		Wrapper or protective packaging
Phenol-Formaldehyde		Many different products, see IPPEU Chapters 10 and 10a
Polyfluoroethylene		See Organic Fibers, see also IPPEU Chapters 10 and 10a
Polyethylene		Many different products, see IPPEU Chapters 10 and 10a
Polystyrene		Many different products, see IPPEU Chapters 10 and 10a
<u>INORGANIC FIBERS</u>		
Alumina (ceramic) [Al <sub>2</sub> O <sub>3</sub> ]		
Aluminum [Al]		See Inorganic Extenders

(Continued)

TABLE B-8 (Continued)

<u>Filler</u>	<u>Consumption†</u>	<u>Use</u>
<u>INORGANIC FIBERS (Continued)</u>		
Aluminum nitride		
Aluminum oxide [Al <sub>2</sub> O <sub>3</sub> ]		See Inorganic Extenders
Aluminum silicate [Al <sub>2</sub> O <sub>3</sub> ·SiO <sub>2</sub> ]		Nonwoven fabrics; woven fabric structures; cordage; thermal insulation; repair of furnace linings; piping molten metals; welding insulation; insulation for rocket and space applications
Asbestos	4.5 x 10 <sup>8</sup> kgs (82) (in plastics)	Fireproof fabric; brake lining; gaskets; roofing compositions; electrical and heat insulation; paint filler; chemical filters; reinforcing agent in rubber and plastics; component of paper dryer felts; diaphragm cells
Beryllia (ceramic)		See Inorganic Extenders (Beryllium Oxide)
Beryllium	2.7 x 10 <sup>5</sup> kgs (73) (total Be capacity)	(Be): Beryllium-copper alloys; refractor in ceramics; radio, television and fluorescent tubes; moderator and neutron source in nuclear reactors; additive in solid propellant rocket fuels
Beryllium carbide [Be <sub>2</sub> C]		(Be <sub>2</sub> C): Atomic energy applications; experimental rocket fuels
Beryllium oxide		See Inorganic Extenders
Boron		Aircraft and spacecraft composites; woven fabrics
Boron carbide [B <sub>4</sub> C]		(B <sub>4</sub> C): Abrasive powders; abrasion resister and refractory; control rods in nuclear reactors; reinforcing agent in composites for military aircraft and other special applications
Boron nitride [BN]		(BN): Refractory; furnace insulation; crucibles; rectifying tubes; dielectric; chemical equipment; self-lubricating bushings; molten metal pump parts; transistor and rectifier mounting wafers; heat shield for plasma; nose-cone windows; heat resistant fibers for military composites; metalworking abrasive; high temperature insulator; high strength fibers
Boron tungsten filament		
Calcium sulfate [Franklin fiber]		See Inorganic Extenders
Carbon	1.6 x 10 <sup>6</sup> kgs (82)	

(Continued)

TABLE B-8 (Continued)

<u>Filler</u>	<u>Consumption†</u>	<u>Use</u>
<u>INORGANIC FIBERS (Continued)</u>		
Carbon-diamond		
Chromium		(Cr): Alloying and plating element on metal and plastic for corrosion resistance; chromium-containing and stainless steels; protective coating for automotive and equipment accessories; nuclear and high temperature research; constituent of inorganic pigments
Copper		Thermal and electrical composites
Fybex [See Potassium titanate]		
Glass	7.3 x 10 <sup>8</sup> kgs (82)	Thermal, acoustic and electrical insulation (coarse fibers in bats or sheets); decorative and utility fabrics such as drapes, curtains, table linen, carpet backing, tenting, etc.; tire cord, as belt between tread and carcass; filter medium; reinforced plastics; light transmission for communication signals; reinforcement of cement products for construction use
Graphite		Heating pads (combined with glass fiber); protective clothing for electrical workers; polyester and epoxy composites for jet engine components, spacecraft, compressor blades, airframe structures; electrodes for spark-hardening metals
Hafia (ceramic) [HfO <sub>2</sub> ]		(HfO <sub>2</sub> ): Refractory metal oxide
Iron		See Inorganic Extenders
Iron-nickel		
Magnesia [MgO]		See Inorganic Extenders (Magnesium Oxide)
Magnesium		(Mg): Alloys for structural parts, die cast auto parts, missiles, space vehicles; powder for pyrotechnics and flash photography; production of iron, nickel, zinc, etc.; magnesium compounds and Grignard synthesis; cathodic protection; reducing agent; precision instruments; optical mirrors; dry and wet batteries
Molybdenum		(Mo): Alloying agent in steels and cast iron; high temperature alloys; tool steels; pigment for printing inks, paints and ceramics; catalyst; solid lubricants; missile and aircraft parts; reactor vessels; cermets; die-casting copperbase alloys; special batteries
Nickel		See Inorganic Extenders

(Continued)

TABLE B-8 (Continued)

<u>Filler</u>	<u>Consumption†</u>	<u>Use</u>
<u>INORGANIC FIBERS (Continued)</u>		
Sapphire [See Aluminum Oxide]		
Processed mineral fiber		
Potassium titanate [Pybex] [K <sub>2</sub> O·(TiO <sub>2</sub> ) <sub>n</sub> n=4-7]		Rockets, missiles, nuclear power applications as an insulator
Quartz (ceramic)		(Quartz): Electronic components; piezoelectric control in filters, oscillators, frequency standards, wave filters, radio and TV components; barrel-finishing abrasive
Silica		Reinforced plastics, see also Inorganic Extenders
Silicon carbide [Silag]		See Inorganic Extenders
Silicon nitride		
Sodium aluminum hydroxycarbonate [Dawsonite]		
Steel		See Inorganic Extenders
Tantalum		(Ta): Capacitors; chemical equipment; dental and surgical instruments; rectifiers; vacuum tubes; furnace components; high speed tools; catalyst; getter alloys; sutures and body implants; electronic circuitry; thin film components
Thoria (ceramic) [ThO <sub>2</sub> ]		(ThO <sub>2</sub> ): Ceramics; gas mantles; nuclear fuel; flame spraying; crucibles; medicine; nonsilica optical glass; catalyst; thoriated tungsten filaments in incandescent lamps, cathode in electron tubes and arc-melting electrodes
Titanium		(Ti): Alloys (especially ferrotitanium); as structural material in aircraft, jet engines, missiles, marine equipment, textile machinery, chemical equipment, surgical instruments, orthopedic appliances, food-handling equipment; X-ray tube targets; abrasives; cermets; metal-ceramic brazing; electrodeposited and dip coating on metals and ceramics; electrode in chlorine battery
Tungsten		(W): High speed tool steel; ferrous and nonferrous alloys; ferrotungsten; filaments for electric light bulbs; contact points; dentistry; X-ray and electron tubes; welding electrodes; heating elements in furnaces and vacuum metallizing equipment; rocket nozzles and other aerospace applications; shell steel; chemical apparatus; high speed rotors as in gyroscopes; solar energy devices

(Continued)



TABLE B-8 (Continued)

<u>Filler</u>	<u>Consumption†</u>	<u>Use</u>
<u>INORGANIC FIBERS</u> (Continued)		
Tungsten monocarbide		
Wollastonite [CaSiO <sub>3</sub> ]		Ceramics; paint extender; welding rod coatings; rubber filler; silica gels; paper coating; filler in plastics, cements and wallboard; mineral wool; soil conditioner
Zirconia [ZrO <sub>2</sub> ]		See Inorganic Extenders
Zircon [66% ZrO <sub>2</sub> + 33% SiO <sub>2</sub> ]		
<u>ORGANIC FIBERS</u>		
<u>NATURAL</u>		
Abaca [Manila hemp]		Heavy cordage and twine; manila paper
Broomroot		
α-Cellulose [Paper pulp]		
Coir		
Corn cobs and stalks		
Cotton flock		Apparel; industrial and household fabrics; automobile tires; upholstery; medicine
Linters		Rayon manufacture; cellulosic plastics; nitrocellulose lacquers; soil-cement binder in road construction; explosives
Cottonseed hulls		
Crin vegetal		
Flax [Bast fibers]		Apparel fabrics (linen); thread; rope; twine; cigarette paper; duplicating paper
Hemp		Blended with cotton or flax in towelling and heavy fabrics; twine; cordage; packaging

(Continued)

TABLE B-8 (Continued)

<u>Filler</u>	<u>Consumption†</u>	<u>Use</u>
<u>NATURAL FIBERS (Continued)</u>		
Henequen		Binder twine; cordage
Istle [Tampico]		
Jute [Bast fibers]		Burlap; sacking; linoleum, twine; carpet backing; packing; coarse paper
Kapok		Life jackets; insulation; pillows; upholstery
Palm		
Palmyra		
Paper		
Piassava		
Ramie [Hemp]		High grade paper; fabrics (weaving apparel and car seat covers); stern-tube packing in ships; patching water mains
Raffia		
Sisal		Twine; rope; sacking; upholstery; life preservers
Sunn		
Wood flour [Wood flock]	1.2 x 10 <sup>10</sup> kgs (82)	Manufacture of dynamite; filler for plastics, rubber and paperboard; fur cleaning; polishing agents; Sorel cement
Wood cellulose [Paper pulp] [See -Cellulose]		Newsprint; cheap manila papers; nonpermanent tissues
Wool		Outerwear; blankets; carpets; upholstery; felts; clothing; source of lanolin
<u>SYNTHETIC FIBERS</u>		
Acrylic		Modacrylic fibers; blankets; carpets, see also IPFEU Chapters 10 and 10a
Aramid	7.7 x 10 <sup>5</sup> kgs (82)	
Carbon	1.6 x 10 <sup>6</sup> kgs (82)	See Graphite Fibers

(Continued)

TABLE B-8 (Continued)

<u>Filler</u>	<u>Consumption†</u>	<u>Use</u>
<b>SYNTHETIC FIBERS (Continued)</b>		
Fluorocarbon (PTFE)		Many different products, see IPPEU Chapters 10 and 10a
Nylon		Tire cord; hosiery; apparel component; bristle for toothbrushes, hair-brushes, paint brushes; cordage and towlines for gliders; fish nets and lines; tennis rackets; rugs and carpets; turf for athletic fields; parachutes; composites; sails; automotive upholstery; surgical sutures; see also IPPEU Chapters 10 and 10a
Polyacrylonitrile [Dynel], [Orlon]		See Acrylic Fibers
Polyester		Tire fabric; seat belts; reinforcement in rubber hose for seawater cooling systems; as blended in clothing fabrics; fire hose jackets; see also IPPEU Chapters 10 and 10a
Polypropylene		Carpets; upholstery; cordage and bristles; storage battery cases; artificial grass and turfs; wearing apparel; fish nets; surgical casts; strapping; synthetic paper; reinforced plastics; see also IPPEU Chapters 10 and 10a
Polyvinyl alcohol		See IPPEU Chapters 10 and 10a
Polyvinyl chloride		Many different products, see IPPEU Chapters 10 and 10a
Rayon		Nonwoven fabrics; surgical dressings; wearing apparel; mechanical rubber goods; coated fabrics; felts and blankets; blends with cotton for home furnishings; tire cord

†Annual Consumption is presented parenthetically for the most recent year available.

TABLE B-9. FLAME RETARDANTS  
CONSUMPTION AND OTHER USES

<u>Flame Retardant</u>	<u>Consumption†</u>	<u>Use</u>
<u>INORGANICS</u>		
Alumina trihydrate	3.2 x 10 <sup>8</sup> kgs (79) (in plastics)	Glass; ceramics; iron-free aluminum and aluminum salts; manufacture of activated aluminas; base for organic lakes; flame retardant; rubber reinforcing agent; paper coating filler; cosmetics; ion exchanger; chromatography; filtering medium; absorbent; antiperspirants; dentrifices; antacid; desiccant; soft abrasive
Ammonium bromide		Precipitating silver salts for photographic plates; medicine (for its bromide ion); analytical chemistry; process engraving; textile finishing; fire retardant for wood; corrosion inhibitors; catalyst in production of diphenylamine
Ammonium fluoroborate		
Ammonium orthophosphate [Ammonium phosphate, dibasic]	5.0 x 10 <sup>9</sup> kgs (75) (total)	Flameproofing of wood, paper, and textiles; coating vegetation to retard forest fires; to prevent afterglow in matches and smoking of candlewicks; fertilizer (high analysis phosphate type); plant nutrient solutions; manufacture of yeast, vinegar and bread improvers; feed additive; flux for soldering tin, copper, brass, and zinc; purifying sugar; in ammoniated dentrifices; halophosphate phosphors
Ammonium pentaborate		Intermediate for boron chemicals; as a power-level control in atomic submarines
Ammonium polyphosphate		
Ammonium sulfamate	2.2 x 10 <sup>6</sup> kgs (72) (total)	Flameproofing agent for textiles and certain grades of paper; weed and brush killer; electroplating; generation of nitrous oxide
Antimony pentoxide		Preparation of antimonates and other antimony compounds
Antimony trioxide	3.2 x 10 <sup>7</sup> kgs (79) (in plastics)	Flameproofing of textiles, paper, and plastics (chiefly polyvinyl chloride); paint pigments; ceramic opacifier; catalyst; intermediate; staining iron and copper; phosphors; mordant; glass decolorizer
Barium metaborate		
Borax	5.4 x 10 <sup>8</sup> kgs (75) (total, estimated)	Manufacture of glass, enamels, and other ceramic products; herbicide; soldering metals; tanning; cleaning compound; artificial aging of wood; preservative; antiseptic; fireproofing fabrics; detergent; astringent; fertilizers; softening water; intermediate for perborates and other boron derivatives

(Continued)

TABLE B-9 (Continued)

<u>Flame Retardant</u>	<u>Consumption†</u>	<u>Use</u>
<u>INORGANICS (Continued)</u>		
Boric Acid	6.8 x 10 <sup>7</sup> kgs (75) (total)	Heat resistant glass; glass fibers; porcelain enamels; boron chemicals; metallurgy (welding flux, brazing copper); fireproofing compositions for textile products such as cotton batting in mattresses; fungus control on citrus fruits; ointment and eyewash; nickel electroplating baths; weatherproofing wood; buffer; catalyst (hydrocarbon oxidation)
Diammonium phosphate [See Ammonium Orthophosphate]		
Disodium octaborate		
Ferrocene		Additive to fuel oils to improve efficiency of combustion and eliminate smoke; antiknock agent; catalyst; coating for missiles and satellites; high temperature lubricant; intermediate for high temperature polymers; ultra-violet absorber
Magnesium sulfate heptahydrate		Fireproofing; textiles (warp sizing and loading cotton goods, weighting silk, dyeing and calico printing); mineral waters; catalyst carrier; ceramics; fertilizers; paper (sizing); cosmetic lotions; dietary supplement; medicine (antidote)
Molybdates		
Molybdenum oxide		Source of molybdenum compounds; agriculture; analytical chemistry; manufacture of metallic molybdenum; introduction of molybdenum in alloys; corrosion inhibitor; ceramic glazes; enamels; pigments; catalyst in petroleum industry; medicine
Molybdenum complex		
Monoammonium phosphate [Ammonium phosphate, monobasic]		Fertilizers; flameproofing agent for paper, wood, and fiberboard; to prevent afterglow in matches; plant nutrient solutions; manufacture of yeast, vinegar, yeast foods and bread improvers; food additive; analytical chemistry
Multi-metal complex		
Red phosphorus		Safety matches, phosphorus compounds
Sodium antimonate	5.4 x 10 <sup>6</sup> kgs (79)	Opacifier in enamels, for cast iron and glass; ingredient of acid resisting sheet steel enamels; high temperature oxidizing agent

(Continued)

TABLE B-9 (Continued)

<u>Flame Retardant</u>	<u>Consumption†</u>	<u>Use</u>
<u>INORGANICS (Continued)</u>		
Zinc borate [Zinc oxide + Boric oxide]		Medicine; fireproofing textiles; fungistat and mildew inhibitor; flux in ceramics
<u>CHLORINATED COMPOUNDS</u>		
Chlorinated hydrocarbons	5.0 x 10 <sup>7</sup> kgs (75) (total)	Solvent for dichloramine-T; extreme pressure lubricant additive (metal-working industry); plasticizer; binder; fire retardant
Chlorinated paraffins		High pressure lubricants; flame retardant in plastics and textiles; plasticizer for polyvinyl chloride in polyethylene sealants; in detergents
Dechlorane Plus		
Dispersions (Chlorinated Organics)		
Methyl pentachlorostearate		
Trichloroethylene	1.3 x 10 <sup>8</sup> kgs (75) (total)	Metal degreasing; extraction solvent for oils, fats, waxes; solvent dyeing; dry cleaning; refrigerant and heat exchange liquid; fumigant; cleaning and drying electronic parts; diluent in paints and adhesives; textile processing; chemical intermediate for pharmaceuticals and organic chemicals; aerospace operations (flushing liquid oxygen); solvent for sulfur and phosphorus
<u>BROMINATED COMPOUNDS</u>		
1,2-Bis(2,4,6-tribromophenoxy)-ethane		
Bis(2,4,6-tribromophenyl)-carbonate		
1,2-Bis(tetrabromophthalimido)-ethane		
Brominated organics		
Decabromobiphenyl		

(Continued)

TABLE B-9 (Continued)

<u>Flame Retardant</u>	<u>Consumption†</u>	<u>Use</u>
<u>BROMINATED COMPOUNDS</u> (Continued)		
Decabromodiphenyl oxide [Decabromodiphenyl ether]		Flame retardant for plastics and textiles
1-(1,2-Dibromoethyl)- 3,4-dibromocyclohexane		
Hexabromobenzene	>4.5 x 10 <sup>2</sup> kgs (75) (total)	Flame retardant for plastics
Hexabromocyclodecane		
Octabromodiphenyl oxide		
Pentabromodiphenyl oxide		
Pentabromoethylbenzene		
Pentabromotoluene		Flame Retardant
Tetrabromoxylene		
<u>MIXED HALOGEN COMPOUNDS</u>		
Brominated organics		
Pentabromochlorocyclohexane		
<u>MIXED HALOGEN/PHOSPHORUS</u> <u>COMPOUNDS</u>		
Chlorinated mixed phosphate		
Chlorinated organic phosphonate		
Bis(2-chloroethyl)2-chloroethyl phosphonate		
Ethylene bis(tris(2-cyanoethyl) phosphonium)bromide		

(Continued)

TABLE B-9 (Continued)

<u>Flame Retardant</u>	<u>Consumption†</u>	<u>Use</u>
<u>MIXED HALOGEN/PHOSPHORUS COMPOUNDS (Continued)</u>		
Chlorinated polyphosphate		
Halogenated organic diphosphate (chloroneopentyl type)		
Halogenated phosphorus compound		
Halogenated organic polyphosphate [Chloroethyl phosphonate (polymeric)]		
Phosphonated chloroepoxy		
Phosphonium bromides [bisphosphonium compounds]		
3,9-Tribromoneopentoxy-2,4,8,10-tetra-oxa-3,9-diphosphaspiro(5,5)-undecane-3,9-dioxide		
Tris(2-chloroethyl)phosphate	>9.1 x 10 <sup>2</sup> kgs (75) (total)	Flame retardant plasticizer
Tris(1-chloro-2-propyl)-phosphate		
Tris(1,3-dichloro-2-propyl)-phosphate		Flame retardant and secondary plasticizer
<u>PHOSPHORUS COMPOUNDS</u>		
Bis(5,5-dimethyl-2-thiono-1,3,2-dioxaphosphorinanyl)oxide		
t-Butyl phenyl diphenyl phosphate		
Cresyl diphenyl phosphate	2.7 x 10 <sup>6</sup> kgs (75) (total)	Plasticizer; extreme pressure lubricant; hydraulic fluids; gasoline additive; food packaging

(Continued)



TABLE B-9 (Continued)

<u>Flame Retardant</u>	<u>Consumption†</u>	<u>Use</u>
<u>PHOSPHORUS COMPOUNDS</u> (Continued)		
Diamyl amyl phosphonate		
Dimethyl methylphosphonate	>4.5 x 10 <sup>2</sup> kgs (75) (total)	Heavy metal extraction; solvent separation; preignition additive for gasoline; antifoam agent; plasticizer and stabilizer; textile conditioner; anti-static agent; low temperature hydraulic fluids
2-Ethylhexyl diphenyl phosphate [Octyl diphenyl phosphate]	>4.5 x 10 <sup>2</sup> kgs (75) (total)	Plasticizer for vinyl films; fireproofing plastics
Isopropyl tri(dioctyl phosphate) titanate		
Isopropyl tri(dioctyl pyrophosphate)titanate		
Isodecyl diphenyl phosphate		
Isopropylphenyl diphenyl phosphate		
Phenyl phosphonates		
Phenyl phosphonate from sulfonyl-bisphenol		
Phosphine oxides		
Octyl diphenyl phosphate	>4.5 x 10 <sup>2</sup> kgs (75) (total)	Plasticizer and flame retardant; hydraulic fluid for aircraft
Phosphonate esters (Cyclic phosphonate)		
Red phosphorus treated with caprolactam		
Tributoxyethyl phosphate	1.1 x 10 <sup>6</sup> kgs (79) (total)	Primary plasticizer for most resins and elastomers; floor finishes and waxes; flame retarding agent; antifoaming agent

(Continued)

TABLE B-9 (Continued)

<u>Flame Retardant</u>	<u>Consumption†</u>	<u>Use</u>
<u>PHOSPHORUS COMPOUNDS</u> (Continued)		
Tributyl phosphate	2.3 x 10 <sup>6</sup> kgs (79) (total)	Heat exchange medium; solvent extraction of metal ions from solution of reactor products; solvent for nitrocellulose, cellulose acetate; plasticizer; pigment grinding assistant; antifoam agent; dielectric; aircraft hydraulic fluid
Tricresyl phosphate		Plasticizer for polyvinyl chloride, polystyrene, nitrocellulose; fire retardant for plastics; air filter medium; solvent mixtures; waterproofing additive to extreme pressure lubricants; hydraulic fluid and heat exchange medium
Tricresyl phosphate dispersions		
Triethyl phosphate	4.1 x 10 <sup>6</sup> kgs (79) (total)	Solvent; plasticizer for resins, plastics, and gums; manufacture of pesticides; catalyst; lacquer remover; ethylating agent; flame retardant; intermediate for tetraethyl pyrophosphate
Triisopropyl phenyl phosphate		
Trioctyl phosphate		Solvent; antifoaming agent; plasticizer
Triphenyl phosphate	>9.1 x 10 <sup>2</sup> kgs (75) (total)	Fire retarding agent; plasticizer for cellulose acetate and nitrocellulose; stabilizer for cellulose derivatives; impregnating roofing paper; lacquers and varnishes
Triphenyl phosphine oxide		
Trixylenyl phosphate [Tri(dimethylphenyl) phosphate]		Plasticizer
<u>REACTIVE ORGANICS</u>		
Alkoxide adducts of TBPA		
Allyl ether of pentabromophenol		
Allyl ether of TBBPA		
Bis(dibromopropyl ether) of TBBPA		

(Continued)

TABLE B-9 (Continued)

<u>Flame Retardant</u>	<u>Consumption†</u>	<u>Use</u>
<u>REACTIVE ORGANICS (Continued)</u>		
Bis(2-chloroethyl) vinyl phosphonate		
Bis(methyl ether) of TBBPA		
Bromine-phosphorus polyol		
3-Bromo-2,2-bis(bromomethyl) propanol		
Bis(chlorendo)cyclooctadiene		
Bis(chlorendo)furan		
Chlorendic acid [hexachloroendomethylene-tetrahydrophthalic acid], [HET Acid]	>4.5 x 10 <sup>2</sup> kgs (75) (total)	Fire retardant monomer; extreme pressure lubricant; intermediate for dibutyl and dimethyl chlorendate
Chlorendic anhydride[hexachloroendomethylene-tetrahydrophthalic anhydride] [HET Anhydride]	>4.5 x 10 <sup>2</sup> kgs (75) (total)	Flame resistant polyester resins; hardening epoxy resins; chemical intermediate; source of chlorendic acid
Chlorine-containing polyol		
Diacylate of ethylene oxide adduct of TBBPA		
trans-2,3-Dibromo-2-butene-1,4-diol		
Dibromoneopentyl glycol	>2.3 x 10 <sup>3</sup> kgs (79) (total)	Flame retardant for epoxy, polyester, and polyurethane foams; intermediate for flame retardants and pentaerythritol ethers
Dibromophenol		
Dibromopropanol	>9.1 x 10 <sup>2</sup> kgs (75) (total)	Intermediate in preparation of flame retardants, insecticides and pharmaceuticals
Dibromopropyl acrylate		

(Continued)

TABLE B-9 (Continued)

<u>Flame Retardant</u>	<u>Consumption†</u>	<u>Use</u>
<u>REACTIVE ORGANICS</u> (Continued)		
O,O-Diethyl-1,N,N-bis-(2-hydroxyethyl) aminomethyl phosphonate		
Di(polyoxyethylene) hydromethyl phosphonate		
Ethylene oxide adduct of TBBPA		
Epibromohydrin		
Hexabromobutene		
Hexachlorocyclopentadiene	>4.5 x 10 <sup>2</sup> kgs (77) (total)	Intermediate in pesticides and fungicides; manufacture of chlorendic acid; fire retardant; intermediate for dyes, resins, and pharmaceuticals
Oligomeric phosphate esters		
Oligomeric phosphite		
Pentabromophenol		
Phosphorus-containing polyols [diol from propylene oxide and dibutyl acid pyrophosphate], [high functionality polyol]		
Tetrabromobisphenol A [TBBPA]		Flame retardant for plastics, paper and textiles
Tetrabromophthalic anhydride [TBPA]		
Tetrabromovinyl cyclohexene		
Tetrachlorophthalic anhydride [C <sub>6</sub> Cl <sub>4</sub> (CO) <sub>2</sub> O]	>4.5 x 10 <sup>2</sup> kgs (75) (total)	Intermediate in dyes, pharmaceuticals, plasticizers and other organic materials; flame retardant in plastics and surface coatings

(Continued)

TABLE B-9 (Continued)

<u>Flame Retardant</u>	<u>Consumption†</u>	<u>Use</u>
<u>REACTIVE ORGANICS</u> (Continued)		
Tetrakis(hydroxymethyl)- phosphonium sulfate		
Tribromoneopentyl alcohol		
Tribromophenol [Bromol], [C <sub>6</sub> H <sub>2</sub> Br <sub>3</sub> OH]		
Tris(dipropylene glycol) phosphate		
Vinyl bromide [CH <sub>2</sub> CHBr]	>9.1 x 10 <sup>2</sup> kgs (75) (total)	Flame retarding agent for acrylic fibers

†Annual Consumption is presented parenthetically for the most recent year available.

TABLE B-10. FREE RADICAL INITIATORS AND RELATED COMPOUNDS  
CONSUMPTION AND OTHER USES

<u>Chemical</u>	<u>Consumption†</u>	<u>Use</u>
<u>ORGANIC INITIATORS</u>		
<u>ALKYL PEROXIDES</u>		
$\alpha, \alpha$ , Bis(t-butylperoxy) diisopropylbenzene		
Bis(p-methoxybenzoyl peroxide)		
t-Butyl cumyl peroxide		
Di-t-butyl peroxide	8.0 x 10 <sup>6</sup> kgs (79)	Polymerization catalyst; resin curing; synthesis of polyketones; ignition acce- lerator for diesel fuel; organic synthesis
Dicumyl peroxide [Bis( $\alpha, \alpha$ - dimethylbenzyl)peroxide]	6.8 x 10 <sup>6</sup> kgs (72) (total)	Vulcanizing agent for natural and synthe- tic rubber; crosslinking agent for poly- ethylene; curing agent for silicone rub- ber; synergist for flame retardants in polystyrene foams
2,5-Dimethyl-2,5-bis(t-butyl- peroxy)hexane		Catalyst for plastics
2,5-Dimethyl-2,5-bis(t-butyl- peroxy)hexene-3		
Hydroxyheptyl peroxide		
Octyl peroxide [caprylyl peroxide]		
<u>DIACETYL PEROXIDES</u>		
Acetyl Peroxide		Catalyst and initiator
Acetyl benzoyl peroxide	Not produced commer- cially in U.S. (75)	Oxidizing agent; bleaching agent for flour and food oils; germicide, disin- fectant
Benzoyl peroxide (various forms)	7.6 x 10 <sup>6</sup> kgs (82)	Oxidizer in bleaching oils, waxes and flour; plastics initiator; keratolytic; acne treatment drying agent for unsatu- rated oils; rubber vulcanization; burn- out agent for acetate yarns; embossing of vinyl flooring; production of cheese; pharmaceuticals and cosmetics

(Continued)

TABLE B-1C (Continued)

<u>Chemical</u>	<u>Consumption†</u>	<u>Use</u>
<u>DIACETYL PEROXIDES</u> (Continued)		
Bis(4-t-butyl benzoyl peroxide)		
Bis(o-bromobenzoyl peroxide)		
Bis(m-bromobenzoyl peroxide)		
Bis(p-bromobenzoyl peroxide)		
Bis(p-methoxy benzoyl peroxide)		
Di-p-chlorobenzoyl peroxide		
Decanoyl peroxide	2.4 x 10 <sup>5</sup> kgs (82)	Polymerization catalyst
Dichlorobenzoyl peroxide (o and p)		
Di-2,4-dichlorobenzoyl peroxide (in various mixtures)		
Diisononanoyl peroxide		
Lauroyl peroxide [Didodecanoyl Peroxide]	1.3 x 10 <sup>7</sup> kgs (82)	Bleach for flour, vegetable oils, fats and waxes; polymerization agent for plastics; curing agent for rubber; burn-out agent for acetate yarns; cosmetics and pharmaceuticals; catalyst for optical and dental castings
Pelargonyl peroxide		Polymerization initiator
Propionyl peroxide		
<u>DIBASIC ACID PEROXIDES</u>		
Succinic Acid Peroxide		Polymerization catalyst; deodorants; antiseptics
<u>HYDROPEROXIDES</u>		
Acetyl acetone peroxide [2,4-pentanedione peroxide]		
t-Amyl hydroperoxide		

(Continued)

TABLE B-10 (Continued)

<u>Chemical</u>	<u>Consumption†</u>	<u>Use</u>
<u>HYDROPEROXIDES (Continued)</u>		
t-Butyl hydroperoxide	2.7 x 10 <sup>5</sup> kgs (79) (Sales)	Intermediate for production of propylene oxide and t-butyl alcohol; polymerization, oxidation and sulfonation catalyst; bleaching; deodorizing; curing agent for thermosets
t-Butyl hydroxyethyl peroxide		
Cumene hydroperoxide [ $\alpha,\alpha$ -dimethylbenzylhydroperoxide]		Production of acetone and phenol; polymerization catalyst, particularly in redox systems
Cyclohexanone peroxide	>4.5 x 10 <sup>2</sup> kgs (75)	Polymerization initiator (100%)
Diisopropylbenzene hydroperoxide	>4.5 x 10 <sup>2</sup> kgs (75) (total)	Free radical initiator
2,5-Dimethylhexane-2,5-dihydroperoxide		Polyester premix initiator, also for silicone resins
p-Menthane hydroperoxide		Initiator for rubber and polymerizations; coatings
Methyl ethyl ketone peroxide	7.2 x 10 <sup>6</sup> kgs (82)	Manufacture of acrylic resins; hardening agent for fiberglass reinforced plastics
1,1,3,3-Tetramethylbutyl-2-hydroperoxide		
<u>PEROXYCARBONATES</u>		
Bis(4-t-butylcyclohexyl)peroxydicarbonate		
oo-t-Butyl-o-isopropyl monoperoxycarbonate		
oo-t-Butyl-o-2(ethylhexyl)monoperoxycarbonate		
Di(sec-butyl)peroxydicarbonate		
Di(2-ethylhexyl)peroxydicarbonate		

(Continued)



TABLE B-10 (Continued)

<u>Chemical</u>	<u>Consumption†</u>	<u>Use</u>
<u>PEROXYCARBONATES</u> (Continued)		
Diisopropyl peroxydicarbonate	>4.5 x 10 <sup>2</sup> kgs (75) (total)	Polymerization initiator (100%)
Di(2-phenoxyethyl)peroxydicarbonate		
Di(n-propyl)peroxydicarbonate	7.4 x 10 <sup>6</sup> kgs (82) (total)	
<u>PEROXYESTERS</u>		
t-Amyl perbenzoate		
t-Amyl perneodecanoate		
t-Amyl peroxy(2-ethylhexanoate)		
t-Amyl peroxyvalerate		
n-Butyl-4,4-di(t-butylperoxy)valerate		
t-Butyl peroxyacetate		Polymerization initiator
t-Butyl peroxybenzoate	1.6 x 10 <sup>6</sup> kgs (79) (total)	Initiator; chemical intermediate
t-Butyl peroxyacrylate		
t-Butyl peroxybenzoyl peroxide		
t-Butyl peroxybutyrate		
t-Butyl peroxyhexanoate		
t-Butyl peroxy(2-ethylhexanoate)		Polymerization catalyst
t-Butyl peroxyisobutyrate		Polymerization catalyst
t-Butyl peroxyisopropyl carbonate		Initiator, crosslinking agent
t-Butyl peroxyphthalate		
t-Butyl peroxysebacate		
t-Butyl peroxyterephthalate		
t-Butyl peroxytrimellitate		
t-Butyl peroxyvalerate		
t-Butyl peroxyneodecanoate		

(Continued)

TABLE B-10 (Continued)

<u>Chemical</u>	<u>Consumption†</u>	<u>Use</u>
<u>PEROXYESTERS (Continued)</u>		
t-Butyl peroxyperphthalic acid		Polymerization catalyst; oxidizing agent
t-Butyl peroxy-pivalate	9.1 x 10 <sup>5</sup> kgs (79) (total)	Polymerization initiator
Butyl peroxy-o-toluate		
Cumyl peroxyneodecanoate		
Cumyl per-pivalate		
Di(t-amylperoxy)cyclohexane		
Di-t-butylperoxyazelaate		
1,1-Di-t-butylperoxycyclohexane		
1,1-Di(t-butylperoxy)-3,3,5-trimethylcyclohexane		
Di-t-butyl diperoxyphthalate		Polymerization catalyst
2,5-Dimethyl-2,5-bis(benzoyl-peroxy)hexane		Oxidizing agent, polymerization agent
2,5-Dimethyl-2,5-bis(2-ethyl-hexanoylperoxy)hexane		
2,5-Dimethyl-2,5-di(t-butyl-peroxy)hexane		Polymerization initiator
2,5-Dimethylhexyl-2,5-diperoxy-2-ethylhexoate		
Mixed peresters		
2,4,4-Trimethylpentyl-2-peroxy-cyclohexane carboxylate		
<u>SULFONYL ACETYL PEROXIDES</u>		
Acetyl cyclohexyl sulfonyl peroxide		

(Continued)

TABLE B-10 (Continued)

<u>Chemical</u>	<u>Consumption†</u>	<u>Use</u>
<u>TERTIARY ALKYL PERKETALS</u>		
2,2-Bis(t-butylperoxy) butane		
1,1-Bis(t-butylperoxy) cyclohexane		
1,1-Bis(t-butylperoxy)3,3,5- trimethylcyclohexane		
n-Butyl-4,4-bis(t-butylperoxy) valerate		
Cyclic peroxyketals		
1,1-Di(t-butylperoxy) cyclohexane		
Ethyl-3,3-bis(t-butylperoxy) butyrate		
<u>AZO COMPOUNDS</u>		
2,2'-Azobis(2,4-dimethyl-4- methoxyvaleronitrile)		
2,2'-Azobis(2,4-dimethyl- valeronitrile)		
2,2'-Azobis-2-methylbutyro- nitrile		
2,2'-azobis(methylisobutyrate)		
2,2'-Azobis(isobutyronitrile)		Catalyst for plastics; blowing agent for plastics
Azo-cyclohexane carbonitrile		
2-t-Butylazo-2-cyanobutane		
1-t-Butylazo-1-cyanocyclohexane		
2-t-Butylazo-1-cyanocyclohexane		
2-t-Butylazo-2-cyano-4-methoxy- 4-methylpentane		

(Continued)

TABLE B-10 (Continued)

<u>Chemical</u>	<u>Consumption†</u>	<u>Use</u>
<u>AZO COMPOUNDS (Continued)</u>		
2-t-Butylazo-2-cyano-4-methylpentane		
2-5-Butylazo-2-cyanopropane		
2-t-Butylazo-2-methoxy-4-methylpentane		
$\alpha,\alpha$ -Diphenyl- $\beta$ -picrylhydrazine		
<u>INORGANIC INITIATORS</u>		
Ammonium Persulfate		Oxidizing agent; bleaching agent; photography; etchant for circuit boards; etching copper; electroplating; manufacture of other persulfates; deodorizing and bleaching oils, aniline dyes; preserving foods; depolarizer in batteries; washing infected yeast
Ferrous Ammonium Sulfate Hexahydrate		Medicine; analytical chemistry; metallurgy
Hydrogen Peroxide	$6.8 \times 10^4$ kgs (72) (total)	Bleaching and deodorizing; source of organic and inorganic peroxides; pulp and paper industry; plasticizers; rocket fuel; foam rubber; manufacture of glycerol; antichlor; dyeing; electroplating; antiseptic; laboratory reagent; epoxidation; hydroxylation; oxidation and reduction; viscosity control; refining and cleaning of metals; bleaching and oxidizing agent for foods; neutralizing agent for wine distillation; seed disinfectant; substitute for chlorine in water and sewage treatment; renovating paintings and engravings; cleaning metal surfaces; production of pesticides
Oxygen	$1.3 \times 10^{10}$ kgs (82) (total)	Chemical intermediate; liquid fuels; to relieve hypoxia; copper smelting and steel production; synthesis gas for ammonia, methyl alcohol, acetylene, etc.

(Continued)

TABLE B-10 (Continued)

<u>Chemical</u>	<u>Consumption†</u>	<u>Use</u>
<u>INORGANIC INITIATORS</u> (Continued)		
Potassium Bisulfate		Production of potassium bitartrate; flux; fertilizers; anisole; methyl acetate; ethylacetate; laboratory reagent
Potassium Persulfate		Bleaching; oxidizing agent for dyes; reducing agent for photography; antiseptic; soap manufacture; analytical reagent; polymerization promoter; pharmaceuticals; modification of starch; flour maturing agent; desizing of textiles
Sodium Metabisulfite		Preservative for foods; laboratory reagent; antioxidant for pharmaceuticals; deodorizing manure
Sodium Persulfate		Bleaching agent for fats, oils, fabrics, and soaps; battery polarizers; medicine
<u>PROMOTORS/ACTIVATORS</u>		
Alkaline Nitroprusside		
Chromate-Arsenious Oxide Mixes		
Cobalt Naphthenate		Paint and varnish dryer; bonding rubber, steel and other metals
Cobalt Octoate		Paint dryer; whitener; catalyst
6% Cobalt Octoate + 14% Potassium Octoate + Triphenyl Phosphite		
Diethyl Aniline	1.2 x 10 <sup>6</sup> kgs (79) (total)	Organic synthesis of pharmaceuticals; dyestuff intermediate
N,N-Dimethylaniline	4.5 x 10 <sup>6</sup> kgs (75) (total)	Dyes; intermediates; solvents; manufacture of vanillin; stabilizer (acid acceptor); hardener for fiberglass resins; reagent; activator for polyester
N,N-Dimethyl-p-toluidine		
Ferrous Pyrophosphate		

(Continued)

TABLE B-10 (Continued)

<u>Chemical</u>	<u>Consumption†</u>	<u>Use</u>
<u>PROMOTORS/ACTIVATOR</u> (Continued)		
Ferrous Sulfate		Iron oxide pigment; other iron salts; ferrites; water and sewage treatment; catalyst for ammonia; fertilizer; feed additive; flour enrichment
Ferrous Sulfide		
Hydrazine	$>4.5 \times 10^2$ kgs (75) (total)	Rocket propellant; agricultural chemicals; drugs; polymerization catalyst; blowing agent; short-stopping agent; Spandex fibers; antioxidants; plating metals on glass and plastic; fuel cells; solder fluxes; scavenger for gases (40%); explosives; photographic developers; corrosion inhibitors; oil well drilling in soils; buoyancy agent; diving equipment; textiles
Hydroquinone	$7.7 \times 10^6$ kgs (75) (total)	Photographic developer; dye intermediate; medicine; antioxidant; inhibitor; stabilizer in paints and varnishes; motor fuels and oils; antioxidant for fats and oils; polymerization inhibitor; phosphate determination; bleaching of skin blemishes
Hydroxylamine		Reducing agent; organic synthesis
Lauryl Mercaptide	$>1.4 \times 10^3$ kgs (75) (total)	Manufacture of rubber and plastics; pharmaceuticals; insecticides and fungicides; nonionic detergent; polymerization regulation; complexing agent; removal of metals from wastes
2-Mercaptobenzothiazole +	$2.7 \times 10^6$ kgs (77) (total)	Vulcanization accelerator for rubber; tire treads; fungicide; corrosion inhibitor for cutting oils and petroleum products; extreme pressure additive in greases.
Cupric Chloride		

(Continued)

TABLE B-10 (Continued)

<u>Chemical</u>	<u>Consumption†</u>	<u>Use</u>
<u>PROMOTORS/ACTIVATOR</u> (Continued)		
2,4-Pentanedione [Acetylacetone]	9.1 x 10 <sup>2</sup> kgs (75) (total)	Solvent for cellulose acetate; intermediate; metal chelates; paint dryers; lubricant additives; pesticide; colorant intermediate; crosslinking agent
Pyrogallol	>9.1 x 10 <sup>2</sup> kgs (75) (total)	Protective colloid for metallics; photography; dyes; intermediates; synthetic drugs; medicine; process engraving; laboratory reagent; gas analysis; reducing agent; antioxidant for lubricating oils
Sodium Formaldehyde Sulfoxylate		Stripping and discharge agent for textiles; bleaching agent for molasses and soap
Sodium Hydrosulfite (sodium dithionite)		Vat dyeing of fibers and textiles; stripping agent for dyes; reagent; bleaching sugar, soap, oil, minerals; oxygen scavenger for synthetic rubbers
Sodium Hyposulfite		
Sodium Sulfide		Organic chemicals, dyes; intermediates; rayon; leather depilatory; paper pulp; solvent for gold; sulfiding oxidized lead and copper ores preparatory to flotation; sheep dips; photographic reagents; engraving and lithography; analytical reagent
Sodium Thiosulfate		Photography; chrome tanning; removing chlorine in bleaching and paper making; extraction of silver from ores; dechlorination of water, mordant; reagent; medicine; bleach; reducing agent in dyeing; sequestrant in foods
Sugar [dextrose], [glucose]		Confectionery; infant foods; medicines; brewing and wine making; intermediate; caramel coloring; baking and canning

(Continued)

TABLE B-10 (Continued)

<u>Chemical</u>	<u>Consumption†</u>	<u>Use</u>
<u>PROMOTORS/ACTIVATOR (Continued)</u>		
Thioglycolic Acid	>4.5 x 10 <sup>3</sup> kgs (79) (total)	Reagent for iron, molybdenum, silver and tin; manufacture of thioglycolates; permanent wave solutions and depilatories; vinyl stabilizer; manufacture of pharmaceuticals; permanent creases in textiles; microorganism growth media; chelating agent
Vanadyl Acetyl Acetone		
Versene Iron		
<u>INHIBITORS</u>		
Benzaldehyde	4.3 x 10 <sup>6</sup> kgs (75) (total)	Chemical intermediate for dyes, flavorings, perfumes, aromatic alcohols; solvent for oils, resins, cellulose ethers, cellulose acetate and nitrate; flavoring compounds; synthetic perfumes; manufacture of cinnamic acid, benzoic acid; pharmaceuticals; photographic chemicals; bee repellent in honey harvesting
p-Benzoquinone	>4.5 x 10 <sup>2</sup> kgs (75) (total)	Manufacture of dyes and hydroquinone; fungicide; polymerization inhibitor for polyesters; photographic chemical; tanning hides; rubber accelerator; pH determinations; making gelatin insoluble; strengthening animal fibers; reagent
p-t-Butyl Catechol		Inhibitors for styrene-butadiene and other olefins
Catechol	>4.5 x 10 <sup>2</sup> kgs (75) (total)	Antioxidant in rubber, chemicals, and dyes; cosmetics and pharmaceuticals; photographic developer
Chloroanil		
Copper	2.2 x 10 <sup>9</sup> kgs (75) (total)	Brass and bronze production (43%); electrical wiring (40%); plumbing and heating (6%); roofing and construction (4%); machinery (1%); other (1%); electroplating; insecticide; catalyst; antifouling paints; coins

(Continued)



TABLE B-10 (Continued)

<u>Chemical</u>	<u>Consumption†</u>	<u>Use</u>
<u>INHIBITORS</u> (Continued)		
2,5-Dichlorobenzoquinone		
2,6-Dichlorobenzoquinone		
$\alpha$ -Dinitrobenzene		
Diphenylamine		
2,5-Diphenyl-p-benzoquinone		Polymerization inhibitor
Ferric Salts		
Furfurylidene malonitrile		
Hydroquinone [see Promoters/ Activators]		
1,4-Naphthalenediol		
Naphthoquinone	Not produced in U.S.	Polymerization regulator for rubber and polyester resins; synthesis of dyes and pharmaceuticals; fungicide, algicide
Nitrites		
p-Nitrotoluene	$>4.5 \times 10^2$ kgs (75) (total)	Explosives; intermediate for dyes and other chemicals
Oxygen (O <sub>2</sub> ) [see Inorganic Initiators]		
Phenylanthraquinone		
N-Phenyl-8-naphthylamine	$7.3 \times 10^5$ kgs (75) (total)	Rubber antioxidant; lubricant; inhibitor; electrical insulating enamels; vulcanization acceleration; component of rocket fuels; surgical plasters; tin electroplating baths; dyes; chemical intermediate; catalyst

(Continued)

TABLE B-10 (Continued)

<u>Chemical</u>	<u>Consumption†</u>	<u>Use</u>
<u>INHIBITORS</u> (Continued)		
Picric Acid	$>4.5 \times 10^2$ kgs (75) (total)	Explosives; leathers; electric batteries; etching copper; manufacture of colored glass; textile mordant; rocket fuel; photographic emulsions; manufacture of picramic acid and chloropicrin; dye; intermediate for metal picrates
Primary and Secondary Amines		
Pyridine	$6.8 \times 10^6$ kgs (75) (total)	Solvent in drug manufacture; intermediate for pharmaceuticals and piperidine; intermediate for textile waterproofing compounds; flavoring; denaturing alcohol; antifreeze mixtures; fungicides; rubber manufacture
Pyrogallol [see Promoters/ Activators]		
Quinone		
Sulfur		Sulfuric acid manufacture; pulp and paper manufacture; carbon disulfide; rubber vulcanization; dyes and chemicals; pharmaceuticals; explosives; insecticides; rodent repellants; soil conditioning fungicide; coating for controlled release fertilizers; nucleating agent for photographic film; cement sealant; road paving compositions; bleaching wood pulp, straw, wool and silk
Trinitrotoluene		Explosives; intermediate for dyestuffs and photographic chemicals

†Annual Consumption is presented parenthetically for the most recent year available.

TABLE B-11. HEAT STABILIZERS  
CONSUMPTION AND OTHER USES

<u>Heat Stabilizer</u>	<u>Consumption†</u>	<u>Use</u>
<u>METAL COMPOUNDS</u>		
<u>BARIUM</u>		
Barium benzoate [Ba(C <sub>7</sub> H <sub>5</sub> O <sub>2</sub> ) <sub>2</sub> ·2H <sub>2</sub> O]		
Barium bis(4-nonylphenoxide)		
Barium caprate		
Barium caprylate		
Barium carbonate [BaCO <sub>3</sub> ]	2.7 x 10 <sup>7</sup> kgs (75) (total)	Treatment of brines in chlorine-alkali cells to remove sulfates; rodenticide; barium salts; ceramic flux; optical glass; case-hardening baths; ferrites; in radiation resistant glass for color television tubes; photographic paper coating; analytical reagent; anticumming agent in brick and clay products
Barium 2-ethylhexanoate		
Barium laurate [Ba(C <sub>12</sub> H <sub>23</sub> O <sub>2</sub> ) <sub>2</sub> ]		
Barium myristate [Ba(C <sub>14</sub> H <sub>27</sub> O <sub>2</sub> ) <sub>2</sub> ]		
Barium naphthenate		
Barium nonylphenate		
Barium oleate		
Barium phenate		
Barium phenoxide		
Barium ricinoleate		
Barium silicate [BaSiO <sub>3</sub> ]		
Barium stearate [Ba(C <sub>18</sub> H <sub>35</sub> O <sub>2</sub> ) <sub>2</sub> ]		Waterproofing agent; lubricant in metal-working, plastics, and rubber; wax compounding; preparation of greases; heat and light stabilizer in plastics

(Continued)

TABLE B-11 (Continued)

<u>Heat Stabilizer</u>	<u>Consumption†</u>	<u>Use</u>
<u>CADMIUM</u>		
Cadmium benzoate [Cd(C <sub>7</sub> H <sub>5</sub> O <sub>2</sub> ) <sub>2</sub> ·2H <sub>2</sub> O]		
Cadmium caprate		
Cadmium caprylate		
Cadmium 2-ethylhexanoate		
Cadmium laurate		
Cadmium lauryl mercaptide		
Cadmium myristate		
Cadmium naphthenate		
Cadmium oleate		
Cadmium phenate		
Cadmium phosphite		
Cadmium ricinoleate [Cd(CH <sub>3</sub> (CH <sub>2</sub> ) <sub>5</sub> CHOHCH <sub>2</sub> CH:CH(CH <sub>2</sub> ) <sub>7</sub> CO <sub>2</sub> ) ]		Heat and light stabilizer for PVC
Cadmium stearate		Lubricant and stabilizer for plastics
<u>CALCIUM</u>		
Calcium benzoate [Ca(C <sub>7</sub> H <sub>5</sub> O <sub>2</sub> ) <sub>2</sub> ·3H <sub>2</sub> O]		
Calcium caprate		
Calcium 2-ethylhexanoate		
Calcium laurate [Ca(C <sub>12</sub> H <sub>23</sub> O <sub>2</sub> ) <sub>2</sub> ·H <sub>2</sub> O]		
Calcium naphthenate		Waterproofing compositions; adhesives; dryers; wood fillers; grafting waxes; cements; varnishes; color lakes

(Continued)

TABLE B-11 (Continued)

<u>Heat Stabilizer</u>	<u>Consumption†</u>	<u>Use</u>
<u>CALCIUM</u> (Continued)		
Calcium oleate $[\text{Ca}(\text{C}_{18}\text{H}_{33}\text{O}_2)_2]$		
Calcium phenoxide $[\text{Ca}(\text{OC}_6\text{H}_5)_2]$		
Calcium ricinoleate $[\text{Ca}(\text{CH}_3(\text{CH}_2)_5\text{CHOHCH}_2\text{CHCH}(\text{CH}_2)_7\text{CO}_2)_2]$		Greases and lubricants; stabilizer for PVC
Calcium stearate $[\text{Ca}(\text{C}_{18}\text{H}_{35}\text{O}_2)_2]$		Water repellent; flattening agent in paints; lubricant in making tablets; emulsions; cements; wax crayons; stabilizer in vinyl resins; anticaking agent in foods; cosmetics
<u>MAGNESIUM</u>		
Magnesium 2-ethylhexanoate		
Magnesium laurate $[\text{Mg}(\text{C}_{12}\text{H}_{23}\text{O}_2)_2 \cdot 2\text{H}_2\text{O}]$		
Magnesium phenoxide		
Magnesium salicylate $[\text{Mg}(\text{C}_7\text{H}_5\text{O}_3)_2 \cdot 4\text{H}_2\text{O}]$		Medicine
Magnesium stearate $[\text{Mg}(\text{C}_{18}\text{H}_{35}\text{O}_2)_2]$	1.8 x 10 <sup>6</sup> kgs (75) (total)	Dusting powder; lubricant in making pharmaceutical tablets; dryer in paints and varnishes; flattening agent; in medicines; stabilizer and lubricant in plastics; emulsifying agent in cosmetics; in foods as anticaking agent, binder and emulsifier
<u>MANGANESE</u>		
Manganese carbonate $[\text{MnCO}_3]$		Manufacture of manganese salts; medicine; dryer for varnishes
Manganese oxide, hydroxide $[\text{Mn}_2\text{O}_4]$		Medicine; textile printing; analytical chemistry; catalyst in manufacture of allyl alcohol; ceramics; paints; colored glass; bleaching tallow; animal feeds; fertilizers; food additives and dietary supplements

(Continued)

TABLE B-11 (Continued)

<u>Heat Stabilizer</u>	<u>Consumption†</u>	<u>Use</u>
<u>POTASSIUM</u>		
Potassium benzoate [ $\text{KC}_7\text{H}_5\text{O}_2 \cdot 3\text{H}_2\text{O}$ ]		
Potassium laurate [ $\text{KOCC}_{11}\text{H}_{23}$ ]		Emulsifying agent; base for liquid soaps and shampoos
Potassium naphthenate		Dryers; emulsifying agents
Potassium oleate [ $\text{C}_{17}\text{H}_{33}\text{COOK}$ ]		Textile soaps; emulsifying agent
Potassium salicylate [ $\text{KC}_7\text{H}_5\text{O}_3$ ]		
Potassium stearate [ $\text{KC}_{18}\text{H}_{35}\text{O}_2$ ]		Base for textile softeners
<u>SODIUM</u>		
Sodium benzoate [ $\text{C}_6\text{H}_5\text{COONa}$ ]	4.3 x 10 <sup>6</sup> kgs (75) (total)	Food preservative; antiseptic; medicine; tobacco; pharmaceutical preparations; intermediate for manufacture of dyes; rust and mildew inhibitor
Sodium borate [ $\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$ ]		Heat resistant glass; porcelain enamel; starch and adhesives; detergents; herbicides; fertilizers; rust inhibitors; pharmaceuticals; leather; photography; bleaches; paint; boron compounds; flux for smelting; antifreeze; adhesives; insulation materials; laboratory reagent
Sodium carbonate [ $\text{Na}_2\text{CO}_3$ ]		Medicine; photography; cleaning and boiler compounds; pH control of water; food additive
Sodium laurate		
Sodium phosphate [ $\text{Na}_3\text{PO}_4 \cdot 10\text{H}_2\text{O}$ ]		
Sodium phosphite [ $2\text{NaH}_2\text{PO}_3 \cdot 5\text{H}_2\text{O}$ ]		Medicine; antidote in mercuric chloride poisoning
Sodium salicylate [ $\text{HOC}_6\text{H}_4\text{COONa}$ ]		Medicine; production of salicylic acid; preservative for paste, mucilage, glue and hides
Sodium stearate [ $\text{NaOCC}_{17}\text{H}_{35}$ ]		Waterproofing and gelling agent; toothpaste and cosmetics; stabilizer in paints

(Continued)

TABLE B-11 (Continued)

<u>Heat Stabilizer</u>	<u>Consumption†</u>	<u>Use</u>
<u>STRONTIUM</u>		
Strontium 2-ethylhexanoate		
Strontium laurate		
Strontium naphthenate		
Strontium stearate		Grease and wax compounding
<u>ZINC</u>		
Zinc benzoate [ $\text{Zn}(\text{C}_7\text{H}_5\text{O}_2)_2$ ]		
Zinc caprate		
Zinc caprylate [ $\text{Zn}(\text{C}_{11}\text{H}_{21}\text{O}_2)_2$ ]		Fungicide
Zinc 2-ethylhexanoate [Zinc octoate], [ $\text{Zn}(\text{OOCCH}(\text{C}_2\text{H}_5)\text{C}_4\text{H}_9)_2$ ]		Catalyst
Zinc laurate [ $\text{Zn}(\text{C}_{12}\text{H}_{23}\text{O}_2)_2$ ]		Paints; varnishes; rubber compounding (softener and activator)
Zinc naphthenate		Dryer and wetting agent in paints, varnishes, and resins; insecticide, fungicide, and mildew preventative; wood preservative; waterproofing textiles; insulating materials
Zinc octoate [see Zinc caprylate]		
Zinc oleate [ $\text{Zn}(\text{C}_{18}\text{H}_{33}\text{O}_2)_2$ ]		Paint, resin and varnish dryer
Zinc phenate		
Zinc stearate [ $\text{Zn}(\text{C}_{18}\text{H}_{35}\text{O}_2)_2$ ]		Cosmetics, lacquers, plastics, powder metallurgy; lubricant; mold-release agent; filler; antifoamer; heat and light stabilizer; medicine (dermatitis); tablet manufacture; dietary supplement

(Continued)

TABLE B-11 (Continued)

<u>Heat Stabilizer</u>	<u>Consumption†</u>	<u>Use</u>
<u>OTHER METAL STABILIZERS</u>		
Aluminum stearate $[Al(C_{18}H_{35}O_2)_3]$		Paint and varnish dryer; greases; waterproofing agent; cement additive; lubricants; cutting compounds; flattening agent; cosmetics and pharmaceuticals; additive for chewing gums
Barium cadmium laurate		
Barium cadmium stearate		
Lithium stearate $[LiC_{18}H_{35}O_2]$		Cosmetics; plastics; waxes; greases; lubricant in powder metallurgy; corrosion inhibitor in petroleum; flattening agent in varnishes and lacquers; high-temperature lubricant
<u>TIN</u>		
Dibutyltin bis(n-butyl maleate) $[(C_4H_9)_2Sn(OOCCH:CHCOOC_4H_9)_2]$		
Dibutyltin S,S-bis(isooctyl thioglycolate) $[(C_4H_9)_2Sn(SCH_2COOC_8H_{17})_2]$ , [Dibutyltin bis(isooctyl mercaptoacetate)]		
Dibutyltin bis(lauryl mercaptide) $[(C_4H_9)_2Sn(SC_{12}H_{25})_2]$		
Dibutyltin bis(n-octyl maleate) $[(C_4H_9)_2Sn(OOCCH:CHCOOC_8H_{17})_2]$		
Dibutyltin diacetate $[(C_4H_9)_2Sn(C_2H_3O_2)_2]$	>4.5 x 10 <sup>2</sup> kgs (75)	Stabilizer for chlorinated organics; catalyst in condensation reactions
Dibutyltin dicaprylate [Dibutyltin dioctoate]		Catalyst for silicone curing; polyether foams
Dibutyltin dilaurate $[(C_4H_9)_2Sn(OOC_{11}H_{23})_2]$ , [Dibutyl tin laurate]		Stabilizer for vinyl resins, lacquers, elastomers; catalyst for urethane and silicones; anthelmintic (chicken tapeworms)

(Continued)



TABLE B-11 (Continued)

<u>Heat Stabilizer</u>	<u>Consumption†</u>	<u>Use</u>
<u>TIN (Continued)</u>		
Dibutyltin laurate-maleate		
Dibutyltin maleate [ $\langle (C_4H_9)_2SnOOCCH:CHCOO \rangle_n$ ] n = 1 to 3		Stabilizer for polyvinyl chloride resins; condensation catalyst
Dibutyltin $\beta$ -mercaptopropionate		
Dibutyltin octoate [see Dibutyltin caprylate]		
Dibutyltin succinate		
Dibutyltin sulfide [ $(C_4H_9)_2Sn:S$ ]		Vinyl stabilizer; antioxidant; lubricating additive
Dimethyltin bis(isooctyl mercaptoacetate)		Heat stabilizer for PVC food packaging
Dimethyltin bis( $\beta$ -alkanonyl oxyethyl mercaptide)		
Dimethyltin bis(dibutyl dithiocarbamate)		
Di-n-octyltin S,S-bis(isooctyl thioglycolate) [Di-n-octyltin S,S-bis-(isooctyl mercaptoacetate)]		
Di-n-octyltin bis(2-ethylhexyl maleate)		
Di-n-octyltin dilaurate		
Di-n-octyltin $\beta$ -mercaptopropionate [Di-n-octyltin thiodipropionate]		
Di-n-octyltin maleate		
Di-n-octyltin maleate polymer		
(Maleoxyldioxy)bis(dibutyl(lauroyloxy)tin)		

(Continued)

TABLE B-11 (Continued)

<u>Heat Stabilizer</u>	<u>Consumption†</u>	<u>Use</u>
<u>TIN</u> (Continued)		
Thiabis(monobutyltin sulfide) [S(Sn(S)C <sub>4</sub> H <sub>9</sub> ) <sub>2</sub> ]		
Thiabismonomethyltin bis(β-alkanoyloxy-ethylmercaptide)		
<u>LEAD</u>		
Basic lead carbonate [2PbCO <sub>3</sub> ·Pb(OH) <sub>2</sub> ], [White Lead]	1.4 x 10 <sup>5</sup> kgs (75) (total)	Industrial paint pigment; putty; ceramic glazes
Basic lead chlorosilicate [47% SiO <sub>2</sub> + 3% Cl]		Vinyl electrical insulation and tape
Basic lead silicate [3PbO·2SiO <sub>2</sub> ·2H <sub>2</sub> O]		Pigment in industrial paints
Basic lead silicatesulfate {undisclosed complex, 24% SiO <sub>2</sub> + 60% SO <sub>3</sub> }		
Basic lead sulfate		Paints; ceramics; pigments
Basic lead sulfate phthalate		
Dibasic lead phosphate [PbHPO <sub>4</sub> ]		Imparting heat resistance and pearlescence to polystyrene and casein plastics
Dibasic lead phosphite [2PbO·PbHPO <sub>3</sub> ·1/2H <sub>2</sub> O]		Heat and light stabilizer for vinyl plastics and chlorinated paraffins; ultraviolet screening and antioxidant for paints and plastics
Dibasic lead phthalate [2PbO·Pb(OOC) <sub>2</sub> C <sub>6</sub> H <sub>4</sub> ·1/2H <sub>2</sub> O]		Heat and light stabilizer for vinyls
Dibasic lead stearate [2PbO·Pb(C <sub>17</sub> H <sub>35</sub> COO) <sub>2</sub> ]		
Lead 2-butenedioic acid [Lectro 78]		
Lead carbonate [PbCO <sub>3</sub> ]		Industrial paint pigment; processing parchment; cements; putty; ceramics; lead carbonate paper

(Continued)

TABLE B-11 (Continued)

<u>Heat Stabilizer</u>	<u>Consumption†</u>	<u>Use</u>
<u>LEAD</u> (Continued)		
Lead chlorosilicate [Lectro 60]		Vinyl electrical insulation and tapes
Lead chlorosilicate sulfate complex [Lectro 80]		
Lead-2-ethylhexanoate [Pb(C <sub>7</sub> H <sub>15</sub> COO) <sub>2</sub> ]		Curing agent for silicone paints and insulating varnishes
Lead naphthenate	1.8 x 10 <sup>5</sup> kgs (75) (total)	Paint and varnish dryer; wood preservative; insecticide; catalyst for reaction between unsaturated fatty acids and sulfates in the presence of air; lube oil additive
Lead salicylate [(Pb(OOC(OH)C <sub>6</sub> H <sub>4</sub> ) <sub>2</sub> ]		Stabilizer and costabilizer for flooring
Lead silicate sulfate		
Lead stearate [see Normal Lead Stearate]		
Lead sulfate [PbSO <sub>4</sub> ]		Storage batteries; paint pigments
Litharge [PbO]		Storage batteries; ceramic cements and fluxes; pottery and glazes; glass; chromium pigments; oil refining; varnishes, paints, enamels, ink, linoleum, insecticides; cement; acid-resisting compositions; matchhead compositions; other lead compounds; rubber accelerator
Monobasic lead sulfate [PbO·PbSO <sub>4</sub> ]		Paints; ceramics; pigments
Normal lead orthosilicate [SiO <sub>2</sub> 35-45%], [PbSiO <sub>3</sub> ]		Ceramics; fireproofing fabrics
Normal lead stearate [Pb(C <sub>17</sub> H <sub>35</sub> COO) <sub>2</sub> ]		Varnish and lacquer dryer; high pressure lubricants; lubricant in extrusion processes; stabilizer for vinyl polymers; corrosion inhibitor for petroleum; component of greases, waxes and paints
Tetrabasic lead fumarate [4PbO·Pb(OOC) <sub>2</sub> C <sub>2</sub> H <sub>2</sub> ·2H <sub>2</sub> O]		Heat stabilizer for plastisols, phonograph records, and electrical insulation
Tetrabasic lead sulfate [4PbO·PbSO <sub>4</sub> ·H <sub>2</sub> O]		

(Continued)

TABLE B-11 (Continued)

<u>Heat Stabilizer</u>	<u>Consumption†</u>	<u>Use</u>
<u>LEAD (Continued)</u>		
Tribasic lead maleate [3PbO·Pb(OOC) <sub>2</sub> C <sub>2</sub> H <sub>2</sub> ·1/2H <sub>2</sub> O]		Highly basic stabilizer for vinyls
Tribasic lead sulfate [3PbO·PbSO <sub>4</sub> ·H <sub>2</sub> O]		Heat stabilizer for electrical and other vinyl compounds
<u>ANTIMONY MERCAPTIDES</u>		
Antimony thioglycolate		
Antimony S,S',S"-tris(isooctyl mercaptoacetate) [Sb(SCH <sub>2</sub> COOC <sub>8</sub> H <sub>17</sub> ) <sub>3</sub> ]		
Antimony tris(lauryl mercaptide) [Sb(SC <sub>12</sub> H <sub>25</sub> ) <sub>3</sub> ]		
<u>MISCELLANEOUS</u>		
2-Aminocrotonic acid		
Benzoguanamine [C <sub>6</sub> H <sub>5</sub> C <sub>3</sub> N <sub>3</sub> (NH <sub>2</sub> ) <sub>2</sub> ]		Thermosetting resins, resin modifiers; chemical intermediate for pesticides, pharmaceuticals and dyestuffs
Dicyandiamide [NH <sub>2</sub> C(NH)(NHCN)]	3.4 x 10 <sup>4</sup> kgs (75) (total refinery production)	57% jewelry and arts; 27% industrial applications; 15% dietary applications; 6% investment products; fertilizers; nitrocellulose stabilizer; organic synthesis; especially for melamine, barbituric acid and guanidine salts; pharmaceutical products; dyestuffs; explosives; retarding rancidity in fats and oils; fireproofing compounds; case-hardening preparations; cleaning compounds; soldering compounds; accelerator; thinner for oil-well drilling muds; stabilizer in detergent compositions; modifier for starch products; catalyst for epoxy resins
Dipentaerythritol [(CH <sub>2</sub> OH) <sub>3</sub> CCH <sub>2</sub> OCH <sub>2</sub> C(CH <sub>2</sub> OH) <sub>3</sub> ]		Paints and coatings
Diphenylthiourea [Thiocarbamilide], [CS(NHC <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> ]		Intermediates; dyes; vulcanization accelerator; synthetic organic pharmaceuticals; flotation agent; acid inhibitor

(Continued)

TABLE B-11 (Continued)

<u>Heat Stabilizer</u>	<u>Consumption†</u>	<u>Use</u>
<u>MISCELLANEOUS (Continued)</u>		
Glycerol		Alkyd resins; explosives; ester gums; pharmaceuticals; perfumery; plasticizer for regenerated cellulose; cosmetics; foodstuffs; conditioning tobacco; liqueurs; solvent; printer's ink rolls; polyurethane polyols; emulsifying agent; rubber stamp and copying inks; binder for cements and mixes; paper coatings and finishes; special soaps; lubricant and softener; bacteriostat; penetrant; hydraulic fluid; humectant
Pentaerythritol $[\text{C}(\text{CH}_2\text{OH})_4]$		Alkyd resins; rosin and tall oil esters; special varnishes; pharmaceuticals; plasticizers; insecticides; synthetic lubricants; explosives; paint swelling agents
$\alpha$ -Penylindole		
Sorbitol $[\text{C}_6\text{H}_8(\text{OH})_6]$		Ascorbic acid fermentation; cosmetic creams and lotions, toothpaste, tobacco, gelatin; bodying agent for paper, textiles, and liquid pharmaceuticals; softener for candy; sugar crystallization inhibitor; surfactants; urethane resins and rigid foams; plasticizer; stabilizer for vinyl resins; varnishes and lacquers; food additive
Thiolauric anhydride		
Trimethylethane $[\text{CH}_3\text{C}(\text{CH}_2\text{OH})_3]$		Conditioning agent; manufacture of varnishes, alkyd and polyester resins; synthetic drying oils
Trimethylolpropane $[\text{C}_2\text{H}_5\text{C}(\text{CH}_2\text{OH})_3]$		Conditioning agent; manufacture of varnishes, alkyd resins; synthetic drying oils; urethane foams and coatings; silicone lube oils; lactone plasticizers; textile finishes; surfactants; epoxidation products

†Annual Consumption is presented parenthetically for the most recent year available.

TABLE B-12. LUBRICANTS AND OTHER PROCESSING AIDS  
CONSUMPTION AND OTHER USES

<u>Lubricant/Processing Aid</u>	<u>Consumption†</u>	<u>Use</u>
<u>FATTY ACIDS AND ALCOHOLS</u>		
Behenic acid		Cosmetics; waxes, plasticizers; chemicals; stabilizers
Oleic acid		Soap base; manufacture of oleates; ointments; cosmetics; polishing compounds; lubricants; ore flotation; intermediate; surface coating; food-grade additives
Palmityl alcohol		Perfumery; emulsifier; emollient; foam stabilizer for detergents; face creams, lotions, lipsticks, and toilet preparations; chemical intermediate; detergents; pharmaceuticals; cosmetics; base for making sulfonated fatty alcohols; to retard evaporation of water when sprayed as a film on reservoirs or sprayed on growing plants
Stearic acid	4.3 x 10 <sup>7</sup> kgs (75) (total)	Chemicals, especially stearates and stearate dryers; lubricants; soaps; pharmaceuticals and cosmetics; accelerator activator, dispersing agent, and softener in rubber compounds; shoe and metal polishes; food packaging; impregnating plaster of paris; candles; release agent in baking goods and confectionaries
Stearyl alcohol		Perfumery; cosmetics; intermediate; surface active agent; lubricants; resins
<u>AMIDES</u>		
Behenamide		
Erucamide		Foam stabilizer; solvent for waxes and resins; emulsions; antiblocking agent for polyethylene
Ethylene bistearamide		
Ethylene hydroxystearamide		
12-Hydroxy-N-(2-hydroxyethyl) stearamide		
Methylene bistearamide		

(Continued)

TABLE B-12 (Continued)

<u>Lubricant/Processing Aid</u>	<u>Consumption†</u>	<u>Use</u>
<u>AMIDES</u> (Continued)		
Oleamide		Slip agent for extrusion of polyethylene; wax additive; ink additive
Saturated fatty amide		
Stearamide		Corrosion inhibitor in oil wells
Stearoguanamine		
<u>ESTERS</u>		
Acetylated partial esters		
12-Acetyloxy-9-octodecenoic acid, butyl ester		
Alkoxyated fatty acid esters		
Butyl stearate		Ingredient of polishes; special lubricants, and coatings; lubricant for metals and in textile and molding industries; in wax polishes as dye solvent; plasticizer for laminated fiber products, rubber hydrochloride, chlorinated rubber, and cable lacquers; carbon paper and inks; emollient in cosmetic and pharmaceutical products; lipsticks; damp-proofer for concrete; flavoring
Castor oil		Plasticizer in lacquers and nitrocellulose; production of dibasic acids; lipsticks; polyurethane coatings, elastomers and adhesives; fatty acids; surface active agents; hydraulic fluids; pharmaceuticals; industrial lubricant; electrical insulating compounds; manufacture of Turkey Red oil; source of sebacic acid and ricinoleates; medicine
Cetyl palmitate		Base for ointments, cerates and emulsions; manufacture of candles, soaps, etc.

(Continued)

TABLE B-12 (Continued)

<u>Lubricant/Processing Aid</u>	<u>Consumption†</u>	<u>Use</u>
<u>ESTERS (Continued)</u>		
Diethylene glycol monostearate		Emulsifier and thickener in cosmetics; mold release lubricant for die casting; temporary binder for ceramics and grinding wheels
Diethylene glycol oleate		Emulsifying agent for fluid water-in-oil emulsions for the manufacture of furniture and automobile polish; water-emulsion paints; agricultural sprays
Diethylene glycol ricinoleate		Plasticizer for high polymers and elastomers
Ethylene glycol distearate		
Ethylene glycol monostearate		
Ethyl stearate		
Glycerol monooleate		Food, pharmaceuticals, and cosmetics; rust-preventive oils; textile finishing; vinyl light stabilizers; odorless base paints; flavoring
Glycerol monoricinoleate		Non-drying emulsifying agent; solvent; plasticizer; in polishes, in cosmetics, in textile, paper, and leather processing; low temperature lubricant; stabilizer for latex paints
Glycerol-mono-12-hydroxy-stearate		
Glycerol monostearate		Thickening and emulsifying agent for margarine; shortenings and other food products; flavoring; emulsifying agent for oils, waxes and solvents; protective coating for hygroscopic powders; cosmetics; opacifier; detacifier; resin lubricant
Glycerol trioleate		
Glycerol tris(12-hydroxy-stearate)		Used in making hydroxystearic acid; lubricants; heavy metal soaps; waxes; plasticizers; cosmetics; chemical intermediate

(Continued)



TABLE B-12 (Continued)

<u>Lubricant/Processing Aid</u>	<u>Consumption†</u>	<u>Use</u>
<u>ESTERS (Continued)</u>		
Guanidine stearate		
Hardened vegetable oils		
Hydrogenated castor oil [see Glycerol tris(12-hydroxy- stearate)]		
Hydrogenated vegetable oil		
Methyl 12-hydroxystearate		Adhesives; inks; cosmetics; greases
Methyl stearate		Intermediate for stearic acid detergents, emulsifiers, wetting agents, stabilizers, resins, lubricants, plasticizers and textiles; biochemical and medical research
Montan esters		
Octyl stearate		
Pentaerythritol tetrastearate		Polishes; coatings; textile finishes
Polyoxyethylene glycol mono- stearate		Ointments; emulsifier; surfactant; food additive
Sorbitan trioleate		Emulsifiers and stabilizers in foods, cosmetics, drugs, textiles, plastics; agricultural chemicals
Stearyl stearate		
Sulfonated castor oil [Turkey Red Oil]		Textiles; leather; manufacture of soaps; alizarin dye assis- tant; paper coatings
Triglyceryl 12-hydroxystearate		
Triglyceryl palmitate		
Triglyceryl stearate		

(Continued)

TABLE B-12 (Continued)

<u>Lubricant/Processing Aid</u>	<u>Consumption†</u>	<u>Use</u>
<u>METALLIC SOAPS</u>		
Aluminum stearate		Paint and varnish dryer; greases; waterproofing agent; cement additive; lubricants; cutting compounds; flatting agent; cosmetics and pharmaceuticals; additive for chewing gum
Barium stearate		Waterproofing agent; lubricant in metal working, plastics and rubber; wax compounding; preparation of greases; heat and light stabilizer in plastics
Cadmium stearate		Lubricant and stabilizer in plastics
Calcium oleate		
Calcium ricinoleate		Greases and lubricants; stabilizer for polyvinyl chloride
Calcium stearate		Water repellent; flatting agent in paints; lubricant for making tablets; emulsions; cements; wax crayons; stabilizers for vinyl resins; anticaking agent in foods; cosmetics
Lead oleate		Varnishes; lacquers; paint dryer; high pressure lubricants
Lead stearate [Dibasic lead stearate]		Varnish and lacquer dryer; high-pressure lubricants; lubricant in extrusion processes; stabilizer for vinyl polymers; corrosion inhibitor for petroleum; component of greases, waxes and paints
Lithium stearate		Cosmetics; plastics; waxes; greases; lubricant in powder metallurgy; corrosion inhibitor in petroleum; flatting agent in varnishes and lacquers; high-temperature lubricant
Magnesium oleate		Varnish dryers; in dry cleaning solvents (to prevent spontaneous ignition); emulsifying agent; lubricant for plasticizers
Magnesium stearate		Dusting powder; lubricant in making tablets; dryer in paints and varnishes; flatting agent; in medicines; stabilizer and lubricant for plastics; emulsifying agent in cosmetics; in foods as anticaking agent, binder, emulsifier

(Continued)

TABLE B-12 (Continued)

<u>Lubricant/Processing Aid</u>	<u>Consumption†</u>	<u>Use</u>
<u>METALLIC SOAPS (Continued)</u>		
Potassium stearate		Base for textile softeners
Sodium dioctyl sulfosuccinate [Dioctyl sodium sulfosuccinate]		Food additive (processing aid for sugar and stabilizer for hydrophilic colloids); wetting agent; dispersant; emulsifier
Sodium stearate		Waterproofing and gelling agent; toothpaste and cosmetics; stabilizer in plastics
Stannous octoate		Polymerization catalyst for urethane foams; lubricant; addition agent; stabilizer for transformer oils
Stannous ricinoleate		
Stannous stearate		
Zinc oleate		Paints, resins and varnishes (dryer)
Zinc stearate		Cosmetics; lacquers; plastics; powder metallurgy; lubricant; mold-release agent; filler; antifoamer; heat and light stabilizer; medicine (dermatitis); tablet manufacture; dietary supplement
<u>NATURAL WAXES</u>		
Carnauba wax		Shoe polishes; leather finishes; varnishes; electric insulating compositions; furniture and floor polishes; carbon paper; waterproofing; to prevent sun-checking of rubber and plastics products; confectionery
Castorwax		Potting compounds, greases, sealants and impregnating compositions; wax blends where increase in grease and solvent resistance, hardness and melting point is desired; blending agent and viscosity reducer in hot melts; direct application to paper for resistance to moisture and fat
Dammar wax		Colorless and overprint varnishes; cellulosic lacquers; alkyd baking enamels; paper and textile coatings

(Continued)

TABLE B-12 (Continued)

<u>Lubricant/Processing Aid</u>	<u>Consumption†</u>	<u>Use</u>
<u>NATURAL WAXES (Continued)</u>		
Spermaceti wax		Base for ointments, cerates and emulsions; manufacture of candles, soaps, cosmetics, laundry wax; finishing and lustering linens
<u>PETROLEUM-BASED WAXES</u>		
Candillilla wax		Leather dressing; polishes; cements; varnishes; candles; electric insulating compositions; sealing wax; waterproofing and insect-proofing containers; paint removers; dentistry; rubber and rubber substitutes; paper sizes; stiffener for soft waxes
Ceresin wax		Candles; sizing; bottles for hydrofluoric acid; electrical insulation; shoe and leather polishes; impregnating and preserving agent; lubricating compounds; wood filler; floor polishes; antifouling paints; waxed papers; cosmetics; ointments; matrix compositions; waterproofing textile fabrics
Microcrystalline wax		
Paraffin wax		Candles; paper coating; protective sealant for food products, beverages, etc.; glass-cleaning preparations; hot-melt carpet backing; biodegradable mulch; impregnating matches; lubricants; crayons; surgery; stoppers for acid bottles; electrical insulation; floor polishes; cosmetics; photography; anti-frothing agent in sugar refining; packing tobacco products; protecting rubber products from sun-cracking; chewing gum base
<u>POLYMERIC LUBRICANTS</u>		
Carboxymethyl cellulose		Detergents, soaps, and food products as thickener, suspending agent, and emulsion stabilizer; textile manufacturing; coating paper and paperboard to lower porosity; drilling muds; emulsion paints; protective colloid; pharmaceuticals; cosmetics

(Continued)

TABLE B-12 (Continued)

<u>Lubricant/Processing Aid</u>	<u>Consumption†</u>	<u>Use</u>
<u>POLYMERIC LUBRICANTS</u> (Continued)		
Cellulose acetate lacquers		Lacquers; protective coating solutions; photographic film; acetate fiber; transparent sheeting; thermoplastic molding composition; cigarette filters; magnetic tapes; osmotic cell membrane
Nylon		Many different products, see IPFEU Chapters 10 and 10a
Polyethylene wax		Mold release agent for rubber and plastics; paper and container coatings; liquid polishes and textile finishing agents
Polypropylene wax		
Polytetrafluoroethylene wax		
Polyvinyl acetate		Many different products, see IPFEU Chapters 10 and 10a
Polyvinyl alcohol		Many different products, see IPFEU Chapters 10 and 10a
Silicone grease [see Silicone Oil]		
Silicone oil		Adhesives; lubricants; protective coatings; coolant; mold-release agent; dielectric fluid; heat transfer; wetting agent and surfactant; foam stabilizer in polyurethanes; diffusion pumps; antifoaming agent for liquids; textile finishes; water repellent; weatherproofing concrete
<u>POLYMER FILMS AND SHEETS</u>		
Cellophane		Wrapper or protective packing for fabricated articles and industrial applications
Cellulose acetate		Acetate fibers; lacquers; protective coating solutions; photographic film; transparent sheeting; thermoplastic molding composition; cigarette filters; magnetic tape; osmotic cell membrane

(Continued)

TABLE B-12 (Continued)

<u>Lubricant/Processing Aid</u>	<u>Consumption†</u>	<u>Use</u>
<u>POLYMER FILMS AND SHEETS</u> (Continued)		
Cellulose acetate butyrate		
Methyl cellulose		Protective colloid in water-based paints to prevent flocculation of pigment; film and sheeting; binder in ceramic glazes; leather tanning; dispersing, thickening and sizing agent; adhesive; food additive
Nylon		Many different products, see IPPEU Chapters 10 and 10a
Polyethylene		Many different products, see IPPEU Chapters 10 and 10a
Polyethylene terephthalate		Many different products, see IPPEU Chapters 10 and 10a
Polyester [Mylar]		Many different products, see IPPEU Chapters 10 and 10a
Polytetrafluoroethylene		Many different products, see IPPEU Chapters 10 and 10a
Polyvinyl acetate		Many different products, see IPPEU Chapters 10 and 10a
Polyvinyl alcohol		Many different products, see IPPEU Chapters 10 and 10a
Polymethacrylate		Many different products, see IPPEU Chapters 10 and 10a
Polydimethylsiloxane		
Polytetrafluoroethylene		Many different products, see IPPEU Chapters 10 and 10a
Polyvinyl chloride		Many different products, see IPPEU Chapters 10 and 10a
Polyvinylidene chloride		Many different products, see IPPEU Chapters 10 and 10a
Silicone resins		Coatings, molding compounds, laminates; filament winding; sealants; room-temperature curing cements; electrical insulation; impregnating electric coils; bonding agent; modifier for alkyd resins; vibration-damping devices

(Continued)

TABLE B-12 (Continued)

<u>Lubricant/Processing Aid</u>	<u>Consumption†</u>	<u>Use</u>
<u>MISCELLANEOUS</u>		
Dibutyl phthalate		Plasticizer for nitrocellulose lacquers, elastomers, explosives, nail polish and solid rocket propellants; solvent for perfume oils; perfume fixative; textile lubricating agent; safety glass; insecticides; printing inks; resin solvent; paper coatings; adhesives
Lecithin		Emulsifying, dispersing, wetting, penetrating agent and antioxidant; in margarine, mayonnaise, chocolate and candies, baked goods, animal feeds; printing inks; soaps and cosmetics; mold release agent for plastics; blending agent in oils and resins; rubber processing; lubricant for textile fibers
<u>INORGANICS</u>		
Aluminum silicate [see Clay]		
Calcium carbonate		Source of lime; neutralizing agent; filler and extender in rubber, plastics, and paints; opacifying agent in paper; fortification of bread; putty; tooth powders; antacid; white-wash; Portland cement; SO <sub>2</sub> removal from stack gases; metallurgical flux; analytical chemistry; CO <sub>2</sub> generation
Calcium silicate		Adsorbent; antacid; adhesives; filler for paper and paper coatings; cosmetics; food additive (anticaking agent)
Clay	1.5 x 10 <sup>8</sup> kgs (81)	Ceramic products; refractories; colloidal suspensions; oil-well drilling fluids; filler for rubber and plastics products; films; paper coatings; decolorizing oils; temporary molds; filtration; carrier in insecticidal sprays; catalyst support; cosmetics; cements; source of alumina
Graphite		Pencils; crucibles; retorts; foundry facings; molds; lubricants; paints and coatings; boiler compounds; powder glazing; electrotyping; monochromator in X-ray diffraction

(Continued)

TABLE B-12 (Continued)

<u>Lubricant/Processing Aid</u>	<u>Consumption†</u>	<u>Use</u>
<u>INORGANICS (Continued)</u>		
Magnesium silicate		Rubber filler; ceramics; glass; refractories; absorbent for crude oil spills; manufacture of permanently dry resins and resinous compositions; paints; varnishes and paper (filler); animal and vegetable oil bleaching agent; odor absorbent; filter medium; catalyst and catalyst carrier; anticaking agent in foods
Mica	4.5 x 10 <sup>5</sup> kgs (80)	Electrical equipment; vacuum tubes; incandescent lamps; dusting agent; lubricant; windows in high temperature equipment; filler in exterior paints; cosmetics; glass and ceramic flux; roofing; rubber; mold release agent; specialty paper for insulation and filtration; wallpaper and wallboard joint cement; oil-well drilling muds
Molybdenum disulfide		Lubricant in greases, oil dispersions, resin-bound films, dry powders, etc.; hydrogenation catalyst
Potassium silicate		Manufacture of glass and refractory material; welding rods; potassium silicate solutions
Silica (fumed)		Thickener; thixotropic and reinforcing agent in inks, resins, rubber, paints, cosmetics, etc.
Talc	1.5 x 10 <sup>8</sup> kgs (82)	Ceramics; cosmetics and pharmaceuticals; filler in rubber, paints, soap, putty, plaster, oilcloth; adherent; dusting agent; lubricant; paper; slate pencils and crayons; electrical insulation

†Annual Consumption is presented parenthetically for the most recent year available.



TABLE B-13. PLASTICIZERS  
CONSUMPTION AND OTHER USES

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<u>PHTHALATES</u>		
Alkyl benzyl phthalate		
Bis(tetrahydrofufural) phthalate		
Butyl benzyl phthalate	6.8 x 10 <sup>7</sup> kgs (79)	Plasticizer for PVC and cellulosics; organic intermediate; carrier and dis- persing media for catalysts, initiators, pesticides, cosmetics, and colorants
Butyl benzyl tetrachloro phthalate		
Butyl cyclohexyl phthalate		Plasticizer for polymers and elastomers; nitrocellulose lacquers
Butyl decyl phthalate		Primary plasticizer for PVC and copolymer resins
Butyl ethylhexyl phthalate		
Butyl hexyl phthalate		
Butyl isodecyl phthalate		PVC plasticizer
Butyl octyl phthalate [see Butyl ethylhexyl phthalate]		Vinyl plasticizer
Cyclohexyl benzyl phthalate		
Cresyl benzyl phthalate		
n-Decyl n-octyl phthalate	>1.4 x 10 <sup>3</sup> kgs (75) (total)	Plasticizer
Decyl tridecyl phthalate		
Diallyl phthalate	>2.3 x 10 <sup>6</sup> kgs (79) (total)	Low pressure laminates with fillers; plasticizer; monomer for unsaturated polyester resins; peroxide diluent for polyester spray; dye carrier; sealant; impregnant

(Continued)

TABLE B-13 (Continued)

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<u>PHthalATES</u> (Continued)		
Di-n-amyl phthalate		Plasticizer
Dibenzyl phthalate		
Dibutoxyethyl phthalate [Dibutyl Cellosolve phthalate]		Plasticizer for PVC, polyvinyl acetate and other resins
Dibutyl phthalate	7.7 x 10 <sup>6</sup> kgs (includes diisobutyl) (79)	Plasticizer (35%) mainly for plastisols, nitrocellulose lacquers, elastomers, explosives, nail polish, and chlorinated rubber; solvent for perfumes; textile lubricant; safety glass; insecticides; printing inks; resin solvent; paper coat- ings and adhesives; manometer fluid
Dibutyl tetrachloro phthalate		
Dicapryl phthalate [Di-2-octyl phthalate], [Bis(-1-methyl- heptyl) phthalate]		Plasticizer for vinyl and cellulose resins
Dicyclohexyl phthalate		Plasticizer for nitrocellulose, ethyl cellulose, chlorinated rubber, polyvinyl acetate, polyvinyl chloride
Didecyl phthalate		Vinyl plasticizer especially for electric cables and plastisols
Di(2,3-epoxypropyl) phthalate		
Diethoxyethoxy ethyl phthalate [Dicarbitol phthalate]		
Di(2-ethylbutyl) phthalate		
Di(2-ethylhexyl) phthalate [Dioctyl phthalate]	1.4 x 10 <sup>7</sup> kgs (79)	Plasticizer for PVC (86%), cellulose ester (4%), synthetic elastomer (3%), other vinyl resins (3%), other polymer (1%); other uses (3%)

(Continued)

TABLE B-13 (Continued)

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<u>PHTHALATES</u> (Continued)		
Diethyl phthalate	$1.0 \times 10^7$ kgs (78)	100% as a plasticizer and solvent for cellulose esters; solid rocket propellant; insecticide spray
Di-n-heptyl phthalate	$>4.5 \times 10^2$ kgs (75) (total)	Plasticizer; carrier and dispersing aid
Dihexyl phthalate		Plasticizer for vinyls and cellulose esters
Dihydroabietyl phthalate		
Diisobutyl phthalate	See dibutyl phthalate	Plasticizer
Diisodecyl phthalate	$7.7 \times 10^7$ kgs (79)	Plasticizer
Diisoheptyl phthalate		
Diisohexyl phthalate		
Diisononyl phthalate	$8.2 \times 10^7$ kgs (79)	
Diisooctyl phthalate	$1.6 \times 10^7$ kgs (79)	Plasticizer for vinyls, cellulose, acrylics, and synthetic rubber
Dilauryl phthalate		
Dimethoxyethyl phthalate	$2.3 \times 10^3$ kgs (79) (total)	Plasticizer, especially for vinyl resins and cellulose acetate; solvent
Dimethyl phthalate	$5.0 \times 10^6$ kgs (79)	Plasticizer (70%), principally for cellulose esters; insect repellent (30%); solvent
Dimethyl isobutyl carbinyl phthalate		
Dinonyl phthalate	$>4.5 \times 10^2$ kgs (75) (total)	Plasticizer for vinyls; stationary liquid phase in chromatography; carrier and dispersing aid for catalysts, initiators, pesticides, cosmetics, and colorants

(Continued)

TABLE B-13 (Continued)

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<u>PHthalATES</u> (Continued)		
Di-n-octyl phthalate	>4.5 x 10 <sup>2</sup> kgs (75) (total)	Plasticizer; perfume fixative; solvent
Di-n-octyl, n-decyl phthalate		Vinyl plasticizer
Diphenyl phthalate		Plasticizer for ethyl cellulose, nitro-cellulose and other polymers
Dipropyl phthalate		Plasticizer, little used
Ditridecyl phthalate	1.2 x 10 <sup>7</sup> kgs (79)	Plasticizer
Di(3,5,5-trimethylhexyl) phthalate		
Diundecyl phthalate	Demand estimated at 6.8 x 10 <sup>6</sup> kgs (79)	Plasticizer
Ethylhexyl decyl phthalate		
2-Ethylhexyl isodecyl phthalate		Plasticizer
Heptyl nonyl phthalate		
n-Heptyl, n-nonyl, n-undecyl phthalate		
n-Hexyl, n-decyl phthalate	7.3 x 10 <sup>6</sup> kgs (78)	
Hexyl octyl decyl phthalate (20%/36%/44%)  (5%/56%/38%)		
Isodecyl benzyl phthalate		
Isooctyl isodecyl phthalate		Plasticizer
Methoxyethoxyethyl phthalate		
Methoxyethoxyethyl benzyl phthalate		

(Continued)

TABLE B-13 (Continued)

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<u>PHTHALATES</u> (Continued)		
Octyl benzyl phthalate		
n-Octyl, n-decyl phthalate		Vinyl plasticizer
7-(2,6,6,8-Tetramethyl-4-oxa-3-oxo-nonyl)benzyl phthalate		
<u>BISPHTHALATES</u>		
Ethylene glycol bis-(n-butyl) phthalate		
<u>HEXAHYDROPHTHALATES</u>		
Di-2-Ethylhexylhexahydro-phthalate		
2-Ethylhexylhexahydro isophthalate		
<u>ISOPHTHALATES</u>		
Diethyl isophthalate		
Di-(2-ethylhexyl) isophthalate [Di-octyl isophthalate]		Plasticizer
Diisooctyl isophthalate		
Dimethyl isophthalate		
Dinonylphenyl isophthalate		
<u>TEREPHTHALATES</u>		
Di-(2-ethylhexyl) terephthalate [Di-octyl terephthalate]		
Chlorinated dioctyl terephthalate		

(Continued)

TABLE B-13 (Continued)

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<u>TETRAHYDROPHthalATES</u>		
<u>[Chlorendates]</u>		
2-Ethylhexyl epoxy tetrahydrophthalate		
<u>PHthalATE MIXTURES AND UNSPECIFIED</u>		
Blend (50/50) of dioctyl and dioctyldecyl phthalates		
Blend (50/50) of dioctyl and didecyl phthalates		
Mixed Alcohol phthalates		
Mixed Alcohol phthalates		
Mixed Normal Alcohol phthalates		
Straight Chain Alcohol phthalates		
Straight Chain Alcohol phthalates		
Mixed alkyl phthalates		
Mixed-n-alkyl phthalates		
Alkyl aryl phthalate		
Alkyl aryl modified phthalate		
Alkyl aryl modified phthalate		
High molecular weight phthalate		
High molecular weight linear phthalate		
High solvating phthalate		
Modified phthalate		

(Continued)

TABLE B-13 (Continued)

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<u>PHthalate MIXTURES</u>		
<u>AND UNSPECIFIED</u> (Continued)		
Octyl fatty phthalate		
High molecular weight phthalate "polyester"		
<u>TRIMELLITATES</u>		
Diisooctyl monoisodecyl trimellitate		
Heptyl nonyl trimellitate		
Heptyl nonyl undecyl trimelli- tate		
Isooctyl isodecyl trimellitate		
n-Octyl, n-decyl trimellitate		
Tricapryl trimellitate		
Tri-(2-ethylhexyl) trimellitate		Plasticizer
Tri-n-hexyl trimellitate		
Triisodecyl trimellitate		
Triisononyl trimellitate		
Triisooctyl trimellitate	4.1 x 10 <sup>6</sup> kgs (79)	Plasticizer
Tri-n-octyl trimellitate	5.4 x 10 <sup>6</sup> kgs (79)	
Tri-n-octyl n-decyl trimelli- tate		
<u>PYROMELLITATES</u>		
Tetra-n-butyl pyromellitate		
Tetraethyl pyromellitate		
Tetramethyl pyromellitate		

(Continued)

TABLE B-13 (Continued)

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<u>EPOXY TYPE PLASTICIZERS</u>		
Bisphenol A diglycidyl ethers (8.0-9.4% oxirane)		Sealing and encapsulating; castings and pottings; epoxy resins; binder for paper, polyester, fiberglass and wood
Di-2-ethylhexyl-4,5-epoxy tetrahydro phthalate (3.6-3.9% oxirane)		
Di-isodecyl tetrahydro-4,5- epoxy tallate		
Diisodecyl-4,5-epoxy tetra hydrophthalate (3.0% oxirane)		Fungi resistant plasticizer and stabi- lizer in vinyls for outdoor use
Epoxidized linseed oil (9.0- 10.0% oxirane)		
Epoxidized soybean oil (6.7- 7.0% oxirane)	3.3 x 10 <sup>7</sup> kgs (79)	
2-Ethylhexyl epoxy tallate (4.4-4.9% oxirane)		
Epoxy tallate		
Epoxy fatty nitrile		
Octyl epoxy stearate (3.5-3.9% oxirane)		
Octyl epoxy tallate		
<u>POLYESTERS AND OTHER POLYMERIC PLASTICIZERS</u>		
Acrylic-type Polyester		
Adipic Acid Polyesters		

(Continued)



TABLE B-13 (Continued)

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<u>POLYESTERS AND OTHER POLYMERIC PLASTICIZERS (Continued)</u>		
Adipic Acid Polyesters		
Low Viscosity		
Medium Viscosity		
Medium Molecular Weight		
Medium High Molecular Weight		
Alkyds		
Azelaic acid polyesters		
Butadieneacrylonitrile polymer		
Easy processing polymeric		
2-Ethyl-1,3-hexanediol polyadipate		
Neopentyl glycol polyadipate		
Polybutylene glycol		
Polyester, acetylated		
Polyester, not acetylated or not "terminated"		
Polyester		
Polypropylene glycol polyadipate		
Polystyrene resin, polyalpha methyl		
Polyurethane-based polymeric powder		

(Continued)

TABLE B-13 (Continued)

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<u>POLYESTERS AND OTHER POLYMERIC PLASTICIZERS (Continued)</u>		
Resinous plasticizer, EVA terpolymer		
Sebacic acid polyester		
Sebacic acid polyester oil modified		
Sulfonamide-Formaldehyde		
Reactive-type plasticizer		
<u>PHOSPHATES</u>		
Alkyl aryl phosphate		
p-t-Butylphenyl diphenyl phosphate		
Chlorophenyl diphenyl phosphate		
Chlorinated diphosphate		
Cresyl diphenyl phosphate	2.7 x 10 <sup>6</sup> kgs (75) (total)	Plasticizer; extreme pressure lubricant; hydraulic fluids; gasoline additive; food packaging; flameproofing
Di-(2-ethylhexyl) phenyl phosphate		
Diphenyl octyl phosphate	>4.5 x 10 <sup>2</sup> kgs (75) (total)	Plasticizer; hydraulic fluid; flame retardant
2-Ethylhexyl diphenyl phosphate	6.4 x 10 <sup>6</sup> kgs (79) (includes isodecyl diphenyl phosphate)	PVC plasticizer; fireproofing
Halogenated organic phosphate		Plasticizer and flame retardant for polyurethane foams

(Continued)

TABLE B-13 (Continued)

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<u>PHOSPHATES</u> (Continued)		
Isodecyl diphenyl phosphate	See 2-ethylhexyl diphenyl phosphate	
Isooctyl diphenyl phosphate		
Isopropylated phenyl phosphate		
Isopropyl phenyl diphenyl phosphate		
Phenyl isopropyl phenyl phosphate		
o-Phenylphenyl diphenyl phosphate		
Triaryl phosphate (synthetic)		
Tributoxyethyl phosphate	1.1 x 10 <sup>6</sup> kgs (79)	Primary plasticizer for most resins and elastomers; floor finishes and waxes; flame retarding agent; antifoaming agent
Tributyl phosphate	2.3 x 10 <sup>6</sup> kgs (79)	Heat exchange medium; solvent extraction of metal ions; solvent for nitrocellulose, cellulose acetate; plasticizer; pigment grinding assistant; antifoam agent; dielectric; hydraulic fluid
Tricresyl phosphate		Plasticizer for PVC, PS, nitrocellulose; fire retardant for plastics; air filter medium; solvent mixtures; waterproofing; additive to extreme pressure lubricants; hydraulic fluid and heat exchange medium
Tricresyl diphenyl phosphate		
Triethyl phosphate	4.1 x 10 <sup>6</sup> kgs (79)	Solvent; plasticizer for resins, plastics, gums; manufacture of pesticides; catalyst; lacquer remover; flame retardant for polyesters
Tri-(2-ethylhexyl) phosphate	1.1 x 10 <sup>6</sup> kgs (79)	Plasticizer with flame retardant and fungicide properties; antifoaming agent

(Continued)

TABLE B-13 (Continued)

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<u>PHOSPHATES</u> (Continued)		
Tri-n-hexyl phosphate		
Triisopropyl phenol phosphate		
Tri-2-methoxyethyl phosphate		
Triphenyl phosphate	3.0 x 10 <sup>6</sup> kgs (79) (estimate)	Fire retarding agent; plasticizer for cellulose acetate and nitrocellulose, lacquers and varnishes, hot melt adhesives; chemical intermediate; metal scavenger; stabilizer for alkyd resins; antioxidant; roofing paper; substitute for camphor in celluloid
Tris(2-chloroethyl) phosphate	>9.1 x 10 <sup>2</sup> kgs (75) (total)	Flame-retardant plasticizer; medication
Tris(chlorophenyl) phosphate		
Tris-chloropropyl phosphate		Essentially 100% as a flame retardant; secondary plasticizer
Tris(2,3-dichloropropyl) phosphate		Flame retardant; secondary plasticizer
Tris(tetrahydrofurfuryl) phosphate		Plasticizer; flame retardant
Trixylenyl phosphate [tri(di-methylphenyl) phosphite]		
Unspecified phosphate		
<u>PHOSPHONATES</u>		
Chlorinated organic phosphonate		
Chlorinated polyphosphonate (27% Cl, 15% P)		
Di-(2-ethylhexyl n-octyl) phosphonate		
Halogenated organic polyphosphonate		

(Continued)

TABLE B-13 (Continued)

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<u>PHOSPHITES</u>		
Triphenyl phosphite	4.5-9.1 x 10 <sup>5</sup> kgs (72)	Chemical intermediate; stabilizer for resins; metal scavenger; diluent for epoxy resins; antioxidant for rubbers
Tris(2-chloroethyl) phosphite	>9.1 x 10 <sup>2</sup> kgs (75) (total)	Intermediate; component of vinyl stabilizers; grease additive; flame proofing compositions; color inhibitor in esterifications
<u>LINEAR PLASTICIZERS</u>		
<u>GLUTARATES</u>		
Dialkyl diether glutarate		
Dibutoxyethyl glutarate		
Dibutoxyethoxyethyl glutarate		
Dicumylphenyl glutarate		
Didecyl glutarate		
Diisodecyl glutarate		
Mixed dialkyl glutarate		
<u>ADIPATES</u>		
Benzyl octyl adipate		
Butyl carbitol adipate		
Dialkoxyethyl adipate		
Dibenzyl adipate		
Dibutoxyethyl adipate		Primary plasticizer for most resins at low temperatures, adds UV stability
Dibutoxyethoxyethyl adipate		
Dibutyl adipate		Little used

(Continued)

TABLE B-13 (Continued)

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<u>ADIPATES</u> (Continued)		
Dicapryl adipate		Plasticizer for vinyls and cellulosics
Didecyl adipate		Plasticizer, especially for electric cables
Di-(1,3-di-methylbutyl) adipate		
Diethyl adipate		
Di-(2-ethylhexyl) adipate	2.1 x 10 <sup>7</sup> kgs (79)	Plasticizer - commonly blended with DOP and DIOP in vinyls and other polymers; solvent; aircraft lubricant
Di-n-hexyl adipate		Plasticizer for SBR (low temperature)
Diisobutyl adipate		Plasticizer
Diisodecyl adipate	5.9 x 10 <sup>5</sup> kgs (79)	Primary plasticizer for polymers
Diisononyl adipate		Low volatility plasticizer
Diisooctyl adipate	1.2 x 10 <sup>5</sup> kgs (79)	Low temperature plasticizer
Diisopropyl adipate	5.9 x 10 <sup>5</sup> kgs (79)	
Dimethyl adipate		Plasticizer
Dinonyl adipate		Low temperature plasticizer
Dipropyl adipate		
Ditridecyl adipate	1.1 x 10 <sup>6</sup> kgs (79)	
Di-(2,2,4-Trimethyl-1,3-pentanediol monoisobutyrate) adipate		
Heptyl nonyl adipate		
n-Hexyl n-decyl adipate		

(Continued)

TABLE B-13 (Continued)

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<u>ADIPATES</u> (Continued)		
Isooctyl isodecyl adipate		
n-Octyl n-decyl adipate		Low temperature plasticizer
Tridecyl adipate		
<u>MIXED ADIPATES</u>		
C7-C9 linear adipates		
Straight chain alcohol adipates		
Straight chain alcohol adipates		
<u>POLYMERIC ADIPATES</u>		
Di-(2-ethylhexyl) adipate (polymeric)		
High molecular weight adipate		
Modified polypropylene adipate		
Polypropylene adipate		
<u>CITRATES</u>		
Acetyl tri-n-butyl citrate	>2.0 x 10 <sup>3</sup> kgs (76) (total)	Plasticizer; flavoring ingredient
Acetyl triethyl citrate		Plasticizer for cellulose
Acetyl tri-(2-ethylhexyl) citrate		Low volatility plasticizer for vinyl resins
Acetyl tri-n-hexyl citrate		
Acetyl tri-(n-octyl, n-decyl) citrate		
Tribenzyl citrate		

(Continued)

TABLE B-13 (Continued)

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<u>CITRATES</u> (Continued)		
Tributyl citrate		Plasticizer; antifoam agent; solvent for nitrocellulose
Triethyl citrate	>4.5 x 10 <sup>2</sup> kgs (75) (total)	Solvent and plasticizer for nitrocellulose and natural resins; softener; paint removers; agglutinant; perfume base; food additive (not over 0.25%)
Tris(-2-ethylhexyl) citrate		
<u>AZELATES</u>		
Dibenzyl azelate		
Dibutoxyethyl azelate		
Diethyl azelate		
Di-(2-ethylbutyl) azelate		
Di-(2-ethylhexyl) azelate		Low temperature plasticizer especially for vinyls; base for synthetic lubricants
Di-n-hexyl azelate		
Diisobutyl azelate		
Diisooctyl azelate		Vinyl resin plasticizer; base for synthetic lubricants
Dimethyl azelate		
Low temperature azelate plasticizer		
<u>SEBACATES</u>		
Butyl acetoxy sebacate		
Butyl benzyl sebacate		

(Continued)



TABLE B-13 (Continued)

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<u>SEBACATES</u> (Continued)		
Dibenzyl sebacate		Plasticizer, especially for plastic linings for containers
Dibutoxyethyl sebacate		
Dibutoxyethoxyethyl sebacate		
Dibutyl sebacate	(see dioctyl sebacate)	Plasticizer; rubber softener; dielectric liquid; cosmetics and perfumes; sealing food containers; flavoring; lubricating ingredient in shaving lotions
Di(-1,3-dimethylbutyl) sebacate		
Dihexyl sebacate		
Diisooctyl sebacate		Plasticizer
Diisopropyl sebacate		
Dimethyl sebacate		Solvent and plasticizer for nitrocellulose and vinyl resins; intermediate
Dinonyl sebacate		
Dioctyl sebacate [di-(2-ethylhexyl) sebacate]	2.5 x 10 <sup>6</sup> kgs (75)	Plasticizer
Heptyl nonyl sebacate		
<u>ISOSEBACATES</u>		
Di-n-butyl isosebacate		
Di-(2-ethylhexyl) isosebacate		
<u>SUCCINATES</u>		
Diethyl succinate		Plasticizer; intermediate; flavoring
Tetrabutyl thiosuccinate		

(Continued)

TABLE B-13 (Continued)

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<u>FORMAL</u>		
Butyl carbitol formal		
Dibutoxyethoxyethyl formal		
<u>PELARGONATES</u>		
Isodecyl pelargonate		
<u>TARTRATES</u>		
Diisobutyl tartrate		
<u>FUMARATES</u>		
Dibutyl fumarate		Monomeric plasticizer; copolymers; intermediate
Diisooctyl fumarate		
Diethyl fumarate		Monomer for polymerization and copolymerization
<u>ISOBUTYRATES</u>		
2,2,4-Trimethyl-1,3-pentandiol diisobutyrate		Intermediate in manufacture of plasticizers, surfactants, pesticides and resins
Sucrose acetate isobutyrate		Modifier for lacquers, hot-melt coating formulations and extrudable plastics
<u>MALEATES</u>		
Di-n-butyl maleate		Copolymers; plasticizers; intermediate
Diethyl maleate		Copolymers; intermediate
Monobutyl maleate		

(Continued)

TABLE B-13 (Continued)

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<u>PENTAERYTHRITOL</u>		
Pentaerythritol fatty acid ester		
Pentaerythritol tetracaprylate-caprate		
<u>OTHER LINEAR ESTERS</u>		
Mixed dibasic ester		
Sucrose octoacetate		Plasticizer for cellulose and synthetic resins; adhesives; coatings; insecticides; termite repellent; denaturant in rubbing alcohol; paper; plastics; lacquers
<u>EXTENDERS</u>		
<u>PETROLEUM DERIVATIVES</u>		
Alkyl aryl hydrocarbons		
Aromatic hydrocarbons (70% aromatic hydrocarbons, 23% polar compounds)		
Biphenyl		
Butyl naphthalene		
Diisopropyl biphenyl		
Naphthalene	1.0 x 10 <sup>8</sup> kgs (75) (total)	Insecticide; vermicide; antiseptic; manufacture of anthranilic acids; naphthols; naphthylamines and sulfonic acid; resins; explosives; surface active agents
Naphthenic Oil		

(Continued)

TABLE B-13 (Continued)

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<u>PETROLEUM DERIVATIVES</u> (Continued)		
Polyalkyl naphthalene		
Terphenyls, partially hydrogenated		
o,m,p-Terphenyl mixture		
Poly-alpha-methyl styrene		
<u>CHLORINATED AROMATICS</u>		
Chlorobenzene	1.5 x 10 <sup>8</sup> kgs (75) (total)	Solvent for paints; dry cleaning solvent; intermediate for phenol, o- and p-chloro-nitrobenzene, DDT, and aniline; insecticide; manufacture of dyestuffs
o-Dichlorobenzene	2.5 x 10 <sup>7</sup> kgs (75) (total)	Organic synthesis of pesticides (53%); solvent in toluene diisocyanate process (15%); dyestuff manufacture (8%); miscellaneous uses (4%) including removing sulfur from illuminating gas, heat transfer medium, degreasing agent, metal polishes, rustproofing, wood preservation, magnetic coil coolant, and deodorizing garbage and sewage
Chlorinated biphenyl		
21% Cl		
32% Cl		
42% Cl		
48% Cl		
54% Cl		
60% Cl		
68% Cl		

(Continued)

TABLE B-13 (Continued)

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<u>CHLORINATED AROMATICS</u>		
(Continued)		
Chlorinated Naphthalene		
22% Cl		
50% Cl		
56% Cl		
70% Cl		
Chlorinated Terphenyl		
60% Cl		
Chlorinated Paraffin	>5.0 x 10 <sup>7</sup> kgs (79)	High pressure lubricants; flame retardant
40% Cl	(Total)	for plastics and textiles; secondary
42% Cl		plasticizer for PVC in polyethylene
52% Cl		sealants; detergents; solvent for
70% Cl		dichloroamine-T
<u>PARAFFIN OILS</u>		
White paraffin oil, highly refined		Floor treatment; lubricant; medicinal (when purified); suspending agent; grain preservation
Petrolatum	3.0 x 10 <sup>8</sup> kgs (75) (total)	Emollient base; lubricating firearms and machinery; leather grease, shoe polish; modeling clays; cosmetics; food additive; rust preventative; protective dressings; perfume extractor; insect repellents; rubber softener; release agent
<u>OTHER CYCLIC PLASTICIZER</u>		
<u>ABIETIC DERIVATIVES</u>		
Hydroabietyl alcohol		Plasticizer
Hydrogenated methyl abietate		
Methyl abietate (methyl ester of rosin)		Solvent and plasticizer; lacquers; varnishes; coating compositions

(Continued)

TABLE B-13 (Continued)

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<b>BENZOIC ACID DERIVATIVES</b>		
Benzyl benzoate	3.4 x 10 <sup>5</sup> kgs (75) (total)	Solvent for cellulose acetate, nitro-cellulose and artificial musk; perfume fixative; camphor substitute in celluloid and plastic pyroxylin compounds; confectionary and chewing gum flavors; remedy for scabies; plasticizer; dye carrier
Cumyl phenyl dibenzoate		
Diethylene glycol dibenzoate		Plasticizer
Dipropylene glycol dibenzoate		Plasticizer
Diethylene and Dipropylene glycol dibenzoate blend		Plasticizer
Ethylene glycol dibenzoate		
Glyceryl tribenzoate		
Neopentyl glycol dibenzoate		
Pentaerythritol tetrabenzoate		
Octylene Glycol Dibenzoate		
Polyethylene glycol (200) dibenzoate		
Polyethylene glycol (300) dibenzoate		
Polyethylene glycol (400) dibenzoate		
Polyethylene glycol (600) dibenzoate		
Sucrose benzoate		

(Continued)

TABLE B-13 (Continued)

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<u>BENZOIC ACID DERIVATIVES</u> (Continued)		
Triethylene glycol dibenzoate		Vinyl plasticizer; adhesives
Trimethylolethane Tribenzoate		
2,2,4-Trimethyl-1,3-pentanediol isobutyrate benzoate		
Proprietary low stain benzoic acid derivative		
<u>POLYPHENYL</u>		
Hydrogenated terphenyl		
<u>LACTAM</u>		
2-Pyrrolidone	>5.9 x 10 <sup>6</sup> kgs (75) (total)	Plasticizer and coalescing agent for acrylic floor polish; solvent for poly- mers, insecticides, polyhydroxylic alcohols, sugar, iodine, inks; monomer for nylon 4 and other polymers
<u>ACETATES</u>		
Cumyl phenyl acetate		
<u>PHENOXYs</u>		
Acetyl paracumyl phenol		
<u>KETONES</u>		
Benzophenone		Organic synthesis; odor fixation; deriva- tives used as UV absorbers; flavoring; soap fragrance; pharmaceuticals; poly- merization inhibitor for styrene

(Continued)

TABLE B-13 (Continued)

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<u>GLYCOLATES</u>		
Butyl phthalyl butyl glycolate		Plasticizer
Dibutyl methylene bithioglycolate		
Dicapryl diglycolate		
Diocetyl thiodiglycolate		
Ethyl phthalyl ethyl glycolate		
Methyl phthalyl ether glycolate		
<u>GLYCEROL DERIVATIVES</u>		
Glycerol	1.4 x 10 <sup>7</sup> kgs (75)	23% in drugs; 21% in production of alkyd surface coatings; 15% as humectant in tobacco; 12% as solvent for flavors and food colors; 11% as plasticizer in cellophane; 7% in manufacture of polyester polyols for urethane foams; 5% as intermediate for nitroglycerin; 6% other applications
Glycerol carbonate		
Glycerol diacetate		
Glycerol monacetate	>4.5 x 10 <sup>2</sup> kgs (79) (total)	Gelatinizing agent for explosives; solvent for basic dyes; tanning leather; food additive
Glycerol triacetate		Plasticizer for cellulose acetate; binder for solid rocket fuels; fixative in perfumes; fungicide in cosmetics; to remove carbon dioxide from natural gas; food additive
Glycerol tributyrates		Synthetic flavoring; solvent; plasticizer
Glycerol trifricinoleate		

(Continued)



TABLE B-13 (Continued)

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<u>GLYCOL DERIVATIVES</u>		
<u>GLYCOLS AND GLYCOL ESTERS</u>		
1,3-Butanediol		Intermediate in manufacture of polyester plasticizers; humectant for cellophane; tobacco; mold inhibitor; surface active agents; coupling agents; solvent; flavoring
2,3-Butanediol 1,4-Butanediol dicaprylate		
1,4-Butanediol dipelargonate		
Butyl carbitol acetate		
Diethylene glycol dipelargonate		
Diethylene glycol monobutyl ether acetate [Butyl Carbitol Acetate]		
2,2-Diethyl-1,3-propanediol		
Ethylene glycol diacetate	>9.1 x 10 <sup>2</sup> kgs (75) (total)	Solvent for oils, explosives, cellulose ethers, printing inks; plasticizer; perfume fixative
Ethylene glycol dipelargonate		
2-Ethyl-1,3-hexanediol		Anthropod and insect repellent; solvent for resins and inks; plasticizer; intermediate in the production of polyurethane resins
1,5-Hexanediol		
Polyethylene glycol 200		
Polyethylene glycol 300		

(Continued)

TABLE B-13 (Continued)

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<u>GLYCOLS AND GLYCOL ESTERS</u>		
(Continued)		
Tetraethylene glycol di-(2-ethylenehexanoate)		
Tetraethylene glycol diheptanoate		
Triethylene glycol diacetate		
Triethylene glycol dicaprylate		
Triethylene glycol dicaprylate-caprate		
Triethylene glycol di-(2-ethylbutyrate)	Plasticizer	
Triethylene glycol di-(2-ethylhexoate)		
Triethylene glycol diheptanoate		
Triethylene glycol diperlargonate		
Triethylene glycol ester of fatty acid		
Triglycol ester of vegetable oil fatty acid		
Trimethylol ethane tricarprylate-caprate		
Trimethylol propane triheptanoate		

(Continued)

TABLE B-13 (Continued)

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<u>GLYCOLS AND GLYCOL ESTERS</u> (Continued)		
Polyethylene glycol 400		
Polyethylene glycol 600		
Polyethylene glycol 900		
Polyethylene glycol 1000		
Polyethylene glycol 1500		
Polyethylene glycol 1450		
Polyethylene glycol 1500 and 500B		
Polyethylene glycol 1530		
Polyethylene glycol 3350		
Polyethylene glycol 4000		
Polyethylene glycol 4500		
Polyethylene glycol 6000		Plasticizer; softening agent; mold release agent; solvent; dispersing agent; binder; chemical intermediate
Polyethylene glycol 8000		
Polyethylene glycol 20M		
Polyethylene glycol (200) di-(2-ethylhexoate) [Polyethylene glycol dioctoate]		
Polyethylene glycol (600) monolaurate		

(Continued)

TABLE B-13 (Continued)

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<u>DERIVATIVES OF FATTY ACIDS</u>		
<u>LAURATES</u>		
Butoxyethyl laurate		
Diethylene glycol monolaurate		Emulsifying agent; emulsions for lubricants, sizing, finishing of textiles, paper and leather; fluid emulsions of oils; dry cleaning soap base; antifoaming agent
Glycerol monolaurate		Emulsifying and dispersing agent for food products, oils, waxes and solvents; antifoaming agent; dry-cleaning soap base
Polyethylene glycol (400) dilaurate		
1,2 Propylene glycol monolaurate		
<u>MYRISTATES</u>		
n-Butyl myristate		Plasticizer; lubricant for textiles, paper stencils, cosmetic preparations
Isopropyl myristate	1.3 x 10 <sup>6</sup> kgs (79)	In cosmetics as emollient and emulsifier; reagent; solvent
Isopropyl myristate-palmitate		Cosmetics (emollient and emulsifier)
<u>OLEATES</u>		
Butoxyethyl oleate		
Butyl oleate	1.2 x 10 <sup>6</sup> kgs (79)	PVC plasticizer; solvent; lubricant; water-resisting agent; coating compositions; polishes; water-proofing compounds

(Continued)

TABLE B-13 (Continued)

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<u>OLEATES</u> (Continued)		
Diethylene glycol monooleate		Emulsifying agent for furniture and automobile polish; water-emulsion paints; agricultural sprays
Ethylene glycol monobutyl ether oleate		
Glycerol monooleate	1.7 x 10 <sup>6</sup> kgs (75) (total)	Foods; pharmaceuticals; cosmetics; rust prevention oil; textile finish; vinyl light stabilizer; odorless base paints; flavoring
Glycerol trioleate [Olein]		
Isopropyl oleate		
Lead oleate		Varnishes; lacquers; paint drier; high pressure lubricant
Methoxyethyl oleate		
Methyl oleate		Intermediate for detergents, emulsifiers, wetting agents, stabilizers; textile treatment; plasticizer for inks, rubbers, waxes, and plastics; chromatographic standard; biomedical research
n-Propyl oleate	1.8 x 10 <sup>5</sup> kgs (79)	
Tetrahydrofurfuryl oleate		Plasticizer
<u>PALMITATES</u>		
Isooctyl palmitate	2.0 x 10 <sup>6</sup> kgs (79)	Secondary plasticizer, extrusion aid; emollient and emulsifier in cosmetics
Isopropyl palmitate		Emollient and emulsifier for cosmetics and lotions
Myricyl palmitate [Beeswax]		

(Continued)

TABLE B-13 (Continued)

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<u>RICINOLEATES</u>		
n-Butyl acetyl ricinoleate		Plasticizer; emulsifier; lubricant; detergent; protective coating; special cleansing compounds; quick-breaking emulsions
Butyl ricinoleate		Plasticizer; lubricant
Diethylene glycol monoricinoleate		Plasticizer for high polymers and elastomers
Glycerol ricinoleate [Caster Oil]		Non-drying emulsifying agent; solvent; plasticizer; paper, cosmetics, textiles, and leather processing; lubricant; paint stabilizer
Glycerol triacetyl ricinoleate		Plasticizer; lubricant; protective coating
Methyl acetyl ricinoleate		Plasticizer; lubricant; protective coating; synthetic rubbers; vinyl compounds
Methoxyethyl acetyl ricinoleate		
Methyl ricinoleate		Plasticizer; lubricant; cutting oil additive; wetting agent
Propylene glycol monoricinoleate		Plasticizer; dye solvent; lubricant; cosmetics; urethane polymers; hydraulic fluids
<u>STEARATES</u>		
Butyl acetoxystearate		Plasticizer; textile oils; adhesives
Butoxyethyl stearate		Plasticizer and solvent
Butyl epoxystearate		

(Continued)

TABLE B-13 (Continued)

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<u>STEARATES</u> (Continued)		
Butyl stearate	3.8 x 10 <sup>6</sup> kgs (79) (total)	Polishes; special lubricants; coatings; metal lubricant; plasticizer for laminated fiber products, rubber hydrochloride, chlorinated rubber and cable lacquers; carbon paper and inks; emollient; in cosmetic preparations; flavoring; softening agent; dye solvent
Diethylene glycol distearate		Emulsifying agent; lubricating agent; suspending medium; temporary binder; protective coating; thickening agent; pharmaceuticals
Ethyl stearate		
Glycerol monostearate		Thickening and emulsifying agent for foods; flavoring; emulsifier for oils; protective coating; cosmetics; opacifier; detackifier; resin lubricant
Glycerol triacetoxystearate		Plasticizer for nitrocellulose, ethyl cellulose and PVC; lubricant; protective coating
Glycerol tri(epoxy acetoxy stearate)		
Hexadecyl stearate [Cetyl Stearate]		
Isobutyl stearate	7.7 x 10 <sup>5</sup> kgs (79) (total)	Waterproof coatings; polishes; face creams; rouge; ointments; soaps; rubber manufacture; dye solution; inks; lubricants
Isooctyl epoxy stearate		
Methoxyethylacetoxy stearate		

(Continued)

TABLE B-13 (Continued)

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<u>STEARATES</u> (Continued)		
Methoxyethyl stearate		
Methyl hydroxystearate wax		
Methyl pentachlorostearate (stabilized)		
Methyl stearate	>4.5 x 10 <sup>2</sup> kgs (75) (total)	Intermediate for stearic acid detergents, emulsifiers, wetting agents, stabilizers, resins, lubricants, textiles, and plasticizers; lubricating oil component; lipstick, nail varnishes, and ointments
Octyl stearate		
1,2-Propylene glycol monostearate		Emulsifier; stabilizer
Vinyl stearate		Plasticizer; lubricant
<u>TALL OILS</u>		
Isooctyl esters of tall oil		
Methyl esters of tall oil		
<u>FATTY NITRILES</u>		
Fatty acid nitrile		
Oleyl nitrile		
Tallow nitrile		
<u>OTHER MISCELLANEOUS PLASTICIZERS</u>		
<u>CARBONATES</u>		
Bis-dimethyl benzyl carbonate		
Dinonyl phenyl carbonate		

(Continued)



TABLE B-13 (Continued)

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<u>ETHERS</u>		
Bis(dimethylbenzyl) ether		
Cumyl phenyl benzyl ether		
Nonylphenol ethylene oxide		
Tridecanol ethylene oxide adduct		
<u>SULFONAMIDES</u>		
n-Cyclohexyl-p-toluene sulfonamide		
n-Ethyl-o,p-toluene sulfonamide		
n-Ethyl-p-toluene sulfonamide		
Sulfonamide-formaldehyde resin		
o,p-Toluene sulfonamide		Reactive plasticizer in hot melt adhesives of thermosetting resins, e.g., amino and phenolic resins; plasticizer for casein, shellac, zein and soya protein coating; carrier for fluorescent pigments; intermediate in production of saccharin
<u>AMIDES</u>		
Benzamide		
Dibutyl lauramide		
2,2'-(2-Ethylhexamidodiethyl) di-2-ethylhexoate		

(Continued)

TABLE B-13 (Continued)

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<u>AMIDES (Continued)</u>		
Urea	3.8 x 10 <sup>6</sup> kgs (75) (total)	37% as a liquid fertilizer; 24% other fertilizers; 22% livestock nutrient; 17% resins and other uses including pharmaceutical production, cellulose softener, ammoniated dentrifices, diuretic, explosives stabilizers, separation of hydrocarbons, and flameproofing agent
<u>NITRO COMPOUNDS</u>		
Nitrobenzene		Solvent; chemical intermediate for aniline and derivatives; soaps; shoe and floor polish; refining lubricating oils; preservative in spray paint
o-Nitrobiphenyl		
2-Nitrodiphenyl ether		
o-Nitrotoluene	9.1 x 10 <sup>6</sup> kgs (75) (total)	Intermediate for o-toluidine, fuchsine, o-nitrobenzoic acid; manufacture of dyes
<u>SULFONATES</u>		
Phenol, cresol esters of pentadecylsulfonic acid		
Cresyl-p-toluene sulfonate		
<u>OTHERS</u>		
Camphor		Explosives; moth repellent; embalming fluid; manufacture of cymene; preservative; insect repellent; cosmetic ingredient
alpha-Methyl-D glucoside		

(Continued)

TABLE B-13 (Continued)

<u>Plasticizer</u>	<u>Production/Consumption†</u>	<u>Uses</u>
<u>OTHERS</u> (Continued)		
Sorbitol	5.9 x 10 <sup>7</sup> kgs (75) (total)	Manufacture of sorbose, ascorbic acid, propylene glycol, synthetic plasticizers, and resins; humectant on printing rolls; in leather; antifreeze mixtures; bulking agent for food; flavor additives; surfactants; cosmetics; stabilizers for vinyl resins

†Annual Consumption is presented parenthetically for the most recent year available.

TABLE B-14. PRESERVATIVES  
CONSUMPTION AND OTHER USES

<u>Preservative</u>	<u>Consumption†</u>	<u>Use</u>
Barium metaborate [Busan 11-M-1]		Paint mildewcide
Butyl p-hydroxybenzoate [Butyl paraben]	1.0 x 10 <sup>4</sup> kgs (72) (total)	Antifungal preservative for pharmaceuticals, creams, and foods; flavoring agent
Copper-8-quinolate		Fungicide and mildew-proofing of fabrics and plastics for military applications; analysis for copper
1,2-Dibromo-2,4-dicyanobutane [Tektamer 38]		
3,5-Dimethyltetrahydro-1,3,5-thiadiazine-2-thione [Mylone], [Dazomet]	4.5 x 10 <sup>4</sup> kgs (75) (total)	Soil fungicide; crop herbicide; antimicrobial agent for alimicide preparations and adhesives
Diphenyl antimony 2-ethylhexanoate		
2-Hydroxy-5-chlorobenzoic-3,4'-dichloro-anilide		
8-Hydroxyquinoline		Precipitating and separating metals; preparation of fungicides; chemical intermediate; antiseptic; stabilizer for hydrogen peroxide
Intercide N-638 [trialkyl organotin]		
2-Methyl-1-naphthyl maleimide		
Methyl p-hydroxybenzoate [Methyl paraben]	2.2 x 10 <sup>5</sup> kgs (75) (total)	Medicine; food additive (preservative); antimicrobial agent for cosmetics, food, and pharmaceuticals
2-N-Octyl-4-isothiazolin-3-one [Micro-Chek 11], [Micro-Chek 11D]		Fungicide for paint and plastics
10,10-Oxybisphenoarsine [Vinyzene BP-5], [Vinyzene BP-5-2], [Vinyzene SB-1]		Antimicrobial agent fo plastics and textiles
Phenyl mercuric salicylate [C <sub>6</sub> H <sub>4</sub> (OH)(COOHgC <sub>6</sub> H <sub>5</sub> )]		Seed disinfectant
Propyl p-hydroxybenzoate [Propyl paraben], [C <sub>10</sub> H <sub>12</sub> O <sub>3</sub> ]	>1.4 x 10 <sup>3</sup> kgs (75) (total)	Medicine; food preservative; fungicide; mold control in sausage casings

(Continued)

TABLE B-14 (Continued)

<u>Preservative</u>	<u>Consumption†</u>	<u>Use</u>
PPC [DM-50], [organometallic]		
Quaternary ammonium naphthenate		Fungicide and bactericide for vinyl film, coating, and fabric
3,5,3',4'-Tetrachlorosalicylanilide		
2,2'-Thiobis(4,6-dichlorophenol)		
Tributyltin fluoride		Antifungal agent for paint
Tributyltin oxide [(C <sub>4</sub> H <sub>9</sub> ) <sub>3</sub> SnOSn(C <sub>4</sub> H <sub>9</sub> ) <sub>3</sub> ]		Bactericide; fungicide for paint and plastics; intermediate
Tributyltin salicylate [Cotin P]		
Trichloromethylmercapto-4-cyclohexene- 1,2-dicarboximide [Captan], [Vancide 89], [C <sub>9</sub> H <sub>8</sub> Cl <sub>3</sub> NO <sub>2</sub> S], [N-trichloromethylmercaptotetrahydrophthalimide]	4.5 x 10 <sup>6</sup> kgs (75) (total)	Seed treatment; fungicide in paints, plastics, lacquers, leather, fabrics, and fruit preservation
n-(Trichloromethylthio)phthalimide [Folpet], [Phaltan], [C <sub>6</sub> H <sub>4</sub> (CO) <sub>2</sub> NSCCl <sub>3</sub> ]	1.8 x 10 <sup>5</sup> kgs (75) (total)	Fungicide-bactericide for vinyls, paints and enamels; fungicide for fruits, vegetables, and flowers
N-(Trichloromethylthio)tetraphthalimide		
Zinc borate [3ZnO·2B <sub>2</sub> O <sub>3</sub> ]		Medicine; fireproofing textiles; fungistat and mildew inhibitor; flux in ceramics

†Annual Consumption is presented parenthetically for the most recent year available.

TABLE B-15. SOLUTION MODIFIERS  
CONSUMPTION AND OTHER USES

<u>Solution Modifier/Polymerization Aid</u>	<u>Consumption†</u>	<u>Use</u>
<u>ACIDS, BASES, AND BUFFERS</u>		
<u>ACIDS</u>		
Formic acid [HCOOH]	2.8 x 10 <sup>7</sup> kgs (74) (total)	Dyeing and finishing of textiles and paper, leather treatment; chemicals (formates, oxalic acid, organic esters); manufacture of fumigants, insecticides, refrigerants, solvents for perfumes, lacquers; electroplating; medicine; brewing (antiseptic); silvering glass; cellulose formate; rubber latex coagulant; ore flotation; vinyl resin plasticizers; animal feed additive; electroplating; chemical analysis
Hydrochloric acid [HCl]	2.3 x 10 <sup>9</sup> kgs (82) (total)	Acidizing of petroleum wells; chemical intermediate; ore reduction for tin and tantalum; food processing; pickling and metal cleaning; industrial acidizing; general cleaning; alcohol denaturant; laboratory reagent; production of chlorides; manufacture of phosphoric acid; starch modifier; production of vinyl chloride
Lactic acid [CH <sub>3</sub> CHOHCOOH]		Cultured dairy products; as acidulent; flavoring; preservative; chemicals (salts, plasticizers, adhesives, pharmaceuticals)
Maleic acid [HOOCCH:CHCOOH]		Organic synthesis (maleic, succinic, aspartic, tartaric, propionic, lactic, malonic, acrylic, hydroacrylic acids); dyeing and finishing of cotton, wool, and silk; preservative for oils and fats
Nitric acid [HNO <sub>3</sub> ]	6.8 x 10 <sup>9</sup> kgs (82) (total)	Manufacture of ammonium nitrate for fertilizer and explosives; organic and inorganic synthesis (dyes, isocyanates, drugs, explosives, cellulose nitrate, nitrate salts); metallurgy; photoengraving; etching steel; ore flotation; medicine; reagent
2-Naphthalenesulfonic acid [C <sub>10</sub> H <sub>7</sub> SO <sub>3</sub> H]		Starting material for β-naphthol, β-naphthol sulfonic acid, β-naphthylaminesulfonic acid, etc.
Phosphoric acid [H <sub>3</sub> PO <sub>4</sub> ]	7.7 x 10 <sup>9</sup> kgs (82) (total)	Fertilizers; soaps and detergents; inorganic phosphates; pickling and rust-proofing metals; pharmaceuticals; sugar refining; gelatin manufacture; water treatment; animal feeds; electro-polishing; gasoline additive; conversion coating for metals; catalyst for ethanol manufacture; lakes in cotton dyeing; yeasts; soil stabilizers; waxes and polishes; binder for ceramics; activated carbon; in foods and carbonated beverages as acidulent and sequestrant; laboratory reagent; source of uranium (experimental); intermediate; catalyst for making ethylene; flavoring for soft drinks

(Continued)

TABLE B-15 (Continued)

<u>Solution Modifier/Polymerization Aid</u>	<u>Consumption†</u>	<u>Use</u>
<u>ACIDS</u> (Continued)		
Sulfuric acid [H <sub>2</sub> SO <sub>4</sub> ]	2.9 x 10 <sup>10</sup> kgs (82) (total)	Fertilizers; chemicals; inorganic pigments; petroleum refining; titanium dioxide; manufacture of ammonium sulfate, dyestuffs, other acids, paper and glue; etchant; alkylation catalyst; electroplating baths; iron and steel; rayon and film; industrial explosives; laboratory reagent; nonferrous metallurgy; dehydrating agent for ethers and esters; gas drying; obtaining glucose from hydrolysis of cellulose
<u>BASES</u>		
Ammonia [NH <sub>3</sub> ]	1.4 x 10 <sup>10</sup> kgs (82) (total)	Fertilizers; manufacture of nitric acid, hydrazine hydrate, caprolactam, acrylonitrile, hydrogen cyanide, urethane, acrylonitrile and sodium carbonate; refrigerant; nitriding of steel; condensation catalyst; synthetic fibers; dyeing; neutralizing agent in petroleum industry; latex preservative; sulfite cooking liquors; fuel cells; rocket fuel; yeast nutrient; developing diazo films; explosives; solvent; cleaning and bleaching; cotton defoliant
Ammonium hydroxide [NH <sub>4</sub> OH] [See Ammonia]		Textiles; manufacture of rayon, rubber, fertilizers; refrigeration; condensation polymerization; photography; pharmaceuticals; ammonia soaps; lubricants; fireproofing wood; ink manufacture; explosives; ceramics; ammonium compounds; saponifying fats and oils; organic synthesis; detergent; food additive; household cleanser
Methanolic sodium methoxide [Sodium methoxide in methyl alcohol] [CH <sub>3</sub> ONa·CH <sub>3</sub> OH]	4.2 x 10 <sup>6</sup> kgs (79) (total)	Condensation reactions; catalyst for treatment of edible fats and oils (especially lard); intermediate for pharmaceuticals; preparation of sodium celluloseate; analytical reagent
Potassium hydroxide [KOH]	1.9 x 10 <sup>8</sup> kgs (75) (total)	Soap manufacture; bleaching; manufacture of potassium carbonate and tetrapotassium pyrophosphate; electrolyte in alkaline storage batteries and some fuel cells; absorbent for carbon dioxide and hydrogen sulfide; dyestuffs; liquid fertilizers; food additive; herbicides; electroplating; inks; analytical chemistry
Sodium hydroxide [NaOH]	8.2 x 10 <sup>9</sup> kgs (82) (total)	Chemical manufacture; rayon and cellophane; petroleum refining; pulp and paper; aluminum; detergents; soaps; textile processing; vegetable oil refining; reclaiming rubber; regenerating ion exchange resins; organic fusions; peeling of fruits and vegetables in food industry; laboratory reagent; etching and electroplating; precipitation of alkaloids; neutralizing acids; deshorning calves; explosives and dyestuffs; electrolytic extraction of zinc

(Continued)

TABLE B-15 (Continued)

<u>Solution Modifier/Polymerization Aid</u>	<u>Consumption†</u>	<u>Use</u>
<b>BUFFERS</b>		
Ammonium acetate [(NH <sub>4</sub> )C <sub>2</sub> H <sub>3</sub> O <sub>2</sub> ]		Reagent in analytical chemistry; drugs; textile dyeing; preservative for meats; foam rubbers; vinyl plastics; explosives
Borax [Na <sub>2</sub> B <sub>4</sub> O <sub>7</sub> ]		Manufacture of glass, enamels, and other ceramic products; herbicide
Calcium carbonate [CaCO <sub>3</sub> ]		Source of lime; neutralizing agent; filler and extender in rubber, plastics, paint; opacifying agent in paper; fortification of bread; putty; tooth powders; antacid; whitewash; Portland cement; SO <sub>2</sub> removal from stack gases; metallurgical flux; analytical chemistry; CO <sub>2</sub> generation (laboratory)
Potassium bicarbonate [KHCO <sub>3</sub> ]		Baking; soft drinks; medicine (antacid); manufacture of pure potassium carbonate; fire extinguishing agent; low pH liquid detergents; laboratory reagent
Sodium acetate [NaC <sub>2</sub> H <sub>3</sub> O <sub>2</sub> ]	5.9 x 10 <sup>5</sup> kgs (79) (total)	Dye and color intermediate; pharmaceuticals; cinnamic acid; soaps; buffer; photography; purification of glucose; meat preservation; medicine; electroplating; tanning; dehydrating agent; buffer in foods; laboratory reagent; meat preservation
Sodium bicarbonate [NaHCO <sub>3</sub> ]		Manufacture of effervescent salts and beverages, artificial mineral water, baking powder; other sodium salts; pharmaceuticals; sponge rubber; gold and platinum plating; treating wool and silk; fire extinguishers; ceramics; prevention of timber mold; laboratory reagent; antacid; mouthwash; skin ointment; cleaning compound
Sodium carbonate [Na <sub>2</sub> CO <sub>3</sub> ·H <sub>2</sub> O]	7.3 x 10 <sup>9</sup> kgs (82) (total)	Medicine; photography; cleaning and boiler compounds; pH control of water; food additive; manufacture of sodium salts; glass; soap; washing wool; bleaching; analytical reagent; aluminum production; petroleum refining; pulp and paper
Sodium formate [HCOONa]	1.5 x 10 <sup>7</sup> kgs (72) (total)	Reducing agent; manufacture of formic acid and oxalic acid; organic chemicals; mordant; manufacture of sodium dithionite; complexing agent; analytical reagent; acidulant in textile and leather industry; precipitant; astringent
Sodium hydrogen phosphate [sodium phosphate, dibasic] [NaH <sub>2</sub> PO <sub>4</sub> ]	3.1 x 10 <sup>7</sup> lbs (72) (total)	Boiler water treatment; electroplating; dyeing; acid cleansers; baking powders; cattle food supplement; buffer, emulsifier, nutrient supplement in food; laboratory reagent; laxative; textile processing

(Continued)



TABLE B-15 (Continued)

<u>Solution Modifier/Polymerization Aid</u>	<u>Consumption†</u>	<u>Use</u>
<u>CHAIN TRANSFER AGENTS</u>		
Acetaldehyde [CH <sub>3</sub> CHO]	4.1 x 10 <sup>8</sup> kgs (79) (total)	Manufacture of acetic acid and acetic anhydride, n-butanol, 2-ethylhexanol, peracetic acid, pentaerythritol, pyridines, chloral, 1,3-butylene glycol, and trimethylolpropane; also as an intermediate; synthetic flavoring; plastics; synthetic rubber; silvering mirrors
Acetic acid [CH <sub>3</sub> COOH]	1.3 x 10 <sup>9</sup> kgs (82) (total)	Manufacture of acetic anhydride, cellulose acetate, vinyl acetate monomer, acetic esters and chloroacetic acid; production of plastics, rubber, pharmaceuticals, dyes, insecticides, photographic chemicals, etc.; food additive; latex coagulant; oil well acidizer; textile printing
Acetic anhydride [CH <sub>3</sub> (CO) <sub>2</sub> O]	5.0 x 10 <sup>8</sup> kgs (82) (total)	Cellulose acetate fibers and plastics; vinyl acetate; dehydrating and acetylating agent in production of pharmaceuticals, dyes, perfumes, explosives, etc.; aspirin; esterifying agent for food starch
Acetone [CH <sub>3</sub> COCH <sub>3</sub> ]	8.2 x 10 <sup>8</sup> kgs (82) (total)	Chemicals (methyl isobutyl ketone, methyl isobutyl carbinol, methyl methacrylate, bisphenol-A); paint, varnish and lacquer solvent; cellulose acetate, especially as spinning solvent; to clean and dry parts of precision equipment; solvent for potassium iodide and permanganate; delusterant for cellulose acetate fibers; specification testing of vulcanized rubber products; photographic films, stopping acetylene gas; hardening and dehydrating tissues; nail polish remover; food additive
Acetylene [HCCH]		Vinyl chloride and vinylidene chloride; vinyl acetate; welding and cutting metals; acrylonitrile; acrylates; per- and trichloroethylene, cyclooctatetraene, 1,4-butanediol; carbon black
Benzene [C <sub>6</sub> H <sub>6</sub> ]	3.5 x 10 <sup>9</sup> kgs (82) (total)	Ethylbenzene (for styrene monomer); dodecylbenzene (for detergents); cyclohexane (for nylon); phenol; nitrobenzene (for aniline); maleic anhydride; chlorobenzene; diphenyl; benzene hexachloride; anthraquinone; cumene; benzene sulfonic acid; solvent; antiknock gasoline
Bromoform [CHBr <sub>3</sub> ]		Intermediate in organic synthesis; geological assaying; solvent for waxes, grease and oils
n-Butane [C <sub>4</sub> H <sub>10</sub> ]	1.1 x 10 <sup>9</sup> kgs (75) (total)	Organic synthesis of acetic acid, butadiene and maleic anhydride; raw material for synthetic rubber and high octane liquid fuels; fuel for household and many industrial purposes; manufacture of ethylene; solvent; refrigerant; standby and enricher gas; propellant in aerosols; pure grades used in calibrating instruments; food additive
1-Butanethiol [C <sub>4</sub> H <sub>9</sub> SH]		Intermediate; solvent; pesticides
Butyl chloride [(CH <sub>3</sub> ) <sub>3</sub> CCl]		Organic synthesis

(Continued)

TABLE B-15 (Continued)

<u>Solution Modifier/Polymerization Aid</u>	<u>Consumption†</u>	<u>Use</u>
<u>CHAIN TRANSFER AGENTS (Continued)</u>		
t-Butyl mercaptan [2-methyl-2-propanethiol]	>4.5 x 10 <sup>2</sup> kgs (75) (total)	Intermediate; gas odorant for detecting leaks
Carbon tetrabromide [CBr <sub>4</sub> ]		Organic synthesis
Carbon tetrachloride [CCl <sub>4</sub> ]	3.2 x 10 <sup>8</sup> kgs (79) (total)	Refrigerants and propellants, especially the chlorofluorohydrocarbons; metal degreasing; agricultural fumigant; chlorinating organic compounds; production of semiconductors; solvent
Chlorobenzene [C <sub>6</sub> H <sub>5</sub> Cl]	1.5 x 10 <sup>8</sup> kgs (75) (total)	Phenol; chloronitrobenzene; aniline; solvent carrier for methylene diisocyanate; solvent; pesticide intermediate
Chloroform [CHCl <sub>3</sub> ]	1.6 x 10 <sup>8</sup> kgs (79) (total)	Fluorocarbon refrigerants and propellants; fluorocarbon plastics; solvent; analytical chemistry; fumigant; insecticides
Crotonaldehyde [2-butenal] [CH <sub>3</sub> CH:CHCHO]		Intermediate for n-butyl alcohol and 2-ethylhexyl alcohol; solvent; preparation of rubber accelerators; purification of lubricating oils; insecticides; tear gas; fuel-gas warning agent; organic synthesis; leather tanning; alcohol denaturant
Cyclohexane [C <sub>6</sub> H <sub>12</sub> ]	5.9 x 10 <sup>8</sup> kgs (82) (total)	Manufacture of caprolactam, hexamethylenediamine, cyclohexanone, cyclohexane, cyclohexyl chloride, and nitrocyclohexane; solvent for cellulose ethers, fats, oils, waxes, bitumens, resins, crude rubber; extracting essential oils; recrystallizing medium; paint and varnish remover; glass substitutes; vapor has been used as lubricant for steel; analytical chemistry
n-Decyl mercaptan [C <sub>10</sub> H <sub>21</sub> SH]		Intermediate; synthetic rubber processing
trans-Dichloroethylene [ClHC:CHCl]		General solvent for organic materials; dye extraction; perfumes; lacquers; thermoplastics; organic synthesis; medicine
Diethyl zinc [Zn(C <sub>2</sub> H <sub>5</sub> ) <sub>2</sub> ]		Organic synthesis; catalyst for polymerization of olefins; high energy aircraft and missile fuel; production of ethyl mercuric chloride
Dipentene [C <sub>10</sub> H <sub>16</sub> ]		Solvent for oleoresinous products, rosin, ester gum, alkyd resins, waxes, metallic soap dryers, rubber, etc.; rubber compounding and reclaiming; dispersing agent for oils, resins, resin-oil combinations, pigments and dryers; paints, enamels, lacquers and varnishes; general wetting and dispersing agent; printing inks; perfumes; floor waxes and furniture polishes; synthetic resins; polyterpenes; chemicals

(Continued)

TABLE B-15 (Continued)

<u>Solution Modifier/Polymerization Aid</u>	<u>Consumption†</u>	<u>Use</u>
<u>CHAIN TRANSFER AGENTS (Continued)</u>		
Dodecylmercaptan [C <sub>12</sub> H <sub>25</sub> SH]	>4.5 x 10 <sup>2</sup> kgs (75) (total)	Manufacture of synthetic rubber, plastics, pharmaceuticals, insecticides, fungicides, and styrene-butadiene rubber
Ethane [C <sub>2</sub> H <sub>6</sub> ]	3.6 x 10 <sup>9</sup> kgs (79) (total)	Petrochemicals (source of ethylene, halogenated ethanes); refrigerant; fuel
Ethanethiol [C <sub>2</sub> H <sub>5</sub> SH]	>9.1 x 10 <sup>2</sup> kgs (75) (total)	LPG odorant; adhesive stabilizer; chemical intermediate for acaricides, defoliants, pharmaceuticals and adhesives
Ethyl acetate [CH <sub>3</sub> COOC <sub>2</sub> H <sub>5</sub> ]	7.7 x 10 <sup>7</sup> kgs (75) (total)	General solvent in coatings and plastics; organic synthesis; smokeless powders; pharmaceuticals; artificial fruit essences; artificial leather; photographic films
Ethylbenzene [C <sub>6</sub> H <sub>5</sub> C <sub>2</sub> H <sub>5</sub> ]	3.0 x 10 <sup>9</sup> kgs (82) (total)	Intermediate in production of styrene and xylene; solvent and diluent; component of gasoline; manufacture of cellulose acetate
Ethylmercaptoacetate		
Formic Acid [See Acids]		
Hydrogen [H <sub>2</sub> ]		Production of ammonia and methanol; hydrocracking, hydroforming and hydrotreating of petroleum; hydrogenation of vegetable oils; hydrogenolysis of coal; reducing agent in organic synthesis and metallic ores; reducing atmospheres to prevent oxidation; as oxyhydrogen flame for high temperatures; atomic-hydrogen welding; instrument carrying balloons; making hydrochloric and hydrobromic acids; production of high-purity metals; coolant and propellant; fuel for nuclear rocket engines for hypersonic transport; missile fuel; cryogenic research
Isobutanol [(CH <sub>3</sub> ) <sub>2</sub> CHCH <sub>2</sub> OH]	6.5 x 10 <sup>7</sup> kgs (79) (total)	Organic synthesis; latent solvent in paints and lacquers; intermediate for amino coating resins; substitute for n-butyl alcohol; paint removers; fluorometric determinations; liquid chromatography; flavorings
Isobutane [(CH <sub>3</sub> ) <sub>2</sub> CHCH <sub>3</sub> ]	6.8 x 10 <sup>8</sup> kgs (75) (total)	Organic synthesis of propylene oxide and t-butyl alcohol; refrigerant; fuel; aerosol propellant; high octane gasoline (aviation fuel); synthetic rubber; instrument calibration fluid
Isopropanol [(CH <sub>3</sub> ) <sub>2</sub> CHOH]	5.9 x 10 <sup>8</sup> kgs (82) (total)	Manufacture of acetone and its derivatives; manufacture of glycerol and isopropyl acetate; solvent for essential and other oils, alkaloids, gums, resins, shellacs, etc.; latent solvent for cellulose derivatives; coatings solvent; deicing agent for liquid fuels; pharmaceuticals; perfumes; lacquers; extraction processes; dehydrating agent; preservative; quick drying inks; antiseptic; coupling agent in oil emulsions

(Continued)

TABLE B-15 (Continued)

<u>Solution Modifier/Polymerization Aid</u>	<u>Consumption†</u>	<u>Use</u>
<u>CHAIN TRANSFER AGENTS (Continued)</u>		
Isopropyl benzene [Cumene], [C <sub>6</sub> H <sub>5</sub> CH(CH <sub>3</sub> ) <sub>2</sub> ]	1.2 x 10 <sup>9</sup> kgs (82) (total)	Production of phenol, acetone, and alpha-methyl styrene; solvent for paints, enamels, lacquers, fats and resins
Lauryl mercaptan [C <sub>12</sub> H <sub>25</sub> SH]		Manufacture of synthetic rubber and plastics, also in synthesis of pharmaceuticals and in insecticides and fungicides; nonionic detergent
Mercaptoacetic acid [Thioglycolic acid], [HSCH <sub>2</sub> COOH]		Reagent for iron; manufacture of thioglycolates, permanent wave solutions and depilatories; vinyl stabilizer; manufacture of pharmaceuticals
2-Mercaptoethanol [HSCH <sub>2</sub> CH <sub>2</sub> OH]		Solvent for dyestuffs; intermediate for producing dyestuffs, pharmaceuticals, rubber, chemicals, flotation agents, insecticides, plasticizers, textile assistants and other compounds; water soluble reducing agent; biochemical reagent
Methane [CH <sub>4</sub> ]		Source of petrochemicals by conversion to hydrogen and carbon monoxide by steam cracking or partial oxidation, important products are methanol, acetylene, hydrogen cyanide; chlorination gives carbon tetrachloride, chloroform, methylene chloride and methyl chloride; in the form of natural gas, methane is used as a fuel, as a source of carbon black, and as a starting material for manufacture of synthetic proteins
Methanol [CH <sub>3</sub> OH]	3.3 x 10 <sup>9</sup> kgs (82) (total)	Manufacture of formaldehyde and dimethyl terephthalate; chemical synthesis (methyl amines, methyl chloride, methyl methacrylate, etc.); aviation fuel (for water injection); automotive antifreeze; solvent for nitrocellulose, ethyl cellulose, polyvinyl butyral, shellac, rosin, manila resin, dyes; denaturant for ethyl alcohol; dehydrator for natural gas; fuel for utility plants (methyl fuel); feedstock for manufacture of synthetic proteins by continuous fermentation; pharmaceuticals
Methylacetate		Paint remover compounds; lacquer solvent; intermediate; synthetic flavoring
2-Methyl-2-propanethiol [See t-Butyl mercaptan]		Intermediate; gas odorant for detecting leaks
α-Methyl styrene dimer		
2-Naphthalenethiol [RPA], [C <sub>10</sub> H <sub>7</sub> SH]		Peptizing agent for natural and synthetic rubber

(Continued)

TABLE B-15 (Continued)

<u>Solution Modifier/Polymerization Aid</u>	<u>Consumption†</u>	<u>Use</u>
<u>CHAIN TRANSFER AGENTS</u> (Continued)		
3-Pentanol [CH <sub>3</sub> CH <sub>2</sub> CHOHCH <sub>2</sub> CH <sub>3</sub> ]		Solvent; flotation agent; pharmaceuticals
Perchloroethylene [Cl <sub>2</sub> C:CCl <sub>2</sub> ]		Dry cleaning solvent; vapor-degreasing solvent; drying agent for metals and certain other solids; vermifuge; heat transfer medium; manufacture of fluorocarbons
Phenol [C <sub>6</sub> H <sub>5</sub> OH]		Phenolics resins; epoxy resins; nylon-6; 2,4-D; selective solvent for refining lubricating oils; adipic acid; salicylic acid; phenolphthalein; pentachlorophenol; acetophenetidine; picric acid; germicidal paints; pharmaceuticals; laboratory reagent; dyes and indicators; slimicide
Polybromobutenes		
Propane [C <sub>3</sub> H <sub>8</sub> ]	4.5 x 10 <sup>9</sup> kgs (79) (total)	Organic synthesis of ethylene and propylene; household and industrial fuel; manufacture of ethylene; extractant; solvent; refrigerant; gas enricher; aerosol propellant; mixture for bubble chambers
2-Propanethiol [C <sub>3</sub> H <sub>7</sub> SH]		Chemical intermediate; herbicide
Propylene [CH <sub>3</sub> CH:CH <sub>2</sub> ]	5.4 x 10 <sup>9</sup> kgs (82) (total)	Isopropyl alcohol, polypropylene, synthetic glycerol, acrylonitrile, propylene oxide, heptene, cumene, polymer gasoline; acrylic acid; vinyl resins; oxo chemicals
Sodium acetate [NaC <sub>2</sub> H <sub>3</sub> O <sub>2</sub> ] [See Buffers]		
Terpinolene [C <sub>10</sub> H <sub>16</sub> ]		Solvent for resins; essential oils; manufacture of synthetic resin, chemical derivatives
Thiophenol [C <sub>6</sub> H <sub>5</sub> SH]		Pharmaceutical synthesis
Toluene [C <sub>6</sub> H <sub>5</sub> CH <sub>3</sub> ]	6.8 x 10 <sup>9</sup> kgs (82) (total)	Aviation gasoline and high octane blending stock; benzene, phenol, and caprolactam; solvent for paints and coatings, gums, resins, most oils, rubber, vinyl organosols; diluent and thinner in nitrocellulose lacquers; adhesive solvent in plastic toys and model airplanes; chemicals (benzoic acid, benzyl and benzoyl derivatives, saccharin, medicines, dyes, perfumes); source of toluene diisocyanates; explosives (TNT); toluene sulfonates; scintillation counter

(Continued)

TABLE B-15 (Continued)

<u>Solution Modifier/Polymerization Aid</u>	<u>Consumption†</u>	<u>Use</u>
<u>CHAIN TRANSFER AGENTS (Continued)</u>		
Trichloroethylene [CHCl:CCl <sub>2</sub> ]	2.0 x 10 <sup>8</sup> kgs (75) (total)	Metal degreasing; extraction solvent for oils, fats, waxes; solvent dyeing; dry cleaning; refrigerant and heat exchange liquid; fumigant; cleaning and drying electronic parts; diluent in paint and adhesives; textile processing; chemical intermediate; aerospace operations (flushing liquid oxygen); pharmaceuticals
Triethylamine [(C <sub>2</sub> H <sub>5</sub> ) <sub>3</sub> N]		Catalytic solvent in chemical synthesis; accelerator activators for rubber; wetting, penetrating and waterproofing agents of quaternary ammonium types; curing and hardening of polymers; corrosion inhibitor; propellant
Water		
<u>COAGULANTS</u>		
Calcium chloride [CaCl <sub>2</sub> ]	8.2 x 10 <sup>8</sup> kgs (82) (total)	De-icing and dust control of roads; drilling muds; dustproofing, freezeproofing and thawing coal, coke, stone, sand, ore; concrete conditioning; paper and pulp industry; fungicides; refrigeration brines; drying and desiccating agent; sequestrant in foods; firming agent in tomato canning; tire weighting; pharmaceuticals; electrolytic cells
Hydrochloric acid [See Acids]		
Sodium chloride [NaCl]		Chemicals (sodium hydroxide, soda ash, hydrochloric acid, chlorine, metallic sodium); ceramic glazes; metallurgy; curing of hides; food preservative; mineral waters; soap manufacture (salting out); home water softeners; highway de-icing; regeneration of ion-exchange resins; photography; food seasoning; herbicides; fire extinguishing; nuclear reactors; mouthwash; medicine (heat exhaustion); salting out dyestuffs; supercooled solutions; single crystals for spectroscopy, ultraviolet and infrared transmission
Sulfuric acid [See Acids]		
<u>CROSSLINKING AGENTS</u>		
Dialdehyde starch		Thickening agent; tanning agent; binder for leaf tobacco; adhesives; wet-strength additive in paper
Diepoxides		

(Continued)

TABLE B-15 (Continued)

<u>Solution Modifier/Polymerization Aid</u>	<u>Consumption†</u>	<u>Use</u>
<u>CROSSLINKING AGENTS</u> (Continued)		
Dimethylolurea [CO(NHCH <sub>2</sub> OH) <sub>2</sub> ]		First stage of urea-formaldehyde resins; impregnating wood to increase hardness and fire resistance and to form self-binding laminations for plywood manufacture; permanent press fabrics
Dihydroxydiphenylsulfone [(C <sub>6</sub> H <sub>4</sub> OH) <sub>2</sub> SO <sub>2</sub> ]		Electroplating; phenolic resins; polyvinyl chloride; intermediate
Diisocyanates		
Divinyl benzene [C <sub>6</sub> H <sub>4</sub> (CH=CH <sub>2</sub> ) <sub>2</sub> ]		Polymerization monomer for special synthetic rubbers, drying oils, ion exchange resins, casting resins and polyesters
Divinyl sulfone [CH <sub>2</sub> :CHSO <sub>2</sub> CH=CH <sub>2</sub> ]		Monomer used in manufacture of polymers with diols, urea, and malonic esters; shrinkage control agents (textiles)
Glutaraldehyde	>2.3 x 10 <sup>3</sup> kgs (76) (total)	Intermediate for adhesives, sealants and electrical products; fixative for tissues; for crosslinking protein and polyhydroxy materials; tanning of soft leather; disinfectant; sterilizing agent
Glycol dimethacrylates		
Glyoxal [OHCCOH]	1.1 x 10 <sup>6</sup> kgs (75) (total)	Permanent press fabrics; dimensional stabilization of rayon and other fibers; insolubilizing agent for compounds containing polyhydroxyl groups (polyvinyl alcohol, starch and cellulosic materials); insolubilizing agent for proteins (casein, gelatin and animal glue); embalming fluids; leather tanning; paper coatings with hydroxyethylcellulose; reducing agent for dyeing textiles; intermediate for dihydroxydimethylol ethylene urea; tobacco treatment; crosslinking agent
Oxalic acid [HOCCOOH]		Automobile radiator cleanser; general metal and equipment cleaning; purifying agent and intermediate for many compounds; leather tanning; catalyst; laboratory reagent; stripping agent for permanent press resins; bleaching of textiles; rare-earth processing
Polyacrolein		
Trimethylolmelamine		First stage in making melamine resins
Trivinyl benzene		

(Continued)

TABLE B-15 (Continued)

<u>Solution Modifier/Polymerization Aid</u>	<u>Consumption†</u>	<u>Use</u>
<u>DEFOAMANTS</u>		
Aluminum oxide, hydrated [See Protective Colloids]		
Decanol $[\text{CH}_3(\text{CH}_2)_8\text{CH}_2\text{OH}]$		Plasticizers; detergents; synthetic lubricants; solvents; perfumes; flavorings
Dimethyl silicone (polymeric) $[\text{((CH}_3)_2\text{SiO)}_x]$		
Glycerol 12-hydroxyoleate [glyceryl monoricinoleate] $[\text{C}_6\text{H}_{13}\text{CHOHC}_{10}\text{H}_{18}\text{COOCH}_2\text{CHOHCH}_2\text{OH}]$		Nondrying emulsifying agent; solvent; plasticizer; in polishes, in cosmetics, in textile, paper and leather processing; low temperature lubricant; stabilizes latex paints against breakdown due to repeated freeze-thaw
Heptanol $[\text{CH}_3(\text{CH}_2)_5\text{CH}_2\text{OH}]$		Organic intermediate; solvent; cosmetic formulations
Hexanol $[\text{CH}_3(\text{CH}_2)_4\text{CH}_2\text{OH}]$		Pharmaceuticals; solvent; plasticizer; intermediate for textile and leather finishing agents
Octanol $[\text{CH}_3(\text{CH}_2)_6\text{CH}_2\text{OH}]$		Perfumery; cosmetics; organic synthesis; solvent; manufacture of high-boiling esters; antifoaming agent; flavoring agent
<u>EMULSIFIERS</u>		
Alkyl naphthalene sulfonic acid		
Ammonium oleate $[\text{C}_{17}\text{H}_{33}\text{COONH}_4]$		Emulsifying agent; cosmetics
Ammonium stearate $[\text{C}_{17}\text{H}_{35}\text{COONH}_4]$		Vanishing creams, brushless shaving creams, other cosmetic products; waterproofing of cements, concrete, stucco, paper, textiles, etc.
Cetyl trimethyl ammonium bromide $[\text{C}_{16}\text{H}_{33}(\text{CH}_3)_3\text{NBr}]$		Surface active agent; germicide
Cetyl pyridinium chloride $[\text{C}_{16}\text{H}_{33}\text{C}_5\text{H}_5\text{NCl} \cdot \text{H}_2\text{O}]$		Medicine
Dihexyl sodium sulfosuccinate		
Dodecyl benzene sulfonate		

(Continued)



TABLE B-15 (Continued)

<u>Solution Modifier/Polymerization Aid</u>	<u>Consumption†</u>	<u>Use</u>
<u>EMULSIFIERS</u> (Continued)		
Dodecyl benzene sodium sulfonate [C <sub>12</sub> H <sub>25</sub> C <sub>6</sub> H <sub>4</sub> SO <sub>3</sub> Na]		Synthetic detergent
Dodecyl pyridinium chloride		
Dresinate [Rosin soap]		Emulsifier; dispersant for soluble oils, cleaning compounds and other compositions
Ethyl crotonate [CH <sub>3</sub> CH:CHCOOC <sub>2</sub> H <sub>5</sub> ]		Solvent and softening agent; lacquers; organic synthesis
Isopropylamine dodecyl benzene sulfonate		
Lauric acid [CH <sub>3</sub> (CH <sub>2</sub> ) <sub>10</sub> COOH]		Alkyd resins; wetting agent; soaps; detergents; cosmetics; insecticides; food additive
Lauryl trimethyl quaternary ammonium bromide		
Lauroxypolyethylene glycol		
Myristic acid [CH <sub>3</sub> (CH <sub>2</sub> ) <sub>12</sub> COOH]		Soaps; cosmetics; synthesis of esters for flavors and perfumes; component of food-grade additives
Palmitic acid [CH <sub>3</sub> (CH <sub>2</sub> ) <sub>14</sub> COOH]	4.9 x 10 <sup>6</sup> kg (79) (total)	Manufacture of metallic palmitates; soaps; lube oils; waterproofing; food grade additives; cosmetic formulations; cleansing cream; intermediate for manufacture of esters
Polyoxyethylene oleate		
Potassium caprate		
Potassium caprylate		
Potassium dehydroabietate		
Potassium laurate [KOOC C <sub>11</sub> H <sub>23</sub> ]		Emulsifying agent; base for liquid soaps and shampoos
Potassium myristate		
Potassium oleate [C <sub>17</sub> H <sub>33</sub> COOK]		Textile soaps; emulsifying agent

(Continued)

TABLE B-15 (Continued)

<u>Solution Modifier/Polymerization Aid</u>	<u>Consumption†</u>	<u>Use</u>
<u>EMULSIFIERS (Continued)</u>		
Potassium palmitate		
Potassium sodium tartrate [KNaC <sub>4</sub> H <sub>4</sub> O <sub>6</sub> ·4H <sub>2</sub> O]		Sequestrant and general-purpose food additive; baking powders; medicine (cathartic); component for Fehling's solution
Potassium stearate [C <sub>17</sub> H <sub>35</sub> COOK]		Base for textile softeners
Sodium capryl sulfonate		
Sodium cetyl sulfate		
Sodium decyl sulfate		
Sodium decyl sulfonate		
Sodium dioctyl sulfosuccinate [C <sub>8</sub> H <sub>17</sub> OOCH <sub>2</sub> CH(SO <sub>3</sub> Na)COOC <sub>8</sub> H <sub>17</sub> ]		Food additive (processing aid in sugar industry, stabilizer for hydrophilic colloids); wetting agent; dispersant; emulsifier
Sodium dodecyl diphenyl ether disulfonate		
Sodium dodecyl sulfate [See Sodium lauryl sulfate]		
Sodium dodecyl sulfonate		
Sodium hexadecyl sulfate		
Sodium lauryl benzene sulfonate		
Sodium lauryl sulfate [NaC <sub>12</sub> H <sub>25</sub> SO <sub>4</sub> ], [Sodium dodecyl sulfate]	9.1 x 10 <sup>6</sup> kgs (79) (total)	Wetting agent in textiles; detergent in toothpaste; food additive and surfactant
Sodium naphthalene sulfonate [C <sub>12</sub> H <sub>7</sub> SO <sub>3</sub> Na]		Organic preparations; liquefying agent in animal glue preparations; naphthols
Sodium oleate [C <sub>17</sub> H <sub>33</sub> COONa]		Ore flotation; waterproofing textiles; emulsifier of oil/water systems; poisindex soap
Sodium resinate [Sodium abietate], [C <sub>19</sub> H <sub>29</sub> COONa]		Medicine; soap making; paper coating

(Continued)

TABLE B-15 (Continued)

<u>Solution Modifier/Polymerization Aid</u>	<u>Consumption†</u>	<u>Use</u>
<u>EMULSIFIERS (Continued)</u>		
Sodium stearate [NaOCC <sub>17</sub> H <sub>35</sub> ]		Waterproofing and gelling agent; toothpaste and cosmetics; stabilizer in plastics
Sodium tetradecyl sulfonate		
Stearic acid [CH <sub>3</sub> (CH <sub>2</sub> ) <sub>16</sub> COOH]	4.3 x 10 <sup>7</sup> kgs (75) (total)	Chemicals, especially stearates and stearate dryers; lubricants; soaps; pharmaceuticals and cosmetics; accelerator activator; dispersing agent and softener in rubber compounds; shoe and metal polishes; coatings; food packaging; impregnating plaster of paris; candles; release agent in baking goods and confectionaries
Stearyl trimethyl ammonium chloride		
Sulfonated castor oil [Turkey Red Oil]		Textiles; leather; manufacture of soaps; alizarin dye assistant; paper coatings
Triton X-100		
Triton X-200		
<u>FEED STREAM DESSICANTS</u>		
Alumina [See Protective Colloids]		
Aluminum alkyls		
Calcium hydride [CaH <sub>2</sub> ]		Reducing agent; drying agent; analytical reagent in organic chemistry; easily portable source of hydrogen; cleaner for blocked-up oil wells
Calcium sulfate (anhydrous) [CaSO <sub>4</sub> ]		Portland cement retarder; tile and plaster; source of sulfur and sulfuric acid; polishing powders; paints; paper; dyeing and calico printing; metallurgy (reduction of zinc minerals); drying industrial gases, solids and many organic liquids; nutrient supplement; in granulated form as solid conditioner; quick-setting cements, molds, and surgical casts; wallboard
Caustic Soda (solid) [See Bases (Sodium hydroxide)]		

(Continued)

TABLE B-15 (Continued)

<u>Solution Modifier/Polymerization Aid</u>	<u>Consumption†</u>	<u>Use</u>
<u>FEED STREAM DESSICANTS (Continued)</u>		
Copper, (metallic) [Cu]		Electrical wiring; switches, plumbing, heating, roofing, building construction; chemical and pharmaceutical machinery; alloys; electroplated protective coatings and undercoats for nickel, chromium, zinc, etc.; cooking utensils; corrosion resistant piping; insecticides; catalysts; antifouling paints; thermal and electrical composites
Molecular sieve		Drying gases and liquids; selective molecular separations; ion exchange; catalyst; chemical carriers; in gas chromatography; in petroleum to remove paraffins
Silica gel		Dehumidifying and dehydrating agent; air conditioning; drying of compressed air and other gases and liquids; recovery of natural gasoline from natural gas; bleaching of petroleum oils; catalyst and catalyst carrier; chromatography; anticaking agent in cosmetics and pharmaceuticals; in waxes to prevent slipping
Sodium, (metal) [Na]		Tetraethyl and tetramethyl lead; titanium reduction; sodium peroxide; sodium hydrides; polymerization catalyst for synthetic rubber; laboratory reagent; coolant in nuclear reactors; electric power cable (encased in polyethylene); non-glare lighting for highways; radioactive forms in tracer studies and medicine
Sodium hydroxide on asbestos [See Bases]		
<u>INERT GASES</u>		
Carbon dioxide [CO <sub>2</sub> ]	3.4 x 10 <sup>9</sup> kgs (82) (total)	Refrigeration; carbonated beverages; aerosol propellant; chemical intermediate; low temperature testing; fire extinguishing; inert atmospheres; municipal waste treatment; medicine; enrichment of air in greenhouses; fracturing and acidizing oil wells; mining; miscellaneous pressure source; hardening of foundry molds and cores; shielding gas for welding; cloud seeding, moderator in some nuclear reactors; immobilization for humane animal killings; special lasers; blowing agent
Nitrogen [N <sub>2</sub> ]	1.6 x 10 <sup>10</sup> kgs (82) (total)	Production of ammonia, acrylonitrile, cyanamide, cyanides, nitrides; inert gas for purging, blanketing and exerting pressure; electric and electronic industries; in-transit food refrigeration and freeze drying; pressurizing liquid propellants; quick-freezing foods; chilling in aluminum foundries; bright annealing of steel; cryogenic preservation; inert pressuring and blanketing gas in missiles; food antioxidant; source of pressure in oil wells; inflating tires

(Continued)

TABLE B-15 (Continued)

<u>Solution Modifier/Polymerization Aid</u>	<u>Consumption†</u>	<u>Use</u>
<u>PROTECTIVE COLLOIDS</u>		
Acrylic acid-2-ethylhexyl- acrylate copolymer		
Alumina [Al <sub>2</sub> O <sub>3</sub> ]	4.5 x 10 <sup>9</sup> kgs (75) (total)	Glass, ceramics, iron-free aluminum and aluminum salts; manufacture of activated alumina; base for organic lakes; flame retardant; rubber reinforcing agent; paper coating; filler; cosmetics; desiccant; abrasive; electrical insulation; dental cements; artificial gems; chromatography; refractory; catalyst
Barium persulfate [BaS <sub>2</sub> O <sub>8</sub> ·4H <sub>2</sub> O]		
Barium phosphate [BaHPO <sub>4</sub> ]		
Barium sulfate [BaSO <sub>4</sub> ]		Weighting mud in oil drilling; paper coatings; paints; filler and delustrant for textiles, rubber, linoleum, oilcloth, plastics and lithographic ink; base for lake colors; X-ray photography; opaque medium for gastrointestinal radiography; in battery plate expanders
Calcium persulfate		
Calcium phosphate [Ca <sub>3</sub> (PO <sub>4</sub> ) <sub>2</sub> ]		Ceramics; calcium acid phosphate; phosphorus and phosphoric acid; polishing powder; cattle foods; clarifying sugar syrups; medicine; mordant (dyeing textiles and Turkey Red); fertilizers; dentrifices; stabilizer for plastics; in meat tenderizers; in foods as anticaking agent, buffer, nutrient supplement; can remove strontium-90 from milk
Carboxymethyl cellulose		Detergents, soaps, food products (especially dietetic foods and ice cream, where it acts as a binder, thickener, suspending agent, and emulsion stabilizer); textile manufacturing (sizing); coating paper and paperboard to lower porosity; drilling muds; emulsion paints; protective colloid; pharmaceuticals; cosmetics
Clay [Kaolin], [Al <sub>2</sub> O <sub>3</sub> SiO <sub>2</sub> ]	1.5 x 10 <sup>8</sup> kgs (81) (in plastics)	Ceramic products; refractories; colloidal suspensions; oil-well drilling fluids; filler for rubber and plastics products; films; paper coatings; decolorizing oils; temporary molds; filtration; carrier in insecticidal sprays; catalyst support; cosmetics; cement; source of alumina
Ethyl cellulose		Hot melt adhesives and coatings for cables, paper, textiles, etc.; extrusion wire insulation; protective coatings; pigment-grinding bases; toughening agent for plastics; printing inks; molding powders; proximity fuses; vitamin preparations; casings for rocket propellants; food and feed additive

(Continued)

TABLE B-15 (Continued)

<u>Solution Modifier/Polymerization Aid</u>	<u>Consumption†</u>	<u>Use</u>
<u>PROTECTIVE COLLOIDS (Continued)</u>		
Gelatin		Photographic film; lithography; sizing; plastic compounds; textile and paper adhesives; cements; capsules for medicinals; matches; light filters; clarifying agent; desserts, jellies, etc.; culture medium for bacteria; blood plasma volume expander; microencapsulation
Gum accacia		
Hydroxyapatite [Ca <sub>10</sub> (PO <sub>4</sub> ) <sub>6</sub> (OH) <sub>2</sub> ]		
Hydroxyethyl cellulose [Cellosize]		Thickener and suspending agent; stabilizer for vinyl polymerization; retards evaporation of water in cements, mortars and concrete; binder in ceramic glazes; films and sheeting
Hydroxypropyl cellulose		Emulsifier; film former; protective colloid; stabilizer; suspending agent; thickener; food additive
Hydroxypropyl methyl cellulose		
Magnesium carbonate [MgCO <sub>3</sub> ]		Magnesium salts; heat insulation and refractory; rubber reinforcing agent; inks; glass; pharmaceuticals, dentrifices and cosmetics; free-running table salts; mineral waters; filtering medium; in foods as alkali, drying agent, color retention agent, anticaking agent and carrier; antacid and cathartic
Magnesium oxide [MgO]	1.1 x 10 <sup>8</sup> kgs (75) (total)	Refractories; polycrystalline ceramic for aircraft windshields; electrical insulation; pharmaceuticals and cosmetics; inorganic rubber accelerator; oxychloride and oxysulfate cements; paper manufacture; fertilizers; removal of sulfur dioxide from stack gases; adsorption and catalysis; semiconductors; pharmaceuticals; feed and food additives; wallboard; petroleum additives; casein glue; laxative; waste treatment
Magnesium persulfate		
Magnesium phosphate [(Mg) <sub>3</sub> (PO <sub>4</sub> ) <sub>2</sub> ·4H <sub>2</sub> O]		Dentrifice polishing agent; pharmaceutical antacid; adsorbent; stabilizer for plastics; food additive and supplement
Magnesium silicate [MgSiO <sub>3</sub> ]		Rubber filler; ceramics; glass; refractories; adsorbent for crude oil spills; manufacture of permanently dry resins and resinous compositions; paints, varnishes and paper (filler); animal and vegetable oil bleaching agent; odor absorbent; filter medium; catalyst and catalyst carrier; anticaking agent in foods

(Continued)

TABLE B-15 (Continued)

<u>Solution Modifier/Polymerization Aid</u>	<u>Consumption†</u>	<u>Use</u>
<u>PROTECTIVE COLLOIDS (Continued)</u>		
Methyl cellulose [Methocel]		Protective colloid in water-based paints to prevent flocculation of pigment; film and sheeting; binder in ceramic glazes; leather tanning, dispersing, thickening, and sizing agent; adhesive; food additive
Methyl(hydroxypropyl)cellulose		
Pectin		Jellies, foods, cosmetics, drugs; protective colloids; emulsifying agents; dehydrating agents
Polyacrylamide resin [(-CH <sub>2</sub> CHONH <sub>2</sub> -) <sub>x</sub> ]		Thickening agent; suspending agent; production of uranium; additive to adhesives
Polyvinyl alcohol [(-CH <sub>2</sub> CHOH-) <sub>x</sub> ]	5.6 x 10 <sup>8</sup> kgs (75) (total)	Many different products, see IPPEU Chapters 10 and 10a
Polyvinyl pyrrolidone [(-C <sub>4</sub> H <sub>7</sub> NO-) <sub>x</sub> ]	3.8 x 10 <sup>3</sup> kgs (75) (total)	Pharmaceuticals; blood plasma expander; cast films; adherent to glass, metals and plastics; complexing agent; detoxification of chemicals such as dyes, iodine, phenol, and poisonous drugs; tableting; photographic emulsions; cosmetics (hair spray, shampoo, hand cream, skin lotion); dentrifices; dyestripping; textile finishes; protective colloid; detergents; adhesives; beer and wine clarification
Potassium persulfate [K <sub>2</sub> S <sub>2</sub> O <sub>8</sub> ]		Bleaching; oxidizing agent; reducing agent for photography; antiseptic; soap manufacture; analytical reagent; polymerization promotor; pharmaceuticals; modification of starch; flour maturing agent; desizing of textiles
Sodium polyacrylate		
Starch [(-C <sub>6</sub> H <sub>9</sub> O <sub>5</sub> -) <sub>x</sub> ]		Adhesive; machine-coated paper; textile filler and sizing agent; beater additive in papermaking; gelling agent and thickener in foods; oil-well drilling fluids; filler in baking powders; fabric stiffener in laundering; urea-formaldehyde resin adhesive for particleboard and fiberboard; explosives; dextrin; chelating and sequestering agent in foods; indicator in analytical chemistry; anticaking agent in sugar; face powders; adherent and mold release agent; polymer base
Sulfonated polystyrene		
Talc [Mg <sub>3</sub> Si <sub>4</sub> O <sub>10</sub> (OH) <sub>2</sub> ] or [3MgO·4SiO <sub>2</sub> ·H <sub>2</sub> O]	1.5 x 10 <sup>8</sup> kgs (82) (total)	Ceramics; cosmetics and pharmaceuticals; filler and pigment in rubber, paints, soap, putty, plaster, oilcloth; adherent; dusting agent; lubricant; paper; slate pencils and crayons; electrical insulation; insecticide diluent; refractories; filtration
Zinc oxide [ZnO]		Diffusing pigment; accelerator; activator; reinforcing agent; ointments; pigment and mold-growth inhibitor in paints; ceramics; floor tile; glass; zinc salts; feed additive; dietary supplement; seed treatment; cosmetics; semiconductor; photoconductor; dental cement; flame retardant; antiseptic

(Continued)

TABLE B-15 (Continued)

<u>Solution Modifier/Polymerization Aid</u>	<u>Consumption†</u>	<u>Use</u>
<u>SOLVENTS</u>		
Acetic acid [See Chain Transfer Agents]		
Acetone [See Chain Transfer Agents]		
Amyl acetate [ $\text{CH}_3\text{COOC}_5\text{H}_{11}$ ]		Solvent for lacquers and paints; extraction of penicillin; photographic film; leather polishes; nail polish; warning odor; flavoring agent; printing and finishing fabrics; solvent for phosphors in fluorescent lamps
n-Amyl alcohol [ $\text{C}_5\text{H}_{11}\text{OH}$ ]		Raw material for pharmaceutical preparations; organic synthesis; solvent
Benzene [See Chain Transfer Agents]		
Benzyl alcohol [ $\text{C}_6\text{H}_5\text{CH}_2\text{OH}$ ]		Perfumes and flavors; photographic developer for color movie films; dyeing nylon filament; textiles and sheet plastic; solvent for dye-stuffs, cellulose esters, casein, waxes, etc.; heat sealing polyethylene films; intermediate for benzyl esters and ethers; local anesthetic; cosmetics, ointments, emulsions; ball point pen inks; stencil inks; embedding material in microscopy
Bromobenzene [ $\text{C}_6\text{H}_5\text{Br}$ ]		Solvent; motor fuels; top-cylinder compounds; crystallizing solvent; organic synthesis
n-Butane [ $\text{C}_4\text{H}_{10}$ ], [See Chain Transfer Agents]		
1-Butanol [ $\text{CH}_3(\text{CH}_2)_2\text{CH}_2\text{OH}$ ]	3.5 x 10 <sup>8</sup> kgs (79) (total)	Preparation of esters, especially butyl acetate and glycol ethers; fats, waxes and coatings; plasticizers; dyeing assistant; hydraulic fluids; detergent for emulsions; dehydrating agent (by azeotropic distillation); intermediate for pharmaceuticals and plasticizers; "butylated" melamine resins; glycol ethers; butyl acrylate; flavoring ingredient
2-Butanol [sec-Butyl Alcohol], [ $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_3$ ]		Preparation of methyl ethyl ketone; solvent; organic synthesis of flotation agents, flavors, perfumes, dyestuffs and wetting agents; industrial cleansers; paint removers; hydraulic brake fluids; polishes
2-Butanone [Methyl ethyl ketone], [ $\text{CH}_3\text{CH}_2\text{COCH}_3$ ]		Solvent in fabric coating, adhesives, varnishes, lacquers, pharmaceuticals, cosmetics, ink, and hardwood pulping; manufacture of terephthalic acid; lube oil dewaxing by solvent extraction

(Continued)



TABLE B-15 (Continued)

<u>Solution Modifier/Polymerization Aid</u>	<u>Consumption†</u>	<u>Use</u>
<u>SOLVENTS (Continued)</u>		
t-Butyl alcohol [(CH <sub>3</sub> ) <sub>3</sub> COH]		Alcohol denaturant; solvent for pharmaceuticals; dehydration agent; perfumery; chemical intermediate in perfumes, flavors, resins, chlorinated derivatives; octane improver in gasoline
t-Butyl benzene [C <sub>10</sub> H <sub>14</sub> ]		Organic synthesis; polymerization solvent; polymer linking agent
Carbon tetrachloride [See Chain Transfer Agents]		
Chlorobenzene [See Chain Transfer Agents]		
Chloroform [See Chain Transfer Agents]		
Cumene [Isopropyl benzene], [See Chain Transfer Agents]		
Cyclohexane [See Chain Transfer Agents]		
Cyclohexanone [C <sub>6</sub> H <sub>10</sub> O]	4.0 x 10 <sup>8</sup> kgs (79) (total)	Organic synthesis, particularly adipic acid and caprolactam; polyvinyl chloride and its copolymers, and methacrylate ester polymers; wood stains; paint and varnish removers; spot removers; degreasing of metals; polishes; leveling agent in dyeing and delustering silk; lube oil additive; general solvent
n-Decane [CH <sub>3</sub> (CH <sub>2</sub> ) <sub>8</sub> CH <sub>3</sub> ]		Organic synthesis; solvent; standardized hydrocarbon; jet fuel research
o-Dichlorobenzene [C <sub>6</sub> H <sub>4</sub> Cl <sub>2</sub> ]	2.6 x 10 <sup>7</sup> kgs (79) (total)	Manufacture of 3,4-dichloraniline; solvent for a wide range of organic materials and for oxides of nonferrous metals; solvent carrier in production of toluene diisocyanate; dye manufacture; fumigant and insecticide; degreasing hides and wool; metal polishes; industrial odor control
1,2-Dichloroethane [ClCH <sub>2</sub> CH <sub>2</sub> Cl]	4.5 x 10 <sup>9</sup> kgs (79) (total)	Vinyl chloride intermediate (Wulff process); solvent; lead scavenger in antiknock gasoline; paint, varnish and finish removers; metal degreasing; soaps and scouring compounds; wetting and penetrating agents; organic synthesis of trichloroethylene, perchloroethylene and methyl chloroform; ore flotation
Diesel fuel, hydrogenated		

(Continued)

TABLE B-15 (Continued)

<u>Solution Modifier/Polymerization Aid</u>	<u>Consumption†</u>	<u>Use</u>
<u>SOLVENTS (Continued)</u>		
Dimethyl acetamide [CH <sub>3</sub> CON(CH <sub>3</sub> ) <sub>2</sub> ]		Solvent for plastics, resins, gums and electrolytes; intermediate; catalyst; paint remover; high purity solvent for crystallization and purification
Dimethyl formamide [HCON(CH <sub>3</sub> ) <sub>2</sub> ]		Solvent for vinyl resins and acetylene, butadiene, and acid gases; catalyst in carboxylation reactions; organic synthesis
Dimethyl sulfoxide [(CH <sub>3</sub> ) <sub>2</sub> SO]		Solvent for polymerization and cyanide reactions; analytical reagent; spinning polyacrylonitrile and other synthetic fibers; industrial cleaners, pesticides, paint stripping; hydraulic fluids; preservation of cells at low temperatures; diffusion of drugs, etc. into blood-stream by topical application; medicine; plant pathology and nutrition; pharmaceutical products
p-Dioxane [OCH <sub>2</sub> CH <sub>2</sub> OCH <sub>2</sub> CH <sub>2</sub> ]		Solvent for cellulose and wide range of organic products; lacquers; paints; varnishes; paint and varnish removers; wetting and dispersing agent in textile processing, dye baths, stain and printing compositions; cleaning and detergent preparations; cements; cosmetics; deodorants; fumigants; emulsions; polishings compositions; stabilizer for chlorinated solvents; scintillation counter
Dodecane [CH <sub>3</sub> (CH <sub>2</sub> ) <sub>10</sub> CH <sub>3</sub> ]		Solvent; organic synthesis; distillation chaser; jet fuel research
Ethanol [C <sub>2</sub> H <sub>5</sub> OH]	4.5 x 10 <sup>8</sup> kgs (82) (total)	Solvent for resins, fats, oils, fatty acids, hydrocarbons, alkali hydroxides; extractive medium; manufacture of intermediates, organic derivatives (especially acetaldehyde), dyes, synthetic drugs, esters, elastomers, detergents, cleaning solutions, surface coatings, cosmetics, pharmaceuticals, explosives, antifreeze; beverages; antiseptics; medicine; gasoline additive; yeast growth medium
Ethylene dichloride [See 1,2-Dichloroethane]		
2-Ethoxyethyl acetate [CH <sub>3</sub> CO <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> OCH <sub>2</sub> CH <sub>3</sub> ]		
Ethyl acetate [CH <sub>3</sub> COOC <sub>2</sub> H <sub>5</sub> ]	7.7 x 10 <sup>7</sup> kgs (75) (total)	General solvent in coatings and plastics; organic synthesis; smokeless powders; pharmaceuticals; artificial fruit essences; photographic films and plates; artificial silk; synthetic flavor
Ethylbenzene [C <sub>6</sub> H <sub>5</sub> C <sub>2</sub> H <sub>5</sub> ]		Intermediate in production of styrene; solvent; fuel component; manufacture of cellulose acetate; solvent for mixed xylenes

(Continued)

TABLE B-15 (Continued)

<u>Solution Modifier/Polymerization Aid</u>	<u>Consumption†</u>	<u>Use</u>
<u>SOLVENTS</u> (Continued)		
Furfuryl alcohol [ $C_4H_3OCH_2OH$ ] or [ $OCH:CHCH:CCH_2OH$ ]		Wetting agent; furan polymers; corrosion-resistant sealants and cements, foundry cores; modified urea-formaldehyde polymers; penetrant; solvent for dyes and resins; flavoring; propellant
Heptane [ $CH_3(CH_2)_5CH_3$ ]		Standard for octane rating determinations; anesthetic; solvent; organic synthesis; preparation of laboratory reagents
Hexane [ $CH_3(CH_2)_4CH_3$ ]	$1.7 \times 10^8$ kgs (79) (total)	Solvent, especially for vegetable oils, low temperature thermometers; calibrations; polymerization reaction medium; paint diluent; alcohol denaturant; determination of refractive index of materials
Isobutane [See Chain Transfer Agents]		
Isobutyl alcohol [See Chain Transfer Agents]		
Isobutyric acid [ $(CH_3)_2CHCOOH$ ]		Manufacture of esters for solvents, flavors and perfume bases; disinfecting agent; varnish; deliming hides; tanning agent
Isooctane [ $(CH_3)_3CCH_2CH(CH_3)_2$ ]		Organic synthesis; solvent; motor fuel; used with normal heptane to prepare standard mixtures to determine antiknock property of gasoline
Isopentane [ $(CH_3)_2CHCH_2CH_3$ ]	$7.2 \times 10^8$ kgs (72) (total)	Solvent; manufacture of chlorinated and alcohol derivatives; blowing agent for polystyrene; antiknock gasoline additive
Isopropyl alcohol [See Chain Transfer Agents]		
Isopropyl benzene [See Chain Transfer Agents (Cumene)]		
Kerosene		Rocket and jet engine fuel; domestic heating; solvent; insecticidal sprays; diesel and tractor fuel
Methanol [See Chain Transfer Agents]		
Methyl acetate [See Chain Transfer Agents]		

(Continued)

TABLE B-15 (Continued)

<u>Solution Modifier/Polymerization Aid</u>	<u>Consumption†</u>	<u>Use</u>
<b>SOLVENTS (Continued)</b>		
Methylene chloride [ $\text{CH}_2\text{Cl}_2$ ]	$2.3 \times 10^8$ kgs (75) (total)	Paint removers; propellant for aerosol sprays; solvent degreasing; plastics processing; blowing agent in foams; solvent extraction; refrigerant; fire extinguisher compositions; solvent for photographic film, synthetic fibers and cellulose acetate
Methyl ethyl ketone [See 2-Butanone]		
Methyl isobutyl ketone [ $(\text{CH}_3)_2\text{CHCH}_2\text{COCH}_3$ ]		Solvent for paints, varnishes, nitrocellulose lacquers; manufacture of methyl amyl alcohol; extraction processes, including extraction of uranium from fission products; organic synthesis; denaturant for alcohol
Methyl isobutyrate		
Mineral oil		
Naphtha		Source of gasoline, special naphthas, petroleum chemicals, especially ethylene; solvent; xylene; cumene; nitrated, for incorporation in dynamite
Nitrobenzene [ $\text{C}_6\text{H}_5\text{NO}_2$ ]	$4.3 \times 10^8$ kgs (79) (total)	Manufacture of aniline; solvent for cellulose ethers; modifying esterification of cellulose acetate; ingredient in metal polishes and shoe polishes; manufacture of benzidine, quinoline, azobenzene, etc.
Pentane [ $\text{CH}_3(\text{CH}_2)_3\text{CH}_3$ ]	$3.3 \times 10^7$ kgs (79) (total)	Artificial ice manufacture; low temperature thermometers; solvent extraction processes; blowing agent in plastics; pesticide; propellant; refrigerant; fuel; cleaning and degreasing
3-Pentanone [Diethyl ketone], [ $\text{C}_2\text{H}_5\text{COC}_2\text{H}_5$ ]		Medicine; organic synthesis
2-Propanol [Isopropyl alcohol], [See Chain Transfer Agent]		
n-Propyl acetate [ $\text{C}_3\text{H}_7\text{OOCCH}_3$ ]		Flavoring agents; perfumery; solvent for nitrocellulose and other cellulose derivatives; natural and synthetic resins; lacquers; plastics; organic synthesis; laboratory reagent
Pyridine [ $\text{N}(\text{CH})_3\text{CN}$ ]		Synthesis of vitamins, drugs, dyes, explosives and disinfectants; solvent; waterproofing; rubber chemicals; denaturant for alcohol and antifreeze mixtures; dyeing assistant in textiles; fungicides; analytical chemistry

(Continued)

TABLE B-15 (Continued)

<u>Solution Modifier/Polymerization Aid</u>	<u>Consumption†</u>	<u>Use</u>
<u>SOLVENTS (Continued)</u>		
1,1,2,2-Tetrafluorodichloroethane [CClF <sub>2</sub> CClF <sub>2</sub> ], [Freon 114]		Solvent; fire extinguishers; refrigerant and air conditioner; aerosol propellants; blowing agent; dielectric fluid
Tetrahydrofuran [CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> O]	5.4 x 10 <sup>7</sup> kgs (79) (total)	Solvent for natural and synthetic resins, particularly vinyls; in top-coating solutions, polymer coating, cellophane, protective coatings, adhesives, magnetic tapes, printing inks, etc.; Grignard reactions, lithium aluminum hydride reductions and polymerizations; chemical intermediate and monomer; solvent for histological techniques
Toluene [See Chain Transfer Agents]		
Triethylamine [See Chain Transfer Agents]		
2,2,4-Trimethylpentane [See Isooctane]		
Water		
Xylene [C <sub>6</sub> H <sub>4</sub> (CH <sub>3</sub> ) <sub>2</sub> ]	2.4 x 10 <sup>9</sup> kgs (82) (total)	Aviation gasoline; protective coatings; solvent for alkyd resins, lacquers, enamels, rubber cements; synthesis of organic chemicals
<u>THICKENERS</u>		
Glycerol [C <sub>3</sub> H <sub>5</sub> (OH) <sub>3</sub> ]		Alkyd resins; explosives; ester gums; pharmaceuticals; perfumery; plasticizer for regenerated cellulose; cosmetics; food stuffs; conditioning tobacco; liqueurs; solvent; printer's ink rolls; polyurethane polyols; emulsifying agent; rubber stamp and copying inks; binder for cements and mixes; paper coatings and finishes; special soaps; lubricant and softener; bacteriostat; penetrant; hydraulic fluid; humectant
Glycols		
Polyglycols		

†Annual Consumption is presented parenthetically for the most recent year available.

TABLE B-16. ULTRAVIOLET STABILIZERS  
CONSUMPTION AND OTHER USES

<u>Ultraviolet Stabilizers</u>	<u>Consumption†</u>	<u>Use</u>
<b>BENZOPHENONES</b>		
4-Alkoxy-2-hydroxybenzophenone [Uvinul 410]		
4-Butoxy-2,2'-dihydroxybenzophenone [Cyasorb UV287]		
5-Chloro-2-hydroxybenzophenone [C <sub>6</sub> H <sub>5</sub> COC <sub>6</sub> H <sub>5</sub> OHC1]		Light absorber
Cyasorb UV 2126 [Polymer of 4-(2-Acryloyloxyethoxy)-2-hydroxybenzophenone]		UV absorber for plastics in automotive, greenhouses, home siding, and solar applications
4-Decyloxy-2-hydroxybenzophenone		
2,4-Dibenzoyl resorcinol [DBR]		Light absorber
2,4-Dihydroxybenzophenone [C <sub>6</sub> H <sub>5</sub> COC <sub>6</sub> H <sub>3</sub> (OH) <sub>2</sub> ]		Ultraviolet absorber in polymers
2,2'-Dihydroxy-4,4'-dimethoxybenzophenone [Uvinul D-49]		
2,2'-Dihydroxy-4-methoxybenzophenone [Cyasorb UV 24]		
2,2'-Dihydroxy-4(octoxy)benzophenone [Cyasorb UV 314]		
Disodium 2,2'-dihydroxy-4,4'-dimethoxy-5,5'-disulfobenzophenone [Uvinul DS-49]		
4-Dodecyloxy-2-hydroxybenzophenone [Rylex D]		Ultraviolet light inhibitor in plastics
4(Heptyloxy)-2-hydroxybenzophenone [Unistat 247]		

(Continued)

TABLE B-16 (Continued)

<u>Ultraviolet Stabilizers</u>	<u>Consumption†</u>	<u>Use</u>
<u>BENZOPHENONES (Continued)</u>		
2-Hydroxy-4-acryloxyethoxybenzo- phenone		
2-Hydroxy-4(-2-ethylhexoyl)benzo- phenone		
2-Hydroxy-4-isooctoxybenzophenone		
2-Hydroxy-4-methoxybenzophenone [Uvinul M 40], [Cyasorb UV9]		
2-Hydroxy-4-methoxy-5-methylbenzo- phenone [Unistat 2211]		
2-Hydroxy-5-methoxybenzophenone		
2-Hydroxy-1-methoxy-5-sulfobenzo- phenone [Uvinul MS-40]		
2-Hydroxy-4-methoxy-5-sulfobenzo- phenone [Cyasorb UV-284]		
2-Hydroxy-4-n-octyloxybenzophenone [Cyasorb UV 531]		
Mark 1535		
Permyl B100 [Substituted phenone]		
Resyn 78-6121 [low molecular weight alkyl methacrylate-substituted benzophenone]		
2,2',4,4'-Tetrahydroxybenzophenone [Uvinul D-50]		
Uvinul 490 [mixture of 2,2'-Dihy- droxy-4,4'-dimethoxybenzophenone]		

(Continued)

TABLE B-16 (Continued)

<u>Ultraviolet Stabilizers</u>	<u>Consumption†</u>	<u>Use</u>
<u>BENZOTRIAZOLES</u>		
2(3'-t-Butyl-2'-hydroxy-5'-methyl-phenyl)-5-chlorobenzotriazole [Tinuvin 326]		
2(3',5'-Di-t-butyl-2'-hydroxy-phenyl)-5-chlorobenzotriazole [Tinuvin 327]		
2(2'-Hydroxy-3',5-di-t-amyl-phenyl)benzotriazole [Tinuvin 328]		
2(2'-Hydroxy-3',5'-di-t-butyl-phenyl)benzotriazole [Tinuvin 320]		
2(2'-Hydroxy-5'-methylphenyl)-benzotriazole [Tinuvin P]		
2(2'-Hydroxy-5-t-octylphenyl)-benzotriazole		
Mark 446		
<u>NICKEL ORGANICS</u>		
Bis(2,2'-thiobis(4-t-octylphenylato))nickel [See Nickel bis(octylphenyl sulfide)]		
Mark 1306A		
Negopex A		
Nickel bis(O-ethyl(3,5-di-t-butyl-4-hydroxybenzyl))phosphonate [Irgastab 2002]		
Nickel bis(octylphenyl sulfide) [Ferro AM-101 and AM-105]		

(Continued)



TABLE B-16 (Continued)

<u>Ultraviolet Stabilizers</u>	<u>Consumption†</u>	<u>Use</u>
<u>NICKEL ORGANICS (Continued)</u>		
Nickel dibutyldithiocarbamate [Ni(SC(S)N(C <sub>4</sub> H <sub>9</sub> ) <sub>2</sub> ) <sub>2</sub> ]		Antioxidant for rubbers
Nickel diisobutyldithiocarbamate [ISO Butyl Niclate]		
Nickel dimethyldithiocarbamate [Methyl Niclate]		
10% Nickel Hex-Cem		
10071 PE MB		
Sanduvor NPU [Phenylmethyl- decanoyl pyrazolate-Nickel]		
(2,2'-Thiobis(4-t-octylpheno- lato))-n-butylamine nickel [Cyasorb UV 1084]		
UV Chek AM-205		
<u>MISCELLANEOUS, ACRYLATES</u>		
Butyl 2-cyano-3-methyl-3-(p-meth- oxyphenyl)acrylate [UV Absorber 317]		
N-(β-Cyano-β-carbomethoxyvinyl)- 2-methylindoline [UV Absorber 340]		
Ethyl 2-cyano-3,3-diphenylacrylate [Uvinul N-35]		
2-Ethylhexyl 2-cyano-3,3-diphenyl- acrylate [Uvinul N-539]		
Methyl-2-carbomethoxy-3-(p-meth- oxyphenyl)acrylate [Cyasorb UV-1988]		

(Continued)

TABLE B-16 (Continued)

<u>Ultraviolet Stabilizers</u>	<u>Consumption†</u>	<u>Use</u>
<u>MISCELLANEOUS, ACRYLATES</u> (Continued)		
Methyl 2-cyano-3-methyl-3-(p-methoxyphenyl)acrylate [UV Absorber 318]		
<u>MISCELLANEOUS, SALICYLATES</u>		
p-t-Butyl phenyl salicylate		Light absorber
10316 COP MP [Proprietary]		
Dipropylene glycol salicylate [C <sub>3</sub> H <sub>6</sub> (OCC <sub>6</sub> H <sub>4</sub> OH)OC <sub>3</sub> H OH]		Ultraviolet light-screening agents; protective coating; plasticizer
2-Ethylhexyl salicylate		
p-Octylphenyl salicylate [C <sub>6</sub> H <sub>4</sub> OHCOOC <sub>6</sub> H <sub>4</sub> C <sub>8</sub> H <sub>17</sub> ] [Inhibitor OPS]		Prevents photooxidation of polyolefins
Phenyl salicylate [C <sub>6</sub> H <sub>4</sub> OHCOOC <sub>6</sub> H <sub>5</sub> ]		Medicine; preservative; UV absorber in plastics, waxes, polishes, suntan oils; laboratory reagent
p-(1,1,3,3-Tetramethylbutyl)phenyl salicylate [See Octylphenyl salicylate]		
<u>OTHER MISCELLANEOUS AND PROPRIETARY</u>		
AST-1001		
Barium metaborate, modified		
Bis(2,2,6,6-tetramethyl-4-piperidinoxy)sebacate		
Carbon black		Reinforcing agent, pigment for cements, ceramic ware, mortar, inks, linoleum, surface coatings, crayons, polishes, carbon paper, soap, etc.; in insulating compositions; liquid-air explosives; matches; fertilizers; furnace lutes; lubricating compositions; carbon brushes

(Continued)

TABLE B-16 (Continued)

<u>Ultraviolet Stabilizers</u>	<u>Consumption†</u>	<u>Use</u>
<u>OTHER MISCELLANEOUS AND PROPRIETARY</u> (Continued)		
Chimassorb 944 [Hindered amine]		
C-HDPE-2764 [Hindered amine]		
C-PPR-8004 [Hindered amine]		
C-PPR-8005 [Hindered amine]		
Copper iodide		Feed additive; in table salt as source of dietary iodide
2,4-Dibenzoyl resorcinol		
3,5-Di-t-butyl-p-hydroxybenzoic acid		
2,4-Di-t-butylphenyl-3,5-di-t-butyl-4-hydroxybenzoate [UV Chek AM-340]		
2,4-Di-t-butylphenyl-3,5-di-t-butyl-4-hydroxybenzoate		
Dimethyl-2-(4-methoxybenzylidene) malonate		
Good-rite UV 3034 [Hindered amine]		
N-Hexadecyl-3,5-di-t-butyl-4-hydroxybenzoate		
Hexamethyl phosphoric triamide [Inhibitor HPT]		UV inhibitor for PVC; chemosterilant for insects; promoting stereospecific reactions; specialty solvent
Hostavin N20		
2-(2-Hydroxy-4-methoxybenzoyl) benzoic acid [Cyasorb UV 207]		
Manganese iodide		
Parabolix-100		

(Continued)

TABLE B-16 (Continued)

<u>Ultraviolet Stabilizers</u>	<u>Consumption†</u>	<u>Use</u>
<u>OTHER MISCELLANEOUS AND PROPRIETARY</u> (Continued)		
PDI-0199 [benzophenone/hindered amine mixture]		
10328 PE MB, 10359 PE MB		
40375 PP MP [Hindered amine]		
Resorcinol monobenzoate [C <sub>6</sub> H <sub>5</sub> COOC <sub>6</sub> H <sub>4</sub> OH]		Noncoloring ultraviolet inhibitor for plastics; color stabilizer in cosmetics
Sanduvor EPU [oxalanitide]		
Sanduvor VSU [oxalanilide]		
Tinuvin 144 [stearically hindered amine]		
Tinuvin 770 [stearically hindered amine]		
Tinuvin 662 [hindered amine]		
Titanium dioxide	2.0 x 10 <sup>8</sup> kgs (82) (in plastics)	53% in paints, varnishes, lacquers; 21% in paper; 10% in plastics; 3% in elastomers; 2.5% in ceramics; 2% in floor covering; 2% in printing inks; 1% in coated fabrics and textiles; 1% in roofing granules; 4.5% for other pigments
UV-Chek 541A		
UV-Check AM-595		
Vanstay L [phosphate-type stabilizer]		
Zinc oxide		Diffusing pigment; accelerator; activator; reinforcing agent; ointments; pigment and mold-growth inhibitor in paints; ceramics; floor tile; glass; zinc salts; feed additive; dietary supplement; seed treatment; cosmetics; semiconductor; photoconductor

†Annual Consumption is presented parenthetically for the most recent year available.

# APPENDIX C. TOXICOLOGICAL AND WORKER EXPOSURE CONCERNS FOR PLASTICS ADDITIVES

## TABLE C-1. ANTIOXIDANTS

<u>Antioxidant</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>PHENOLICS</u>				
1,2-Bis(3,5-di-t-butyl-4-hydroxyhydrocinnamoyl)hydrazine [Irganox MD 1024]				[32687-78-8]
2,6-Bis(1-methylheptadecyl)-p-cresol				
4-((4,6-Bis(octylthio)-s-triazin-2-yl)-amino)-2,6-di-t-butylphenol				[991-84-4]
Bisphenol A [(CH <sub>3</sub> ) <sub>2</sub> C(C <sub>6</sub> H <sub>4</sub> OH) <sub>2</sub> ]	Oral, rat LD <sub>50</sub> :4040 mg/kg	Teratogen Primary Irritant		[80-05-7]
Butylated Bisphenol A [Vanox 1004]				
Butylated hydroxyanisole [BHA], [(CH <sub>3</sub> ) <sub>3</sub> CC <sub>6</sub> H <sub>3</sub> OH(OCH <sub>3</sub> )]	Moderate Oral, rat LD <sub>50</sub> :2200 mg/kg	Ingestion Tumorigen Mutagen Teratogen		[25013-16-5]
Butylated hydroxytoluene [BHT], [DBPC], [Di-t-butyl-p-cresol]	Oral, mouse LD <sub>50</sub> :1040 mg/kg	Tumorigen Mutagen Teratogen Primary Irritant	10 mg/m <sup>3</sup> TWA (recommended)	[128-37-0]
Butylated octylated phenol				
Butylated reaction product of p-cresol and dicyclopentadiene				
Butylated styrenated cresols				
4,4'-Butylidenebis(6-t-butyl-m-cresol) [Santowhite powder]				[32509-66-3]
Cyclohexylidenebis(2-cyclohexylphenol)				
2,6-Di-t-butyl dimethyl amino-p-cresol [Ethanox 703], [(C <sub>4</sub> H <sub>9</sub> ) <sub>2</sub> C <sub>6</sub> H <sub>2</sub> OH(CH <sub>2</sub> N(CH <sub>3</sub> ) <sub>2</sub> )]				
2,6-Di-t-butyl-4-ethylphenol				

(Continued)

TABLE C-1 (Continued)

<u>Antioxidant</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>PHENOLICS</u> (Continued)				
3,5-Di-t-butyl-4-hydroxybenzyl alcohol [Antioxidant 754]	Oral, rat LD <sub>50</sub> : 7 gm/kg	Mutagen		[88-26-6]
3,5-Di-t-butyl-4-hydroxyhydrocinnamic acid, 1,3,5-tris(2-hydroxyethyl)-s- triazine-2,4,6(1H,3H,5H)-trione [Good-Rite 3125]				[34137-09-2]
2,6-Di-t-butyl methylamino-p-cresol				
2,4-Di(α-methylbenzyl)-4-methylphenol				[1817-68-1]
Dioctadecyl(3,5-di-t-butyl-4-hydroxy- benzyl)phosphonate [Irganox 1093]				[3135-18-0]
Hexamethylenebis(3,5-di-t-butyl hydroxy- cinnamate) [Irganox 259]				[35074-77-2]
N,N-Hexamethylenebis-(3,5-di-t-butyl-4- hydroxyhydrocinnamamide) [Irganox 1098]				[23128-74-7]
2(-4-Hydroxy-3,5-t-butylanilino)-4,6-bis- (n-octylthio)1,3,5-triazine [Irganox 565]				
4-Hydroxymethyl-2,6-di-t-butylphenol	May be Toxic	Ingestion		
3-Methyl-6-t-butylphenol/crotonaldehyde condensate				
2,2-Methylenebis(6-t-butyl-4-ethylphenol) [Cyanox 425]	Oral, rat LD <sub>50</sub> : >15 gm/kg	Mild Eye and Skin Irritant		[88-24-4]
2,2'-Methylenebis(6-t-butyl-4-methyl- phenol) [See 2,2'-Methylenebis(4-methyl- 6-t-butylphenol)]				

(Continued)

TABLE C-1 (Continued)

<u>Antioxidant</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>PHENOLICS (Continued)</u>				
4,4'-Methylenebis(2,6-di-t-butylphenol) [Ethanox 702]				
2,2'-Methylenebis(4-methyl-6-t-butyl phenol) [CAO 5], [Bis(2-Hydroxy-3-t- butyl-5-methyl phenyl)methane], [Cyanox 2246]	Oral, rat LD <sub>50</sub> :4880 mg/kg	Primary Irritant		[119-47-1]
2,2-Methylenebis(6(1-methylcyclohexyl)-p- cresol) [Nonox WSP]				[77-62-3]
2,2-Methylenebis(4-methyl-6-nonylphenol) [Naugawhite]				
4-Methyl-2-(1-methylcyclohexyl)phenol [Nonox WSL]				[16152-65-1]
Octadecyl 3,5-di-t-butyl-4-hydroxyhydro- cinnamate [Irganox 1076]				[2082-79-3]
Phenol alkylated with approximately 1:4 ratio of 2,3-Benzofuran and Indene [Nevastain A], [Nevastain B]				
Tetrakis(methylene(3,5-di-t-butyl-4- hydroxyhydrocinnamate))methane [Irganox 1010]	Nontoxic			[6683-19-8]
4,4'-Thiobis(6-t-butyl-m-cresol) [Santonox]	Intraperitoneal, mouse LD <sub>50</sub> :50 mg/kg		10 mg/m <sup>3</sup> TWA (recommended)	[96-69-5]
4,4'-Thiobis(6-t-butyl-o-cresol) [Antioxidant 736], [Santonox R]	Oral, mammal LD <sub>50</sub> :6340 mg/kg			[96-66-2]
2,2'-Thiobis(6-t-butyl)-4-methylphenol) [CAO 4]				[90-66-4]

(Continued)

TABLE C-1 (Continued)

<u>Antioxidant</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>PHENOLICS (Continued)</u>				
4,4'-Thiobis(2-t-butyl)5-methylphenol [see 4,4'-Thiobis(6-t-butyl-m-cresol)]	Intraperitoneal, mouse LD <sub>50</sub> : 50 mg/kg		10 mg/m <sup>3</sup> TWA 20 mg/m <sup>3</sup> STEL (recommended)	[96-69-5]
Thiodiethylenebis(3,5-di-t-butyl-4-hydroxy)hydrocinnamate [Irganox 1035]				[41484-35-9]
2,2'-(3,5-Trimethylhexylidene)bis(4,6-dimethyl phenol) [Nonox WSO]				[7292-14-0]
1,3,5-Trimethyl-2,4,6-tris(3,5-di-t-butyl-4-hydroxybenzyl)benzene [Ethyl 330]	Low Oral, rat TD <sub>Lo</sub> : 1100 mg/kg Toxic Effect: Reproductive; Developmental	Teratogen		[1790-70-2]
1,3,5-Tris(4-t-butyl-3-hydroxy-2,6-dimethylbenzyl)1,3,5-triazine-2,4,6-(1H,3H,5H)-trione [Cyanox 1790]	Oral, rat LD <sub>50</sub> : >10 gm/kg			[40601-76-1]
1,3,5-Tris(3,5-di-t-butyl-4-hydroxyphenyl)methyl-1,3,5-triazine-2,4,6-(1H,3H,5H)-trione [Good-Rite 3114]				[27676-62-6]
Tris(2-methyl-4-hydroxy-5-t-butylphenyl)-butane [Topanol CA]				[1843-03-4]
<u>AROMATIC AMINES</u>				
N-(1,3-Dimethylbutyl)-N'-phenyl-1,4-benzendiamine [Vulkanox 4020]				[793-24-8]
Di-8-naphtha-p-phenylenediamine	Oral, mouse TD <sub>Lo</sub> : 31 gm/kg/78W-I Toxic Effect: Equivalent Tumorigenic Agent	Tumorigen Primary Irritant		[93-46-9]
4-Isopropyl-N'-phenyl-p-phenylenediamine [Vulkanox 1040 NA]	Oral, rat LD <sub>50</sub> : 555 mg/kg	Primary Irritant (Dermatitis)		[101-72-4]

(Continued)



TABLE C-1 (Continued)

<u>Antioxidant</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>AROMATIC AMINES (Continued)</u>				
4-(1-Methyl-1-phenylethyl)-N-(4-(1-methyl-1-phenylethyl)phenyl)benzenamine [Naugard 445]				[10081-67-1]
<u>THIOESTERS</u>				
Dicetyl thiodipropionate				
Dilauryl thiodipropionate	Nontoxic Generally Recognized as Safe Eye, rabbit 500 mg/24H Toxic Effect: Moderate Irritation	Eye Irritant		[123-28-4]
Dimethyl thiodipropionate				
Dimyristyl thiodipropionate				
Distearyl thiodipropionate	Low			[693-36-7]
Ditridecyl thiodipropionate	Oral, rat LD <sub>50</sub> : >10 gm/kg			
Mixed lauryl-stearyl thiodipropionate [Cyanox 1212]	Generally Recognized as Safe			
Pentaerythritol tetrakis( -lauryl thiodipropionate)				
<u>PHOSPHORUS COMPOUNDS</u>				
Alkylaryl bisphenol phosphite				
Bis-tridecyl phosphite				
2-t-Butyl-a(3-t-butyl-4-hydroxyphenyl)-p- cumenyl-bis(p-nonylphenyl)phosphite				

(Continued)

TABLE C-1 (Continued)

<u>Antioxidant</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>PHOSPHORUS COMPOUNDS (Continued)</u>				
Dibutyl phosphite	Oral, rat LD <sub>50</sub> : 3200 mg/kg	Primary Irritant Moderate Fire Risk		[1809-19-4]
Didecyl phosphite				
Disodecyl pentaerythritol phosphite [Weston 600]				
Disodecyl pentaphosphite				
Dilauryl phosphite [(C <sub>12</sub> H <sub>25</sub> O) <sub>2</sub> PHO]				
Dimethyl phosphite [(CH <sub>3</sub> O) <sub>2</sub> PHO]	Oral, rat LD <sub>50</sub> : 4250 mg/kg	Tumorigen Primary Irritant		[868-85-9]
Diocetyl phosphite [(C <sub>8</sub> H <sub>17</sub> O) <sub>2</sub> PHO]				
Dioleyl phosphite				[25088-57-7]
Diphenyl decyl phosphite [(C <sub>6</sub> H <sub>5</sub> O) <sub>2</sub> POC <sub>10</sub> H <sub>21</sub> ]				
Diphenyl isodecyl phosphite [Weston DPDP]				
Diphenyl phosphite [Weston DPP]				
Distearyl pentaerythritol diphosphite [Weston 618]				[3806-34-6]
Ditetradecyl phosphite [Dimystyl phosphite]				
Isooctyl diphenyl phosphite [Mark C]				[26401-27-4]
Octyl diphenyl phosphite				
Phenyl didecyl phosphite [C <sub>6</sub> H <sub>5</sub> OP(OC <sub>10</sub> H <sub>21</sub> ) <sub>2</sub> ]				

(Continued)

TABLE C-1 (Continued)

<u>Antioxidant</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>PHOSPHORUS COMPOUNDS (Continued)</u>				
Tetrakis(2,4-di-t-butyl)phenyl-(1,1-bi-phenyl)-4,4'-diylbisphosphite [Sandostab P-EPQ]				[38613-77-3]
Tributyl phosphite [(C <sub>4</sub> H <sub>9</sub> O) <sub>3</sub> P]	Low Oral, rat LD <sub>50</sub> : 3000 mg/kg	Primary Irritant		[102-85-2]
Tridecyl phosphite [(C <sub>10</sub> H <sub>21</sub> O) <sub>3</sub> P]				
Triisodecyl phosphite [Weston TDP]				
Trisononylphenyl phosphite				
Trisooctyl phosphite [Weston TIOP]				
Triisopropyl phosphite [(CH <sub>3</sub> ) <sub>2</sub> CH] <sub>3</sub> PO <sub>3</sub>	Intraperitoneal, mouse LD <sub>50</sub> : 500 mg/kg	Mutagen		[116-17-6]
Trilauryl phosphite [Weston TLP]	Probably Low			
Trilauryl trithiophosphite [Weston TLTP]	Probably Low			
Trimethyl phosphite [(CH <sub>3</sub> O) <sub>3</sub> P]		Moderate Fire Risk		[121-45-9]
Trioctyl phosphite [Tris-2-ethylhexyl phosphite], [C <sub>4</sub> H <sub>9</sub> CH(C <sub>2</sub> H <sub>5</sub> )CH <sub>2</sub> O] <sub>3</sub> P]	Low Intraperitoneal, mouse LD <sub>50</sub> : 5234 mg/kg			[3028-88-4]
Triphenyl phosphite [(C <sub>6</sub> H <sub>5</sub> O) <sub>3</sub> P]	Oral, rat LD <sub>50</sub> : 1600 mg/kg	Primary Irritant		[101-02-0]
Tri(polynonylphenyl)phosphite [Polygard]	Oral, rat LD <sub>50</sub> : 20 gm/kg			[58968-53-9]
Tris(2-chloroethyl)phosphite [(ClC <sub>2</sub> H <sub>4</sub> O) <sub>3</sub> P]	Intraperitoneal, mouse LD <sub>50</sub> : 250 mg/kg			[140-08-9]

(Continued)

TABLE C-1 (Continued)

<u>Antioxidant</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>PHOSPHORUS COMPOUNDS</u> (Continued)				
Tris(2,4-di-t-butylphenyl)phosphite				[31570-04-4]
Trisnonylphenyl phosphite				[63981-08-8]
Trisnonylphenyl phosphite/formaldehyde polymer [Wytox 438]				[56889-59-9]
Tristearyl phosphite [Weston TSP]				
<u>MISCELLANEOUS, QUINONES</u>				
p-Benzoquinone [C <sub>6</sub> H <sub>4</sub> O <sub>2</sub> ]	Toxic Intravenous, rat LD <sub>50</sub> : 25 mg/kg	Tumorigen Mutagen Inhalation Strong Skin Irritant	0.01 ppm TWA	[106-51-4]
2,5-Di-t-butylhydroquinone	Oral, rat LD <sub>50</sub> : 800 mg/kg			[88-58-4]
Hydroquinone [C <sub>6</sub> H <sub>4</sub> (OH) <sub>2</sub> ]	Toxic Oral, rat TD <sub>LO</sub> : 2500 mg/kg Toxic Effect: Repro- ductive, Fertility	Tumorigen Mutagen Teratogen Ingestion Inhalation Irritant	2 mg/m <sup>3</sup> TWA	[123-31-9]
Hydroquinone monomethyl ether [CH <sub>3</sub> OC <sub>6</sub> H <sub>4</sub> OH]	Moderately Toxic Oral, rat LD <sub>50</sub> : 1600 mg/kg	Eye Contact		[150-76-5]
Mono-t-butylhydroquinone [C <sub>6</sub> H <sub>3</sub> (OH) <sub>2</sub> C(CH <sub>3</sub> ) <sub>3</sub> ]	Oral, rat LD <sub>50</sub> : 800 mg/kg			[1948-33-0]
Tolhydroquinone [CH <sub>3</sub> C <sub>6</sub> H <sub>3</sub> (OH) <sub>2</sub> ]				
<u>MISCELLANEOUS, OTHER</u>				
Distearyl disulfide				
Mark 1475 [N-(2H,1,2,4-triazol-5-yl)- salicylamide]		Mutagen		[36411-52-6]

(Continued)

TABLE C-1 (Continued)

<u>Antioxidant</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>MISCELLANEOUS</u> (Continued)				
Thermolite 31 [Bis(isooctyloxycarbonyl-methylthio)dibutylstannate]	Oral, rat LD <sub>50</sub> : 500 mg/kg		0.1 mg(Sn)/m <sup>3</sup> TWA	[25168-24-5]
Thiodipropionic acid [HOOCCH <sub>2</sub> SCH <sub>2</sub> CH <sub>2</sub> COOH]				
Zinc dibutyldithiocarbamate [Zn(SC(S)N(C <sub>4</sub> H <sub>9</sub> ) <sub>2</sub> ) <sub>2</sub> ]	Toxic	Ingestion Inhalation		[136-23-2]

TABLE C-2. ANTISTATIC AGENTS  
TOXICOLOGICAL AND WORKER EXPOSURE CONCERNS

<u>Antistatic Agent</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>AMINES</u>				
Bis(hydroxyethyl) coco amine		Primary Irritant		
Bis(hydroxyethyl) tallow amine	Oral LD <sub>50</sub> : 1850 mg/kg	Primary Irritant		[37241-10-4]
Ethoxylated amines				
Octadecyl amine salt of stearic acid				
2,2'-(Octadecylimino)bisethanol	LD <sub>50</sub> : 2500 mg/kg			[10213-78-2]
Polyoxyethylene alkyl amine	Oral, rat LD <sub>50</sub> : 1.26 gm/kg	Eye Irritant		
Triethanolamine				
Triethanolamine salt of octadecyl phosphonic acid				
<u>QUATERNARY AMMONIUM COMPOUNDS</u>				
AHCO C-330	Oral, rat LD <sub>50</sub> : 1.43 gm/kg	Eye Irritant Respiratory Irritant		
Baraquat CME [N-Cetyl-n-ethyl morpholinium etho sulfate]	Oral, rat LD <sub>50</sub> : 1.68 ml/kg	Eye Irritant		[78-21-4]
Benzyl hexadecyldimethyl ammonium chloride				[122-18-9]
N,N-Bis(2-hydroxyethyl)-N-(3-dodecyloxy-2-hydroxypropyl) methylammonium methosulfate	Oral, rat LD <sub>50</sub> : 4.1 ml/kg	Skin Irritant Eye Contact		
(Carboxymethyl)dimethyl-octadecyl ammonium hydroxide				[820-66-6]

(Continued)

TABLE C-2 (Continued)

<u>Antistatic Agent</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>QUATERNARY AMMONIUM COMPOUNDS</u> (Continued)				
(Carboxymethyl)hexadecyl- dimethyl ammonium hydroxide				[693-33-4]
Dihexadecyldimethyl ammonium chloride	Subcutaneous, mouse TD <sub>50</sub> : 50 mg/kg Toxic Effect: Repro- ductive Developmental			[1812-53-9]
Dimethyldioctadecyl ammonium chloride	Oral, rat LD <sub>50</sub> : 7 gm/kg			[107-64-2]
Diocetyldimethyl ammonium bromide				
(3-(Dodecyloxy)2-hydroxypropyl) bis(2-hydroxyethyl)methyl ammonium methyl sulfate				[18602-17-0]
Salt of Guanidine and octa- decyltrimethyl ammonium chloride				
(2-Hydroxyethyl)dimethyl(3- stearamidopropyl) ammonium nitrate				[2764-13-8]
(3-Lauramidopropyl)trimethyl- ammonium methyl sulfate	Oral, rat LD <sub>50</sub> : 1.8 mg/kg	Eye Contact Skin Irritant		
Stearamidopropyldimethyl-2- hydroxyethylammonium dihydro- gen phosphate	Oral, rat LD <sub>50</sub> : 1 gm/kg (35% solution)	Eye Contact		
Stearamidopropyldimethyl-2- hydroxyethylammonium nitrate	Oral, rat LD <sub>50</sub> : 320 mg/kg	Eye Contact		
Tetrabutyl ammonium bromide				
Trimethyl ammonium methyl- sulfate				

(Continued)

TABLE C-2 (Continued)

<u>Antistatic Agent</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>ANIONICS</u>				
Didodecyl hydrogen phosphate				[39464-66-9]
$\alpha$ -Dodecyl- $\omega$ -hydroxypoly(oxy-1,2-ethanediyl)phosphate				[39464-66-9]
Garfac RS 710				[12674-36-1]
$\alpha$ -Nonylphenyl- $\omega$ -hydroxypoly(oxy-1,2-ethanediyl) phosphate				[51811-79-1]
Potassium alkyl phosphate	Oral, rat LD <sub>50</sub> : 6.6 gm/kg	Eye Irritant Mild Skin Irritant	50 ppm TLV (skin)	
Sodium dodecylbenzene sulfonate				
$\alpha$ -Tridecyl- $\omega$ -hydroxypoly(oxy-1,2-ethanediyl) phosphate				[9046-01-9]
<u>MISCELLANEOUS</u>				
Butyl stearate	Low Oral, rat LD <sub>50</sub> : >32 gm/kg			[123-95-5]
Glycerol				[56-81-5]
Glycerol monostearate [1-mono-stearin]	Intraperitoneal, mouse LD <sub>50</sub> : 200 mg/kg			[31566-31-1] [123-94-4]
Polyethylene glycol hexadecyl ether				
Polyethylene glycol monodecyl ether				[9002-92-0]
Polyethylene glycol 200 monolaurate	Oral, rat LD <sub>50</sub> : >10 gm/kg		10 mg/m <sup>3</sup> TLV (recommended)	[9005-64-5]

(Continued)



TABLE C-2 (Continued)

<u>Antistatic Agent</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>MISCELLANEOUS</u> (Continued)				
Polyethylene glycol monostearate	Intravenous, mouse LD <sub>50</sub> : 250 mg/kg			[9004-99-3]
Sorbitan, dodecanoate, poly-(oxy-1,2-ethanediyl) derivatives				[9062-73-1]
Tris(isooctadecanoato-O)-(2-propanolato)titanium				[61417-49-0]
<u>INORGANICS</u>				
Aluminum flakes	Nontoxic	Fine Powders- Fire Risk	10 mg/mg <sup>3</sup> TWA	[7429-90-8]
Carbon black	Intravenous, mouse LD <sub>50</sub> : 440 mg/kg		3.5 mg/m <sup>3</sup> TWA	[1333-86-4]
Lithium chloride				

TABLE C-3. BLOWING AGENTS AND OTHER ADDITIVES FOR FOAMED PLASTICS  
TOXICOLOGICAL AND WORKER EXPOSURE CONCERNS

<u>Blowing Agent/Foam Modifier</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>PHYSICAL BLOWING AGENTS</u>				
Acetone [ $\text{CH}_3\text{COCH}_3$ ]	Inhalation, humans $\text{TC}_{10}$ : 500 ppm Toxic Effect: Eye Irritation	Primary Irritant Inhalation Dangerous Fire Risk Mutagen	1000 ppm TWA	[67-64-1]
Air				
Ammonia [ $\text{NH}_3$ ]	Toxic Oral, rat $\text{LD}_{50}$ : 350 mg/kg	Inhalation Irritant Moderate Fire Risk Mutagen	50 ppm	[7664-41-7]
Benzene [ $\text{C}_6\text{H}_6$ ]	Toxic Inhalation, humans $\text{TC}_{10}$ : 100 ppm/10Y-1 Toxic Effect: Carcinogen	Dangerous Fire Risk Ingestion Inhalation Skin Absorption Mutagen Teratogen Carcinogen Primary Irritant	10 ppm TWA	[71-43-2]
Carbon dioxide [ $\text{CO}_2$ ]	Inhalation, humans $\text{LC}_{10}$ : 100,000 ppm/1H		5000 ppm TWA	[124-38-9]
Dichlorodifluoromethane [see Freon 12]				
1,2-Dichloroethane [ $\text{ClCH}_2\text{CH}_2\text{Cl}$ ]	Toxic Oral, humans $\text{TD}_{10}$ : 428 mg/kg Toxic Effect: Gastroin- testinal Tract	Mutagen Tumorigen Ingestion Inhalation Primary Irritant Skin Absorption Strong Eye and Skin Irritant	50 ppm TWA 100 ppm Ceiling	[107-06-2]
Dichloromethane [see Methylene Chloride]				
Ethyl alcohol [ $\text{C}_2\text{H}_5\text{OH}$ ]	Oral, rat $\text{LD}_{50}$ : 14 gm/kg	Depressant Drug Dangerous Fire Risk	1000 ppm TWA	[64-17-5]

(Continued)

TABLE C-3 (Continued)

<u>Blowing Agent/Foam Modifier</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>PHYSICAL BLOWING AGENTS</u> (Continued)				
Freon 11 [Trichlorofluoromethane]	Inhalation, rat LC <sub>Lo</sub> :10 pph/30 min.	Inhalation Skin Contact	1000 ppm TWA	[75-69-4]
Freon 11A				
Freon 11B [Trichlorofluoromethane]				
Freon 12 [Dichlorodifluoromethane]	Inhalation, rat LC <sub>50</sub> :80 pph/30 min.	Inhalation	1000 ppm TWA	[75-71-8]
Freon 22				
Freon 113 [1,1,2-trichlorotrifluoroethane], [Cl <sub>2</sub> CFCClF <sub>2</sub> ]	Oral, rat LD <sub>50</sub> :43 gm/kg	Inhalation Nervous System Disorders Primary Irritant	1000 ppm TWA	[76-13-1]
Freon 114 [Dichlorotetrafluoroethane], [Cl <sub>2</sub> CFCF <sub>3</sub> ]	Moderately Toxic Inhalation, rat LC <sub>50</sub> :72 pph/30 min.	Inhalation	1000 ppm TWA	[76-14-2]
Freon HE [Blend of Freon 11]				
n-Heptane [CH <sub>3</sub> (CH <sub>2</sub> ) <sub>5</sub> CH <sub>3</sub> ]	Moderately Toxic Intravenous, mouse LD <sub>50</sub> :222 mg/kg	Inhalation Dangerous Fire Risk	500 ppm TWA	[142-82-5]
n-Hexane [CH <sub>3</sub> (CH <sub>2</sub> ) <sub>4</sub> CH <sub>3</sub> ]	Moderately Toxic Inhalation, humans TC <sub>Lo</sub> :5000 ppm/10M Toxic Effect: Central Nervous System; Behavioral Symptoms	Primary Irritant Ingestion Inhalation Dangerous Fire Risk Teratogen	500 ppm TWA	[110-54-3]
Isopentane [2-methylbutane], [(CH <sub>3</sub> ) <sub>2</sub> CHCH <sub>2</sub> CH <sub>3</sub> ]	Low	Dangerous Fire Risk	350 mg/m <sup>3</sup> TWA 1800 mg/m <sup>3</sup> /15M ceiling (recommended)	[78-78-4]

(Continued)

TABLE C-3 (Continued)

<u>Blowing Agent/Foam Modifier</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>PHYSICAL BLOWING AGENTS (Continued)</u>				
Isopropyl alcohol [ $\text{CH}_3\text{CH}(\text{OH})\text{CH}_3$ ]	Oral, man $\text{LD}_{50}$ : 8600 mg/kg Inhalation, humans $\text{TC}_{\text{LO}}$ : 400 ppm Toxic Effect: Irritation	Primary Irritant Ingestive Inhalation Dangerous Fire Risk Tumorigen Mutagen	400 ppm TWA	[67-63-0]
Isopropyl ether	Toxic Oral, rat $\text{LD}_{50}$ : 8470 mg/kg	Inhalation Irritant Dangerous Fire Risk	500 ppm TWA	[108-20-3]
K-11 [See Freon 11]				
Methylene chloride [ $\text{CH}_2\text{Cl}_2$ ]	Moderately Toxic Oral, rat $\text{LD}_{50}$ : 167 mg/kg	Inhalation Ingestion Skin Absorption Primary Irritant Tumorigen Teratogen Mutagen	500 ppm TWA 1000 pm Ceiling	[75-09-2]
Nitrogen [ $\text{N}_2$ ]				
n-Pentane [ $\text{CH}_3(\text{CH}_2)_3\text{CH}_3$ ]	Inhalation, humans $\text{TC}_{\text{LO}}$ : 90,000 ppm/5M Toxic Effect: Central Nervous System	Narcotic Dangerous Fire and Explosion Risk	1000 ppm TWA	[109-66-0]
Perchloroethylene [ $\text{Cl}_2\text{C:CCl}_2$ ]	Moderately Toxic Inhalation, humans $\text{TC}_{\text{LO}}$ : 96 ppm/7H Toxic effect: Systemic	Irritant to Eyes and Skin Positive Animal Carcinogen	100 ppm TWA 200 ppm Ceiling	[127-18-4]
Toluene [ $\text{C}_6\text{H}_5\text{CH}_3$ ]	Toxic Inhalation, rat $\text{TC}_{\text{LO}}$ : 4000 ppm/4H	Primary Irritant Ingestion Inhalation Skin Absorption Dangerous Fire Risk Tumorigen Mutagen Teratogen	200 ppm TWA 300 ppm Ceiling	[108-88-3]

(Continued)

TABLE C-3 (Continued)

<u>Blowing Agent/Foam Modifier</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>PHYSICAL BLOWING AGENTS</u> (Continued)				
Trichloroethylene	Toxic Inhalation, humans TD <sub>LO</sub> : 6900 mg/m <sup>3</sup> /10H Toxic Effect: Central Nervous System	Inhalation Positive Animal Carcinogen Mutagen Teratogen Primary Irritant	100 ppm TWA 200 ppm Ceiling	[79-01-6]
Trichlorofluoromethane [see Freon 11]				
Trichloromethane [Chloroform], [CHCl <sub>3</sub> ]	Toxic Inhalation, humans TC <sub>LO</sub> : 1000 mg/m <sup>3</sup> /1Y Toxic Effect: Systemic; Behavioral Symptoms; Gas- trointestinal Tract	Ingestion Inhalation Narcotic Suspected Carcinogen Tumorigen Mutagen Teratogen Primary Irritant	50 ppm TWA	[67-66-3]
1,1,2-Trichlorotrifluoroethane [see Freon 113]				
Water [H <sub>2</sub> O]				
<u>CHEMICAL BLOWING AGENTS</u>				
Ammonium bicarbonate [NH <sub>4</sub> HCO <sub>3</sub> ]	Intravenous, mouse LD <sub>50</sub> : 96 mg/kg	Fumes are Irritant		[506-87-6]
Ammonium carbonate [(NH <sub>4</sub> )HCO <sub>3</sub> ·NH <sub>2</sub> OCONH <sub>4</sub> ]	Intravenous, mouse LD <sub>50</sub> : 245 mg/kg	Fumes are Irritant		[1066-33-7]
1,1'-Azobiscyclohexanecarbonitrile				
Azobisformamide [Azodicarbonamide], [ABPA], [AZ], [H <sub>2</sub> NCON:CONH <sub>2</sub> ]	Nontoxic	Respirable Dust		[123-77-3]
Azobisformamide, nonplateout				
Azobis(isobutyronitrile) [AZDN]	Toxic Oral, mouse LD <sub>50</sub> : 700 mg/kg	Ingestion		[78-67-1]

(Continued)

TABLE C-3 (Continued)

<u>Blowing Agent/Foam Modifier</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>CHEMICAL BLOWING AGENTS (Continued)</u>				
Barium azodicarboxylate			0.5 mg(Ba)/m <sup>3</sup> TWA	
Benzene disulfonyl dihydrazide				
Benzene sulfonyl hydrazide [BSH]				
1,3-Bis(o-xenyl)triazene				
2-Butylazo-2-hydroxy-5-methylhexane [Lucel 7-Azo]				
2-Butylazo-2-methoxy-5-methylpentane [Lucel 135]				
Celogen CB [Proprietary hydrazide]				
Celogen HT-500 [Modified hydrazine derivative]				
Celogen HT-550 [Hydrazine derivative]				
Celogen XP-100 [Sulfonyl hydrazide type]				
Citric acid [HOC(CH <sub>2</sub> CO <sub>2</sub> H) <sub>2</sub> CO <sub>2</sub> H]				
Diazoaminobenzene [1,3-Diphenyl- triazene]	Oral, rat TD <sub>Lo</sub> :1480 mg/kg/59D Toxic Effect: Equivocal Tumorigenic Agent	Explosive at 150°C or greater		[136-35-6]
N,N'-di-t-butylazobisformamide				
N,N'-di-n-decylazobisformamide				
N,N'-Dinitroso-N,N'-dimethyltere- phthalamide [N,N'-dimethyl-N,N'- dinitrosoterephthalamide], [NTA]				
Dinitrosopentamethylenetetramine	Oral, rat LD <sub>50</sub> :940 mg/kg	Mutagen		[101-25-7]

(Continued)

TABLE C-3 (Continued)

<u>Blowing Agent/Foam Modifier</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>CHEMICAL BLOWING AGENTS</u> (Continued)				
Diphenylsulfon-3,3'-disulfonyl hydrazide				
N,N'-Diphenylazobisformamide				
Ethylene carbonate [OC(CH <sub>2</sub> ) <sub>2</sub> ]	Low Oral, rat LD <sub>50</sub> : 10 gm/kg	Combustible Primary Irritant		[96-49-1]
Expandex 150 [5-phenyltetrazole analog]				
Expandex 175 [5-phenyltetrazole analog]				
Picel AF-100				
KemTec 350				
KemTec 500				
N-Nitroguanidine	Toxic	Explosive		
Nitropore ATA				
N-Nitrourea		Severe Explosion Risk		
Oxamic acid [NH <sub>2</sub> COCO <sub>2</sub> H]				
p,p'-Oxybis(benzene sulfonyl hydrazide) [OBSH]		Mutagen		[29221-52-1] [80-51-3]
p,p'-Oxybis(benzene sulfonyl semicarbazide) [OBSC]				
5-Phenyl tetrazine				
5-Phenyl tetrazole				[86-93-1]
Potassium borohydride [KBH <sub>4</sub> ]	Toxic	Ingestion		

(Continued)

TABLE C-3 (Continued)

<u>Blowing Agent/Foam Modifier</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>CHEMICAL BLOWING AGENTS (Continued)</u>				
Salicylaldehyde hydrazone				
Silicon oxyhydride				
Sodium bicarbonate [NaHCO <sub>3</sub> ]	Low Oral, rat LD <sub>50</sub> : 4220 mg/kg	Primary Irritant		[144-55-8]
Sodium borohydride [NaBH <sub>4</sub> ]	Oral, rat LD <sub>50</sub> : 160 mg/kg	Reacts with Water Dangerous Fire Risk		[16940-66-2]
3,3'-Sulfonbis(benzene sulfonyl hydrazide)				
p-Toluene sulfonyl hydrazine				
p-Toluene sulfonyl semicarbazide [TSSC]				
Trihydrazine triazine [THT], [Cyanuric trihydrazide]				
<u>GASEOUS DECOMPOSITION PRODUCTS OF CHEMICAL BLOWING AGENTS</u>				
Ammonia [see Physical Blowing Agents]				
Carbon dioxide [see Physical Blowing Agents]				
Carbon monoxide [CO]	Highly Toxic Inhalation, humans LD <sub>50</sub> : 4000 ppm/30 min.	Inhalation Highly Flammable	50 ppm TWA	[630-08-0]
Formaldehyde [HCHO]	Highly Toxic Inhalation, humans TC <sub>LD</sub> : 17 mg/m <sup>3</sup> /30 min. Toxic Effect: Eye Irritation, Pulmonary System	Inhalation Strong Irritant Moderate Fire Risk Positive Animal Carcinogen Mutagen	3 ppm TWA 5 ppm Ceiling 10 ppm Peak/30 min./ 8 hours	[50-00-0]

(Continued)



TABLE C-3 (Continued)

<u>Blowing Agent/Foam Modifier</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>GASEOUS DECOMPOSITION PRODUCTS OF CHEMICAL BLOWING AGENTS (Continued)</u>				
Nitrogen [see Physical Blowing Agents]				
Nitrous oxide [N <sub>2</sub> O]	Inhalation, humans TD <sub>Lo</sub> : 24 mg/kg/2 hours Toxic Effect: Behavioral Symptoms, Cardiovascular, Metabolism, Nutrition	Moderate Fire Risk Mutagen	25 ppm TWA (recommended)	[10024-97-2]
Water [see Physical Blowing Agents]				
<u>RESIDUE FROM CHEMICAL BLOWING AGENTS</u>				
Ammonium bicarbonate [see Chemical Blowing Agents]				
Ammonium carbamate [NH <sub>4</sub> CO <sub>2</sub> NH <sub>2</sub> ]	Intravenous, mouse LD <sub>50</sub> : 77 mg/kg	Irritant		[1111-78-0]
Barium carbonate [BaCO <sub>3</sub> ]	Toxic Oral, humans LD <sub>Lo</sub> : 57 mg/kg	Ingestion	0.5 mg(Ba)/m <sup>3</sup> TWA	[513-77-9]
Biurea				
Cyamelide				
Cyanuric acid [HOCNC(OH)NC(OH)N·2H <sub>2</sub> O]	Low Oral, rat LD <sub>Lo</sub> : 500 mg/kg	Primary Irritant Equivocal Tumorigenic Agent		[108-80-5]
Diisopropyl carbonate				
Diisopropyl ether [see Physical Blowing Agents]				
2,3-Dimethylbutane [see Physical Blowing Agents]				

(Continued)

TABLE C-3 (Continued)

<u>Blowing Agent/Foam Modifier</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>RESIDUE FROM CHEMICAL BLOWING AGENTS</u> (Continued)				
N,N'-Dimethylterephthalamide				
Diphenylamine [(C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> NH]	Toxic Oral, rat LD <sub>50</sub> : 3000 mg/kg	Skin Absorption Inhalation	10 mg/m <sup>3</sup> TWA 20 mg/m <sup>3</sup> STEL (recommended)	[122-39-4]
Diphenyl disulfide				
Ditolyl disulfide	Intraperitoneal, mouse LD <sub>50</sub> : 100 mg/kg			[882-33-7]
Hydrazine [H <sub>2</sub> NNH <sub>2</sub> ]	Toxic Inhalation, rat LC <sub>50</sub> : 570 ppm/4 hours	Ingestion Inhalation Skin Absorption Skin and Eye Irritant Severe Explosion Hazard Positive Animal Carcinogen Mutagen	1 ppm TWA (skin)	[302-01-2]
Isobutyronitrile	Oral, rat LD <sub>50</sub> : 102 mg/kg	Primary Irritant	22 mg/m <sup>3</sup> TWA (recommended)	[78-82-0]
Ketenimine				
Methacrylonitrile	Highly Toxic Oral, rat LD <sub>50</sub> : 250 mg/kg	Primary Irritant Ingestion Inhalation Skin Absorption Dangerous Fire Risk	1 ppm TWA (skin) 2 ppm STEL (recommended)	[126-98-7]
Oxamide [NH <sub>2</sub> COCONH <sub>2</sub> ]	Intraperitoneal, mouse LD <sub>50</sub> : 128 mg/kg	Primary Irritant		[471-46-5]
Phenylbenzenethiosulfonate				
Tetramethylsuccinonitrile	Intravenous, mouse LD <sub>50</sub> : 18 mg/kg		3 mg/m <sup>3</sup> TWA (skin)	[3333-52-6]

(Continued)

TABLE C-3 (Continued)

<u>Blowing Agent/Foam Modifier</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>RESIDUE FROM CHEMICAL BLOWING AGENTS</u> (Continued)				
p-Thiocresol	Intraperitoneal, mouse LD <sub>50</sub> : 200 mg/kg			[106-45-6]
p-Toluene sulfinic acid				
p-Tolyl p-toluene thiosulfonate				
Urazole				
<u>BLOWING AGENT CATALYSTS</u>				
Actafoam F2				
Actafoam R-3				
Actafoam R-5				
Actafoam R-10				
Actafoam R-34				
BIK [urea (surface treated)]				
Interstab ABC 1				
Interstab ABC 2				
Interstab ABC 6				
Interstab ABC 7				
Interstab ABC 18				
Interstab ABC 50				
Nuostabe V-1530 [Zinc-based activator]				
RIA				
Zinc oxide	Nontoxic Oral, rat LD <sub>50</sub> : 6846 mg/kg	Primary Irritant Inhalation Teratogen Mutagen	5 mg/m <sup>3</sup> TWA	[1314-13-2]

(Continued)

TABLE C-3 (Continued)

<u>Blowing Agent/Foam Modifier</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>SURFACTANTS</u>				
<u>SILICONES</u>				
Dabco [silicone, tetraethylene-diamine]				
Dimethylsilicone oil	Low			
Dow 190 [silicone-glycol]				
Dow 192 [silicone-glycol]				
Dow 193 [silicone]				
Dow 194 [silicone-glycol]				
Dow 195 [silicone-glycol]				
Dow 197 [silicone-glycol]				
Dow 1250 [silicone-glycol]				
Dow 1251 [silicone-glycol]				
Dow 1252 [silicone-glycol]				
Dow 1253 [silicone-glycol]				
Dow 1254 [silicone-glycol]				
Dow 1312 [silicone-glycol]				
Dow F-11630 [silicone-glycol]				
G. E. SS-4255 [silicone]				
Tegostab B 3640 [silicone]				
Tegostab B 4113 [silicone]				
Union Carbide L-520 [silicone]	Oral, rat LD <sub>50</sub> : 22 gm/kg			

(Continued)

TABLE C-3 (Continued)

<u>Blowing Agent/Foam Modifier</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>SILICONES</u> (Continued)				
Union Carbide L-532 [silicone]				
Union Carbide L-540 [silicone]				
Union Carbide L-546 [silicone]				
Union Carbide L-548 [silicone]				
Union Carbide L-550 [silicone]				
Union Carbide L-562 [silicone]				
Union Carbide L-5302				
Union Carbide L-5303				
Union Carbide L-5305				
Union Carbide L-5307				
Union Carbide L-5340				
Union Carbide L-5350				
Union Carbide L-5410				
Union Carbide L-5420				
Union Carbide L-5430				
Union Carbide L-5612				
Union Carbide L-5710				
Union Carbide L-5720				
Union Carbide L-6202				
Union Carbide LC-5613				

(Continued)

TABLE C-3 (Continued)

<u>Blowing Agent/Foam Modifier</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>SILICONES (Continued)</u>				
Union Carbide Y-6402				
Union Carbide Y-6454				
<u>SURFACTANTS</u>				
<u>MISCELLANEOUS</u>				
Air Prod LK-221 [organic amine]				
Air Prod LK-322 [all organic]				
Air Prod LK-443				
Empicol LZ [sodium alkyl sulfate]				
Ethylan TC [amine ethylene oxide]				
Ethylan TCO [fatty amine oxide]				
Interwet 212 [non-ionic ester]				
Zonyl FSA [fluorosurfactant]				
Zonyl FSB [fluorosurfactant]				
Zonyl FSC [fluorosurfactant]				
Zonyl FSJ [fluorosurfactant]				
Zonyl FSN [fluorosurfactant]				
Zonyl FSP				

(Continued)

TABLE C-3 (Continued)

<u>Blowing Agent/Foam Modifier</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>NUCLEATING AGENTS</u>				
Adipic Acid	Oral, rat LD <sub>50</sub> : 3600 mg/kg	Primary Irritant		[124-04-9]
Benzoic Acid	Oral, man LD <sub>50</sub> : 500 mg/kg	Primary Irritant		[65-85-0]
Calcium carbonate [CaCO <sub>3</sub> ]	Nontoxic		10 mg/m <sup>3</sup> TWA (recommended)	[471-34-1]
Silica [SiO <sub>2</sub> ]	Toxic Oral, rat LD <sub>50</sub> : 3160 mg/kg	Inhalation (silicosis)	80 mg/m <sup>3</sup> TWA	[7631-86-9]
Sodium silicofluoride [Na <sub>2</sub> SiF <sub>6</sub> ]				
Talc	Moderate Skin, humans 300 g/3D-I Toxic Effect: Mild Irritation	Inhalation Primary Irritant Tumorigen	20 mppcf TWA (nonfibrous) (recommended)	[14807-96-6]

TABLE C-4. CATALYSTS FOR THERMOPLASTICS POLYMERIZATION  
TOXICOLOGICAL AND WORKER EXPOSURE CONCERNS

<u>Catalyst</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
Acetic Acid [ $\text{CH}_3\text{COOH}$ ]	Toxic Skin, humans 50 mg/24H Toxic Effect: Mild Irritation	Moderate Fire Risk Ingestion Inhalation Primary Irritant Mutagen	10 ppm TWA	[64-19-7]
Acetic Anhydride [ $(\text{CH}_3\text{CO})_2\text{O}$ ]	Oral, rat LD <sub>50</sub> : 1780 mg/kg	Primary Irritant Corrosive	5 ppm TWA	[108-24-7]
N-Acetylcaprolactam				
Acetyl perchlorate				
Aluminum chloride	Toxic Oral, rat LD <sub>50</sub> : 3700 mg/kg	Ingestion Inhalation Strong Irritant Reacts Violently With Water		[7446-70-0]
Aluminum isopropoxide	Oral, rat LD <sub>50</sub> : 11300 mg/kg			[555-31-7]
Aluminum oxide	Nontoxic Intraleural, rat TD <sub>Lo</sub> : 90 mg/kg Toxic Effect: Equivocal Tumorigenic Agent	Inhalation Tumorigen	10 mg/m <sup>3</sup> TWA (recommended)	[1344-28-1]
ε-Aminocaprolactam	Inhalation, humans TC <sub>Lo</sub> : 100 ppm Toxic Effect: Irritation		20 mg/m <sup>3</sup> TWA	[105-60-2]
Ammonium hexafluorotitanate [ $(\text{NH}_4)_2\text{TiF}_6$ ]	Intravenous, mouse LD <sub>50</sub> : 56 mg/kg		2.5 mg(F)/m <sup>3</sup> TWA (recommended)	[16962-40-6]
Antimony trifluoride	Toxic Subcutaneous, frog LD <sub>Lo</sub> : 224 mg/kg	Strong Eye and Skin Irritant	0.5 mg(Sb)/m <sup>3</sup> TWA (recommended)	[7783-56-4]
Antimony trioxide [ $\text{Sb}_2\text{O}_3$ ]	Toxic Intravenous, dog LD <sub>Lo</sub> : 3 mg/kg	Dermatitis	500 ug/m <sup>3</sup> TWA	[1327-33-9]

(Continued)



TABLE C-4 (Continued)

<u>Catalyst</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
Benzil [C <sub>6</sub> H <sub>5</sub> CO·COC <sub>6</sub> H <sub>5</sub> ]	Oral, rat LD <sub>50</sub> : 2710 mg/kg	Primary Irritant		[134-81-6]
Benzophenone [(C <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> CO]	Oral, rat LD <sub>50</sub> : 2895 mg/kg	Tumorigen		[119-61-9]
Biacetal	Oral, rat LD <sub>50</sub> : 1580 mg/kg			[431-03-8]
Bis(cyclopentadienyl) titanium chloride				[127-19-8]
Bis(triphenylsilyl) chromate [((C <sub>6</sub> H <sub>5</sub> ) <sub>3</sub> SiO) <sub>2</sub> CrO <sub>2</sub> ]	Oral, rat LD <sub>50</sub> : 3360 mg/kg		100 ug(CrO <sub>3</sub> )/m <sup>3</sup> Ceiling	[1624-02-8]
Boric Acid [H <sub>3</sub> BO <sub>3</sub> ]	Toxic Oral, humans LD <sub>50</sub> : 214 mg/kg	Ingestion Irritant		[10043-35-3]
Boron trifluoride	Toxic Inhalation, rat LC <sub>50</sub> : 750 ppm/5.5H	Inhalation Corrosive to Skin and Tissue	1 ppm Ceiling	[7637-07-2]
Boron trifluoride dibutyl- etherate				
Boron trifluoride etherate	Toxic	Inhalation Corrosive to Skin and Tissue		
Butyl lithium	Toxic	Highly Flammable Irritant		[109-72-8]
Butyl zinc				
Cadmium acetate [Cd(OOCCH <sub>3</sub> ) <sub>2</sub> ]	Toxic Intraperitoneal, rat TD <sub>50</sub> : 2371 ug/kg	Mutagen Teratogen	4 ug(Cd)/m <sup>3</sup> TWA (recommended)	[543-90-8]
Calcium acetate [Ca(CH <sub>3</sub> COO) <sub>2</sub> ]	Nontoxic Intravenous, rat TD <sub>50</sub> : 147 mg/kg			[62-54-4]

(Continued)

TABLE C-4 (Continued)

<u>Catalyst</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
Carbon dioxide [CO <sub>2</sub> ]	Inhalation, rat TC <sub>Lo</sub> : 6 pph/24 Hr. Toxic Effect: Reproductive, Developmental	Inhalation	5000 ppm TWA	[124-38-9]
p-Chlorophenyl diazonium hexafluoroarsenate				
p-Chlorophenyl diazonium hexafluorophosphate				
Chromocene [(C <sub>5</sub> H <sub>5</sub> ) <sub>2</sub> Cr]				[1271-24-5]
Chromic Acid [CrO <sub>3</sub> ]	Toxic Inhalation, humans TC <sub>Lo</sub> : 110 ug/m <sup>3</sup>	Skin Corrosion Strong Reducing Agent Tumorigen Mutagen Teratogen	100 mg(CrO <sub>3</sub> )/m <sup>3</sup>	[1333-82-0]
Chromyl chloride [CrO <sub>2</sub> Cl <sub>2</sub> ]	Toxic Subcutaneous, mouse LD <sub>Lo</sub> : 5.45 mg/kg	Skin Corrosion	0.025 ppm TLV	[14977-61-8]
Cobalt acetate [Co(C <sub>2</sub> H <sub>3</sub> O <sub>2</sub> ) <sub>2</sub> ]	Intravenous, mouse LD <sub>50</sub> : 31 mg/kg			[71-48-7]
Cobalt on charcoal				
Copper (I) chloride [CuCl]	Toxic Oral, rat LD <sub>50</sub> : 265 mg/kg	Ingestion		[7758-89-6]
Copper (II) chloride [CuCl <sub>2</sub> ]	Moderately Toxic Oral, rat LD <sub>50</sub> : 140 mg/kg		1 mg(Cu)/m <sup>3</sup> TWA	[1344-67-8]
Cyanuric chloride [C <sub>3</sub> N <sub>3</sub> Cl <sub>3</sub> ]	Low Intravenous, mouse LD <sub>50</sub> : 18 mg/kg			[108-77-0]
Dibutyl aluminum chloride [Al(C <sub>4</sub> H <sub>9</sub> ) <sub>2</sub> Cl]				

(Continued)

TABLE C-4 (Continued)

<u>Catalyst</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
Diethyl aluminum chloride [(C <sub>2</sub> H <sub>5</sub> ) <sub>2</sub> AlCl]		Highly Flammable		
Diethyl ethoxy aluminum [AlEt <sub>2</sub> OEt]				
Diethyl zinc [ZnEt <sub>2</sub> ]		Ignites Spontaneously in Air Decomposes Violently in Water Inhalation	5 mg/m <sup>3</sup> TLV (ZnO fume)	[557-20-0]
Di-(2-methyl borneal) chromate				
Di(triphenylsilyl) chromate				[1634-02-8]
Ethyl aluminum sesquichloride [(C <sub>2</sub> H <sub>5</sub> ) <sub>3</sub> Al <sub>2</sub> Cl <sub>3</sub> ]		Ingestion Inhalation Ignites on Contact With Air Reacts Violently in Water Irritant to Eyes and Mucous Membranes		[12075-68-2]
Ethyl magnesium bromide		Dangerous Fire Risk		
Ferric acetyl acetonate [Fe(OC(CH <sub>3</sub> ):CHC(O)CH <sub>3</sub> ) <sub>3</sub> ]	Intravenous, mouse LD <sub>50</sub> : 100 mg/kg			[14024-18-1]
Germanium dioxide [GeO <sub>2</sub> ]	Intraperitoneal, rat LD <sub>50</sub> : 750 mg/kg			[1310-53-8]
Iodine	Highly Toxic Oral, rat LD <sub>50</sub> : 14 gm/kg	Ingestion Inhalation Strong Eye and Skin Irritant	0.1 ppm Ceiling	[7553-56-2]
Lead acetate [Pb(C <sub>2</sub> H <sub>3</sub> O <sub>2</sub> ) <sub>2</sub> ]	Highly toxic Oral, rat TD <sub>LO</sub> : 314 mg/kg	Tumorigen Mutagen Ingestion Inhalation Skin Absorption Teratogen	200 ug(Pb)/m <sup>3</sup> TWA	[301-04-2]

(Continued)

TABLE C-4 (Continued)

<u>Catalyst</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
Lead dioxide [PbO <sub>2</sub> ]	Toxic Intraperitoneal, guinea pig LD <sub>50</sub> : 220 mg/kg	Fire Risk in Presence of Organic Materials	200 ug(Pb)/m <sup>3</sup> TWA	[1309-60-0]
Lead oxide [PbO]	Toxic Intraperitoneal, rat LD <sub>50</sub> : 430 mg/kg	Primary Irritant Ingestion Inhalation Tumorigen Mutagen	50 ug(Pb)/m <sup>3</sup> TWA	[1317-36-8]
Lithium acetate [LiC <sub>2</sub> H <sub>3</sub> O <sub>2</sub> ]				
Lithium s-butoxide				
Lithium carbonate [Li <sub>2</sub> CO <sub>3</sub> ]	Low Oral, human TD <sub>Lo</sub> : 4111 mg/kg	Mutagen Teratogen		[554-13-2]
Lithium hydride [LiH]	Inhalation, rat LC <sub>Lo</sub> : 22 mg/m <sup>3</sup> /4H Toxic Effect: Pulmonary System	Primary Irritant Fire Risk Ignites Spontaneously in Moist Air	25 ug/m <sup>3</sup> TWA	[7580-67-8]
Magnesium	Oral, dog LD <sub>Lo</sub> : 230 mg/kg	Fire Risk (powder)		[7439-95-4]
Magnesium acetate [Mg(OOCCH <sub>3</sub> ) <sub>2</sub> ]	Intravenous, mouse LD <sub>50</sub> : 16 mg/kg			[142-72-3]
Magnesium dichloride [MgCl <sub>2</sub> ]	Moderate Oral, rat LD <sub>50</sub> : 2800 mg/kg			[7786-30-3]
Magnesium hydroxide [Mg(OH) <sub>2</sub> ]	Nontoxic			[1309-42-8]
Magnesium hydroxychloride [Mg(OH)Cl]				
Magnesium oxide [MgO]	Toxic Inhalation, humans TC <sub>Lo</sub> : 400 mg/m <sup>3</sup>	Inhalation	15 mg/m <sup>3</sup> TWA	[1309-48-4]

(Continued)

TABLE C-4 (Continued)

<u>Catalyst</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
Magnesium sulfate [MgSO <sub>4</sub> ]	Low Intraperitoneal, rat Mutagen: 450 mg/kg			[14567-64-7]
Manganese acetate [Mn(C <sub>2</sub> H <sub>3</sub> O <sub>2</sub> ) <sub>2</sub> ]	Moderate Oral, rat LD <sub>50</sub> :2940 mg/kg	Mutagen		[638-38-0]
Manganese dioxide	Moderate Subcutaneous, mouse LD <sub>50</sub> :422 mg/kg	Oxidizing Agent May Ignite Organics		[1313-13-9]
Molybdenum trioxide [MoO <sub>3</sub> ]	Toxic Oral, rat LD <sub>50</sub> :125 mg/kg	Inhalation	5 mg(Mo)/m <sup>3</sup> TWA	[1313-27-5]
Nickel on charcoal			1 mg(Ni)/m <sup>3</sup> TWA (skin)	[7440-02-0]
Palladium [Pd]				[7601-90-3]
Perchloric acid	Oral, rat LD <sub>50</sub> :1100 mg/kg Toxic Effect: Behavioral Symptoms, Pulmonary Sys- tem, Metabolism and Nutrition	Skin Contact Inhalation Ingestion Strong Oxidizer - Sometimes Explosive Strong Irritant		
Phenyl isocyanate [C <sub>6</sub> H <sub>5</sub> NCO]	Toxic Oral, rat LD <sub>50</sub> :940 mg/kg	Irritant Lachrymator Fire Risk		[103-71-9]
Phenyl-N-phenyl benzimidazole				
Phosphoric acid [H <sub>3</sub> PO <sub>4</sub> ]	Toxic Inhalation, humans TC <sub>Lo</sub> :100 mg/m <sup>3</sup> Toxic Effect: Irritant	Ingestion Inhalation Primary Irritant	1 mg/m <sup>3</sup> TWA	[7664-38-2]
Potassium carbonate [K <sub>2</sub> CO <sub>3</sub> ]	Oral, rat LD <sub>50</sub> :1870 mg/kg	Tissue Irritant		[584-08-7]

(Continued)

TABLE C-4 (Continued)

<u>Catalyst</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
Potassium ferrocyanide [K <sub>3</sub> Fe(CN) <sub>6</sub> ]	Low Oral, rat LD <sub>50</sub> :1600 mg/kg			[13746-66-2]
Potassium triphenyl methoxide				
Pyridine [N(CH) <sub>4</sub> CH] [ ]	Toxic Oral, rat LD <sub>50</sub> :891 mg/kg	Primary Irritant Ingestion Inhalation Mutagen	5 ppm TWA	[110-86-1]
Sodium acetate	Nontoxic Oral, rat LD <sub>50</sub> :3530 mg/kg			[127-90-3]
Sodium caprolactam				
Sodium carbonate [Na <sub>2</sub> CO <sub>3</sub> ]	Low Oral, rat LD <sub>50</sub> :4000 mg/kg	Primary Irritant		[497-19-8]
Sodium hydride [NaH]	Toxic	Fire Risk Reacts Violently With Water Ingestion Inhalation Skin Contact		[7646-69-7]
Sodium hydroxide [NaOH]	Toxic Eye, rabbit 1 mg/24H Toxic Effect: Severe Irritant	Corrosive Primary Irritant	2 mg/m <sup>3</sup> TWA	[1310-73-2]
Sodium hypophosphite [NaH <sub>2</sub> PO <sub>2</sub> ]	Intraperitoneal, rat LD <sub>50</sub> :1584 mg/kg	Explosion Risk With Oxidizing Agents		[7681-53-0]
Sodium methoxide	Toxic	Corrosive Fire Risk Skin Contact Inhalation Ingestion		[124-41-4]

(Continued)

TABLE C-4 (Continued)

<u>Catalyst</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
Sulfuric acid [H <sub>2</sub> SO <sub>4</sub> ] [SO <sub>3</sub> in H <sub>2</sub> O]	Highly Toxic Humans LD <sub>50</sub> : 135 mg/kg	Irritant	1 mg/m <sup>3</sup> TWA	[7664-93-9]
Tetraallyl zirconium [Zr(allyl) <sub>4</sub> ]				
Tetrabenzyl arsonium chloride				
Tetrabenzyl phosphonium chloride				
Tetrabenzyl titanium [Ti(C <sub>6</sub> H <sub>5</sub> ) <sub>4</sub> ]				
Tetrabenzyl zirconium [Zr(C <sub>6</sub> H <sub>5</sub> ) <sub>4</sub> ]				
Tetrabutyl zirconate [Zr(OC <sub>4</sub> H <sub>9</sub> ) <sub>4</sub> ]				
Tetrabutyl titanium [TiBu <sub>4</sub> ]	Oral, rat LD <sub>50</sub> : 3122 mg/kg			[5593-70-4]
Tetraethyl titanium [Ti(OC <sub>2</sub> H <sub>5</sub> ) <sub>4</sub> ]				
N,N,N',N'-Tetramethylethylene- diamine [(CH <sub>3</sub> ) <sub>2</sub> NCH <sub>2</sub> CH <sub>2</sub> N (CH <sub>3</sub> ) <sub>2</sub> ]	Skin, mouse LD <sub>50</sub> : 7 gm/kg			[110-18-9]
Tetramethylguanidine [(CH <sub>3</sub> ) <sub>2</sub> NC(NH)N(CH <sub>3</sub> ) <sub>2</sub> ]				
Thiocarboximide				
Titanium dichloride [TiCl <sub>2</sub> ]		Fire Risk		[10049-06-6]
Titanium dichloride diiso- propylate [TiCl <sub>2</sub> (OPr) <sub>2</sub> ]				

(Continued)

TABLE C-4 (Continued)

<u>Catalyst</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
Titanium dioxide [TiO <sub>2</sub> ]	Nontoxic Intramuscular, rat TD <sub>Lo</sub> : 30 mg/kg/84W Toxic Effect: Carcinogen	Tumorigen Primary Irritant	15 mg/m <sup>3</sup> TWA	[13463-67-7]
Titanium isopropylate [Ti(OC <sub>3</sub> H <sub>7</sub> ) <sub>4</sub> ]				[546-68-9]
Titanium tetrachloride [TiCl <sub>4</sub> ]	Toxic Inhalation, mouse LC <sub>Lo</sub> : 10 mg/m <sup>3</sup> /2H	Inhalation Skin Irritant	No Standard	[7550-45-0]
Titanium trichloride [TiCl <sub>3</sub> ]	Intratesticular, rat LD <sub>Lo</sub> : 12341 ug/kg Toxic Effect: Reproduc- tive, Paternal	Fire Risk Skin Irritant		[7705-07-9]
Triallyl hafnium bromide				
Triallyl titanium bromide [Ti(allyl) <sub>3</sub> Br]				
Triallyl zirconium bromide				
Tributyl aluminum [(CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> ) <sub>3</sub> Al]		Fire Risk Ignites Spontaneously		[1116-70-7]
Tricyclohexyl aluminum [Al(C <sub>6</sub> H <sub>13</sub> ) <sub>3</sub> ]				
Triethyl aluminum [(C <sub>2</sub> H <sub>5</sub> ) <sub>3</sub> Al]	Highly Toxic	Tissue Destruction Fire Risk Reacts Violently With Water, Alcohol, Amines, Halogens		[97-93-8]
Triethylamine [(C <sub>2</sub> H <sub>5</sub> ) <sub>3</sub> N]	Toxic Oral, rat LD <sub>50</sub> : 460 mg/kg	Fire Risk Ingestion Inhalation Primary Irritant Mutagen	25 ppm TWA	[121-44-8]

(Continued)



TABLE C-4 (Continued)

<u>Catalyst</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
Triethylbenzyl ammonium chloride	Intravenous, mouse LD <sub>50</sub> : 18 mg/kg			[56-37-1]
Triethyl sulfonium iodide				[1829-92-1]
Triphenylphosphine	Oral, rat LD <sub>50</sub> : 800 mg/kg			[603-35-0]
Triisobutyl aluminum [ $((CH_3)_2CHCH_2)_3Al$ ]	Highly Toxic	Ignites Spontaneously Tissue Destruction		
Vanadium oxytrichloride [VOCl <sub>3</sub> ]	Highly Toxic Oral, rat LD <sub>50</sub> : 140 mg/kg	Strong Tissue Irritant	0.05 mg(V)/m <sup>3</sup> 15 minute ceiling (recommended)	[7727-18-6]
Vanadium trioxybutylate [VO(OC <sub>4</sub> H <sub>9</sub> ) <sub>3</sub> ]				
Vanadium tetrachloride [VCl <sub>4</sub> ]	Highly Toxic Oral, rat LD <sub>50</sub> : 160 mg/kg	Ingestion Inhalation Skin Absorption	0.05 mg(V)/m <sup>3</sup> 15 minute ceiling (recommended)	[7632-51-1]
Vanadium trichloride [VCl <sub>3</sub> ]	Toxic Oral, rat LD <sub>50</sub> : 350 mg/kg	Irritant	0.05 mg(V)/m <sup>3</sup> 15 minute ceiling (recommended)	[7727-18-6]
Zinc acetate [Zn(C <sub>2</sub> H <sub>3</sub> O <sub>2</sub> ) <sub>2</sub> ]	Low Oral, rat LD <sub>50</sub> : 2510 mg/kg			[557-34-6]
Zinc chloride	Toxic Oral, rat LD <sub>50</sub> : 350 mg/kg	Skin Irritant Inhalation	1 mg/m <sup>3</sup> TWA (fume)	[7646-85-7]
Zinc formate [Zn(CHO <sub>2</sub> ) <sub>2</sub> ]	May be Toxic	Ingestion		
Zinc oxide [ZnO]	Nontoxic Oral, rat TD <sub>LO</sub> : 6846 mg/kg	Inhalation Mutagen Teratogen	5 mg/m <sup>3</sup> TWA (fume)	[1314-13-2]

(Continued)

TABLE C-4 (Continued)

<u>Catalyst</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>SUPPORTS</u>				
SiO <sub>2</sub>	Toxic Oral, rat LD <sub>50</sub> : 3160 mg/kg	Inhalation (Silicosis)	80 mg/m <sup>3</sup> TWA	[7631-86-9]
Al <sub>2</sub> O <sub>3</sub> [See Catalysts]				
MgO [See Catalysts]				[1309-48-4]
MgOHCl [See Catalysts]				
MgCl <sub>2</sub> [See Catalysts]				
Mg(OH) <sub>2</sub> [See Catalysts]				[1309-42-8]
TiO <sub>2</sub> [See Catalysts]				[13463-67-7]
TiCl <sub>3</sub> [See Catalysts]				[7705-07-9]
CaO		Strong Irritant	5 mg/m <sup>3</sup> TWA	[1305-78-8]
Ca <sub>5</sub> (PO <sub>4</sub> ) <sub>3</sub> OH				[12167-74-7]
Mg(ORt) <sub>2</sub>				
MgSO <sub>4</sub>	Low Oral, mouse LD <sub>50</sub> : 500 mg/kg			[7487-88-9]
<u>NEUTRALIZERS</u>				
Calcium oxide [See Supports]				
Calcium stearate	Low			
n-Heptane [CH <sub>3</sub> (CH <sub>2</sub> ) <sub>5</sub> CH <sub>3</sub> ]	Toxic Intravenous, mouse LD <sub>50</sub> : 222 mg/kg	Fire Risk Inhalation	500 ppm TWA	[142-82-5]

(Continued)

TABLE C-4 (Continued)

<u>Catalyst</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>NEUTRALIZERS</u> (Continued)				
Hydrochloric acid [HCl]	Toxic Inhalation, humans LC <sub>Lo</sub> :1300 ppm/30M	Inhalation Ingestion Irritant to Eyes and Skin	5 ppm ceiling	[7647-01-0]
Isopropyl alcohol [(CH <sub>3</sub> ) <sub>2</sub> CHOH]	Toxic Oral, rabbit LD <sub>Lo</sub> :5000 mg/kg	Fire Risk Ingestion Inhalation		[67-63-0]
Methanol	Eye, human 5 ppm Toxic Effect: Irritation	Mutagen Teratogen Primary Irritant	200 ppm TWA	[67-56-1]
Phosphoric Acid [See Catalysts]				
n-Propanol [CH <sub>3</sub> CH <sub>2</sub> CH <sub>2</sub> OH]	Low Inhalation, mouse LC <sub>50</sub> :48 gm/m <sup>3</sup>	Skin Contact Inhalation Fire Risk Primary Irritant	200 ppm TWA	[71-23-8]
Triphenyl phosphate	Toxic Oral, rat LD <sub>50</sub> :260 mg/kg	Inhalation	3 mg/m <sup>3</sup> TWA	[115-86-6]
Water (as steam)				

TABLE C-5. COLORANTS  
TOXICOLOGICAL AND WORKER EXPOSURE CONCERNS

Colorant	Color Index	Toxicity	Concern	OSHA Regulation	[CAS No.]
<u>INORGANIC PIGMENTS</u>					
<u>WHITE</u>					
Aluminum Silicate [Al <sub>2</sub> (SiO <sub>3</sub> ) <sub>3</sub> ]			Irritant Inhalation	10 mg/m <sup>3</sup> TWA (recommended)	[14504-95-1]
Barium Sulfate [BaSO <sub>4</sub> ] [Blanc fixe]	Fig. White 22, 77102 Fig. White 21, 77115	Nontoxic Intrapleural, rat TD <sub>Lo</sub> : 200 mg/kg Toxic Effect: Tumorigen	Tumorigen		[7727-43-7] [13462-86-7]
Calcium Silicate [CaSiO <sub>3</sub> ] [Wollastonite]		Nontoxic	Irritant Dust	10 mg/m <sup>3</sup> TWA (recommended)	[10101-39-0]
Lithopone [28% ZnS and 72% BaSO <sub>4</sub> ], [see Barium Sulfate and Zinc Sulfide]	Fig. White 5, 77115				[1345-05-7]
Titanium dioxide [TiO <sub>2</sub> ]	Fig. White 6, 77891	Nontoxic Skin, humans 300 ug/3D Toxic Effect: Mild Irritation	Tumorigen Primary Irritant Inhalation	15 mg/m <sup>3</sup> TWA	[1317-80-2] [13463-67-7]
Wollastonite [see Calcium Silicate]		Nontoxic	Irritant Dust	10 mg/m <sup>3</sup> TWA (recommended)	[14567-51-2] [13983-17-0]
Zinc oxide [ZnO]	Fig. White 4, 77947	Nontoxic Oral, rat LD <sub>Lo</sub> : 6846 mg/kg	Primary Irritant Inhalation Mutagen Teratogen	5 mg/m <sup>3</sup> TWA	[1314-13-2]
Zinc Sulfide [ZnS]	Fig. White 7, 77957	Moderate	Mutagen Teratogen Primary Irritant	5 mg/m <sup>3</sup> TWA	[1314-98-3]
<u>BLACK</u>					
Bone Black [C+Ca <sub>3</sub> (PO <sub>4</sub> ) <sub>2</sub> ]	Fig. Black 9, 77267				
Ceramic Black	Fig. Black 26, 77494 Fig. Black 28, 77428				

(Continued)

TABLE C-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>BLACK (Continued)</u>					
Iron Oxide [FeO.Fe <sub>2</sub> O <sub>3</sub> ]	Fig. Black 11, 77499	Subcutaneous, rat TD <sub>Lo</sub> :135 mg/kg Toxic Effect: Equivocal Tumorigenic Agent	Inhalation Tumorigen Indefinite Carcinogen	5 mg(Fe)/m <sup>3</sup> TWA 10 mg(Fe)/m <sup>3</sup> STEL (recommended)	[1317-61-9]
Copper Chromite Black [Cu(CrO <sub>2</sub> ) <sub>2</sub> ]				0.5 mg(Cr(VI))/m <sup>3</sup> TWA	[12018-10-9]
Cobalt Black [CoO]	Fig. Black 13, 77322	Intratracheal, rat LD <sub>Lo</sub> :50 mg/kg		100 ug(Co)/m <sup>3</sup> TWA (fume and dust)	[1307-96-6]
<u>BLUE, GREEN</u>					
Barium Manganate [BaMnO <sub>4</sub> ] [Manganese green]				5 mg(Mn)/m <sup>3</sup> TWA (recommended)	[7787-35-1]
Cassel Green [MnO]	77726	Subcutaneous, mouse LD <sub>50</sub> :1000 mg/kg		5 mg(Mn)/m <sup>3</sup> TWA (recommended)	[1344-43-0]
Chrome Cobalt-Alumina (turquoise) [CrCoAl oxides]	Fig. Blue 36, 77343				
Chrome Green (green) [PbCrO <sub>4</sub> .PbSO <sub>4</sub> . FeNH <sub>4</sub> Fe(CN) <sub>6</sub> ]	Fig. Green 15, 77510, 77600	Toxic	Tumorigen Mutagen	0.5 mg(Cr(VI))/m <sup>3</sup> TWA	[7758-97-6]
Chromium Oxide (dull green) [Cr <sub>2</sub> O <sub>3</sub> ]	Fig. Green 17, 77288, 77289	Impregnation, rat TD <sub>Lo</sub> :90 mg/kg Toxic Effect: Equivocal Tumorigenic Agent	Tumorigen Mutagen Indefinite Carcinogen	0.5 mg(Cr(VI))/m <sup>3</sup> TWA	[1308-38-9]
Cobalt Aluminate (blue) [CoO.Al <sub>2</sub> O <sub>3</sub> ]	Fig. Blue 28, 77346			100 ug(Co)/m <sup>3</sup> TWA	[1333-88-6]
Cobalt Chrome Green	Fig. Green 26				
Hydrated Chrome Oxide (green) [Cr <sub>2</sub> O <sub>3</sub> .2H <sub>2</sub> O]	Fig. Green 18, 77289		Tumorigen Mutagen	0.5 mg(Cr(VI))/m <sup>3</sup> TWA	[12182-82-0]
Iron Blue (blue) [Prussian Blue] [Milor and Chinese Blue] [FeNH <sub>4</sub> Fe(CN) <sub>6</sub> ] or [FeNH <sub>4</sub> Fe(CN) <sub>6</sub> .FeKFe(CN) <sub>6</sub> ]	Fig. Blue 27, 77510 77520				[14038-43-8]

(Continued)

TABLE C-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>BLUE, GREEN (Continued)</u>					
Manganese (blue) [BaMnO <sub>4</sub> .BaSO <sub>4</sub> ]	Fig. Blue 33, 77112				
Myrtle Green [CrCoAl oxides]					
Shamrock [CoTiZnNiAl oxides]					
Titanium Pigments (blue) [TiO <sub>2</sub> with CaO.Al <sub>2</sub> O <sub>3</sub> ]					
Titanium Pigments (green)	Fig. Green 50, 77377				
Titanium Pigments (light green) [TiO <sub>2</sub> with Ni and Co]	Fig. Green 50, 77377				
Ultramarine Blue (blue) [NaAlSiOS] [Complex aluminum sulfo-silicate produced by heating Ultramarine Green in presence of sulfur]	Fig. Blue 29, 77007	Low			[57455-37-5]
Ultramarine Green (green) [Approximately Na <sub>7</sub> Al <sub>6</sub> Si <sub>6</sub> O <sub>24</sub> S <sub>3</sub> ]	77013		Tumorigen Mutagen		[1308-38-9]
<u>VIOLET</u>					
Cobalt Lithium Phosphate [CoLiPO <sub>4</sub> ]	Fig. Violet 14, 77360 Fig. Violet 47, 77363 Fig. Violet 48, 77352				[13824-63-0]
Cobalt Phosphate [Co <sub>3</sub> (PO <sub>4</sub> ) <sub>2</sub> ]	Fig. Violet 14	Low Oral, rat TD <sub>50</sub> : 387 mg/kg Toxic Effect: Behavioral Symptoms; Gastrointestinal Tract; Metabolism and Nutrition		100 ug(Co)/m <sup>3</sup> TWA	[13455-36-2]
Manganese Violet [MnHP <sub>2</sub> O <sub>7</sub> .NH <sub>3</sub> ] [Mineral Violet]	Fig. Violet 16, 77742			5 mg(Mn)/m <sup>3</sup> Ceiling	[10101-66-3]
Ultramarine Violet [Complex aluminum sulfosilicate]	Fig. Violet 5				[12769-96-9]

(Continued)

TABLE C-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>VIOLET</u> (Continued)					
Ultramarine Pink [Complex aluminum sulfosilicate produced by heating Ultramarine Green at 200-250°C for 4 days in the presence of ammonium chloride]	Pig. Violet 15, 77007				
<u>RED, RED-ORANGE</u>					
Cadmium Mercury [maroon, red, orange] [CdS and HgS]	Pig. Red 113, 77201 Pig. Orange 23, 77201	Toxic		200 ug(Cd)/m <sup>3</sup> TWA	
Cadmium Sulfoselenide (maroon, red, orange) [CdSe and CdS]	Pig. Red 108, 77196, 77202	Toxic Oral, mouse LD <sub>50</sub> : 2425 mg/kg Toxic Effect: Behavioral Symptoms; Metabolism and Nutrition		200 ug(Cd)/m <sup>3</sup> TWA 200 ug(Se)/m <sup>3</sup> TWA	[1306-24-7] [12626-36-7]
Cadmium Sulfide (orange) [CdS]	Pig. Orange 20, 77106, 77196, 77198, 77199	Toxic Subcutaneous, rat TD <sub>Lo</sub> : 90 mg/kg Toxic Effect: Carcinogenic	Ingestion Inhalation Tumorigen Mutagen Positive Animal Carcinogen	200 ug(Cd)/m <sup>3</sup> TWA (dust)	[1306-23-6]
Chrome-tin (pink)				0.5 mg(Cr(VI))/m <sup>3</sup> TWA	
Chrome Orange [PbCrO <sub>4</sub> ·PbO]	Pig. Orange 21, 77601	Toxic Subcutaneous, rat TD: 135 mg/kg Toxic Effect: Neoplastic	Carcinogen Mutagen	50 ug(Pb)/m <sup>3</sup> TWA 100 ug(CrO <sub>3</sub> )/m <sup>3</sup> Ceiling	[1344-38-3] [18454-12-1]
Copper Maroon [CuK <sub>2</sub> Fe(CN) <sub>6</sub> ]	Pig. Red 121, 77320			1.0 mg(Cu)/m <sup>3</sup> TWA	
Hematite [Fe <sub>2</sub> O <sub>3</sub> ]	See Iron Oxide			5 mg(Fe)/m <sup>3</sup> TWA 10 mg(Fe)/m <sup>3</sup> STEL (recommended)	[1317-60-8]

(Continued)

TABLE C-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>RED, RED-ORANGE</u> (Continued)					
Iron Oxide (maroon, red, light red) [Fe <sub>2</sub> O <sub>3</sub> ]	Pig. Red 101, 77419 Pig. Red 102, 77419	Subcutaneous, rat TD <sub>Lo</sub> :135 mg/kg Toxic Effect: Equivocal Tumorigenic Agent	Tumorigen Inhalation Suspected Human Carcinogen	5 mg(Fe)/m <sup>3</sup> TWA 10 mg(Fe)/m <sup>3</sup> STEL (recommended)	[1309-37-1]
Mercuric Sulfide [HgS]		Highly Toxic	Ingestion Inhalation Skin Absorption	0.1 mg(Hg)/m <sup>3</sup> TWA	[1344-48-5]
Molybdate Orange [PbCrO <sub>4</sub> ·PbO· PbMoO <sub>4</sub> ]	Pig. Orange 21, 77601 Pig. Red 104, 77605	Toxic	Ingestion	50 ug(Pb)/m <sup>3</sup> TWA 5 mg(Mo)/m <sup>3</sup> TWA 100 ug(Cr(VI))/m <sup>3</sup> Ceiling	[12656-85-8]
Molybdate Orange (coated)	Same as Molybdate Orange				
Red Ochre (natural) [Fe <sub>2</sub> O <sub>3</sub> ]	See Iron Oxide Pig. Red 101, 77491 Pig. Red 102, 77491			5 mg(Fe)/m <sup>3</sup> TWA 10 mg(Fe)/m <sup>3</sup> STEL (recommended)	[1309-37-1]
Red Lead (synthetic) [Pb <sub>3</sub> O <sub>4</sub> ]	Pig. Red 105, 77578	Intraperitoneal, mouse LD <sub>50</sub> :630 mg/kg		50 ug(Pb)/m <sup>3</sup> TWA	[1314-41-6]
Ultramarine Red [Complex aluminum sulphosilicate produced by heating Ultramarine Green at 70-200°C for 4 days in presence of HCl or by reac- tion with gaseous HNO <sub>3</sub> at higher temperature]	Pig. Red 5, 12490				
<u>YELLOW</u>					
Burnt Umber (natural) [Fe <sub>2</sub> O <sub>3</sub> ·H <sub>2</sub> O]	See Iron Oxide Pig. Yellow 42, 77492 Pig. Yellow 43, 77492			5 mg(Fe)/m <sup>3</sup> TWA 10 mg(Fe)/m <sup>3</sup> STEL (recommended)	[1309-37-1]
Cadmium Sulfide (yellow) [CdS and ZnS] [Cadmium Yellow]	Pig. Yellow 37, 77117, 77199	Toxic Subcutaneous, rat TD <sub>Lo</sub> :90 mg/kg Toxic Effect: Carcinogen	Ingestion Inhalation Tumorigen Mutagen Possible Carcinogen	200 ug(Cd)/m <sup>3</sup> TWA	[1306-23-6]

(Continued)



TABLE C-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>YELLOW</u> (Continued)					
Ceramic Buff [Yellow buff] [Sb, Ti, Cr oxides]		Toxic	Ingestion Inhalation		
Chrome Yellow [PbCrO <sub>4</sub> ]	Fig. Yellow 34, 77603, 77600	Toxic Subcutaneous, rat TD <sub>Lo</sub> : 135 mg/kg Toxic Effect: Neoplastic	Mutagen Ingestion Inhalation Positive Carcinogen	50 ug(Pb)/m <sup>3</sup> TWA 100 ug(CrO <sub>3</sub> )/m <sup>3</sup> Ceiling	[7758-97-6]
Chrome Yellow (heat resistant) [PbCrO <sub>4</sub> ], coated	Fig. Yellow 34		Positive Carcinogen	50 ug(Pb)/m <sup>3</sup> TWA 100 ug(CrO <sub>3</sub> )/m <sup>3</sup> Ceiling	[7758-97-6]
Iron oxide (yellow) [Fe <sub>2</sub> O <sub>3</sub> ·xH <sub>2</sub> O]	Fig. Yellow 42, 77492	Subcutaneous, rat TD <sub>Lo</sub> : 135 mg/kg Toxic Effect: Equivocal Tumorigenic Agent	Inhalation Tumorigen	5 mg(Fe)/m <sup>3</sup> TWA 10 mg(Fe)/m <sup>3</sup> STEL (recommended)	[1309-37-1]
Lead Chromate	See Chrome Yellow	Toxic	Ingestion Inhalation Positive Carcinogen	50 ug(Pb)/m <sup>3</sup> TWA 100 ug(CrO <sub>3</sub> )/m <sup>3</sup> Ceiling	[7758-97-6]
Lead Molybdate		Toxic	Inhalation	100 ug(Pb)/m <sup>3</sup> TWA (recommended)	
Ocher [Fe <sub>2</sub> O <sub>3</sub> ·H <sub>2</sub> O]	Fig. Yellow 43 See Iron Oxide	Nontoxic	Inhalation	5 mg(Fe)/m <sup>3</sup> TWA 10 mg(Fe)/m <sup>3</sup> STEL (recommended)	[1309-37-1]
Sienna [Fe <sub>2</sub> O <sub>3</sub> ]	Fig. Yellow 43 See Iron Oxide			5 mg(Fe)/m <sup>3</sup> TWA 10 mg(Fe)/m <sup>3</sup> STEL (recommended)	[1309-37-1]
Titanium Pigment (light yellow) [Nickel titanate] [NiO.TiO <sub>2</sub> ] (buff) [Ni, Sb, Ti oxides] [Fe, Zn, Ti oxides] and [Fe, Cr, Ti, Sb, Zn oxides]	Fig. Yellow 53, 77788				
Zinc Chromate (yellow) [ZnCrO <sub>4</sub> (complex)]	Fig. Yellow 36, 77955	Toxic Intravenous, mouse TD <sub>Lo</sub> : 30 mg/kg.	Ingestion Inhalation Carcinogen	100 ug(CrO <sub>3</sub> )/m <sup>3</sup> TWA	[13530-65-9]

(Continued)

TABLE C-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>BROWN</u>					
Iron Oxide (buff, brown) [(FeO) <sub>x</sub> ·(Fe <sub>2</sub> O <sub>3</sub> ) <sub>y</sub> ]	Fig. Brown 6, 77491, 77492, 77499 Fig. Brown 7, 77491		Inhalation Tumorigen	5 mg(Fe)/m <sup>3</sup> TWA 10 mg(Fe)/m <sup>3</sup> STEL (recommended)	[1309-38-2]
Limonite [hematite brown]	Fig. Brown 6, 77491 Fig. Brown 7, 77491			5 mg(Fe)/m <sup>3</sup> TWA 10 mg(Fe)/m <sup>3</sup> STEL (recommended)	[1317-63-1]
Ocher [Fe <sub>2</sub> O <sub>3</sub> ]	See Iron Oxide			5 mg(Fe)/m <sup>3</sup> TWA 10 mg(Fe)/m <sup>3</sup> STEL (recommended)	[1309-37-1]
Sienna (natural) [Fe <sub>2</sub> O <sub>3</sub> ]	See Iron Oxide			5 mg(Fe)/m <sup>3</sup> TWA 10 mg(Fe)/m <sup>3</sup> STEL (recommended)	[1309-37-1]
Titanium Pigments (brown) [TiO <sub>2</sub> with up to 10% Fe] [rutile]	Fig. Brown 24				
Umber [Fe <sub>2</sub> O <sub>3</sub> with silica, alumina, manganese oxides and lime]	Fig. Brown 43			5 mg(Fe)/m <sup>3</sup> TWA 10 mg(Fe)/m <sup>3</sup> STEL (recommended)	[12713-03-0]
<u>ORGANIC PIGMENTS</u>					
<u>BLACK</u>					
Aniline Black	Fig. Black 1, 50440				
Bone Black [85% Ca <sub>3</sub> (PO <sub>4</sub> ) <sub>2</sub> and CaCO <sub>3</sub> with 12-23% C]	Fig. Black 9, 77267	Nontoxic			
Carbon Black (furnace black) [C]	Fig. Black 7, 77266	Intravenous, mouse LD <sub>50</sub> : 440 mg/kg		3.5 mg/m <sup>3</sup> TWA	[1333-86-4] [7440-44-0]
Carbon Black (lamp carbon black) [C]	Fig. Black 6, 77266	Intravenous, mouse LD <sub>50</sub> : 440 mg/kg		3.5 mg/m <sup>3</sup> TWA	[7440-86-4]
Channel Black [C]		Intravenous, mouse LD <sub>50</sub> : 440 mg/kg		3.5 mg/m <sup>3</sup> TWA	[1333-86-4]
Thermal Black		Intravenous, mouse LD <sub>50</sub> : 440 mg/kg		3.5 mg/m <sup>3</sup> TWA	[7440-86-4]

(Continued)

TABLE C-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>BROWN</u>					
Azoic Brown [Monoazo]	Fig. Brown 25, 12510 Fig. Brown 32				
Disazo Brown	Fig. Brown 23				[57972-00-6]
<u>BLUE, GREEN</u>					
Alumina Lake [Monoazo]	Acid Blue 4, 73015				
Cromophtal Blue A3R	Fig. Blue 60, see Indanthrone				
Cromophtal Green GF					
Dianisidene Blue [Disazo]	Fig. Blue 25				[5437-88-7] [10127-03-4]
FD&C Blue 1 Aluminum Lake (food blue 2) [Ethyl(4-p-(ethyl(m-sulfobenzyl) amino)- $\alpha$ -(o-sulfo-phenyl)benzylidene) -2,5-cyclohexadien-1-ylidene)(m-sul- fobenzyl)hydroxide ammonium inner salt, sodium salt]	42090:2	Subcutaneous, rat TD <sub>Lo</sub> : 5.5 gm/kg/97W-1 Toxic Effect: Neoplastic	Positive Animal Carcinogen		[3844-45-9]
FD&C Blue 2 Aluminum Lake (food blue 1) [indigoid]	Fig. Blue 63, 73013	Subcutaneous, rat TD <sub>Lo</sub> : 5.5 gm/kg	Positive Animal Carcinogen		[3844-45-9]
Indanthrone Blue-Red Shade [Anthraquinone]	Fig. Blue 64, 68925				[81-77-6]
Indanthrone [6,15-dihydro-5,9,14,18- anthrazine tetrone] [Cromophtal Blue A3R] [Anthraquinone]	Fig. Blue 22, 69810 Fig. Blue 60, 69800				
Nickel-Azo Yellow (greenish yellow) [metal complex of p-chloroaniline coupled to 2,4-dihydroxyquinoline]	Fig. Green 10, 12755				[51931-46-5] [61725-51-7]
Oracet Blue 2R					

(Continued)

TABLE C-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>BLUE, GREEN (Continued)</u>					
Phthalocyanine (blue)	01206	Subcutaneous, rat TD <sub>Lo</sub> : 990 mg/kg/44W-I Toxic Effect: Tumorigenic Agent	Primary Irritant		[3468-11-9] [147-14-8]
red shade	Fig. Blue 15, 76160, 74160				
green shade	Fig. Blue 15:3, 74160, 76160				
metal free	Fig. Blue 16, 74100				[574-93-6]
Phthalocyanine (green)	Fig. Green 7, 74260, 74160				[1328-53-6]
Phthalocyanine Green, brominated	Fig. Green 36, 74265				
Pigment Green B (dark green) [Nitroso]	Fig. Green 8, 1006				
PTA PMA Toners (blue, green) [triphenyl-methane, phospho- tungstomolybdic acid]	Fig. Blue 1, 42595 Fig. Green 2, 42040				
<u>VIOLET</u>					
Alizarine Maroon (maroon) [Anthraquinone]	Fig. Violet 5, 58055				
Benzimidazolone Violet [Monoazo]	Fig. Violet 32, 12517 See Monoazo Red				
Carbazole Dioxazine Violet	Fig. Violet 23, 51319 Fig. Violet 25, 51319				[6358-30-1]
Isoviolanthrone Violet [Anthraquinone] [Vat pigment]	Fig. Violet 33 Fig. Violet 31 Vat Violet 9, 60005				[81-28-7] [1324-55-6] [1324-17-0]
Methyl Violet	Basic Violet 1, 42535	Oral, mouse LD <sub>50</sub> : 105 mg/kg	Mutagen		[8004-87-3]
Methyl Violet Lake	Fig. Violet 3, 42535:2			5 mg(Mo)/m <sup>3</sup> TWA	[1325-82-2]
Monoazo Red, blue shade [Benzimidazolone violet]	Fig. Violet 32, 12517 Fig. Red 83, 58000				

(Continued)

TABLE C-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>VIOLET (Continued)</u>					
Oracet Violet 2R					[128-95-0]
P T M A Toners [Phosphotungatomo- lybdic acid salt of basic dye] [Xanthene]	Fig. Violet 2, 45175				[1325-82-2]
Perrindo Violet [Anthraquinone]	Fig. Violet 29, 71129				
Quinacridone Red (yellow shade)	Fig. Violet 19, 16500, 46500				
Quinacridone (violet-maroon)	Fig. Violet 19, 16500, 46500				[1047-16-1]
Thioindigo Violet	Fig. Violet 36, 73385				
<u>RED</u>					
Alizarine Red B Lake	Fig. Red 83, 58000 See Madder Lake				[72-48-0]
Alumina Lake [phthalein]	Fig. Red 172, 43439:1				[4216-01-7]
Anthraquinone Red	Fig. Red 177				
Orange RK	Fig. Red 168, 59300 See Vat Orange				
Anthraquinone Red	Fig. Red 194, 71100 See Vat Red				[4378-61-4]
Azo Condensate Red	Fig. Red 242				
Ba Lithol (medium red)	Fig. Red 49, 15630 See Lithol Red				
Benzimidazolone Reds	Fig. Red 171, 12521 See Monoazo				
[Permanent Red HFT]	Fig. Red 175, 12513 See Monoazo				
[Monoazo]	Fig. Red 176, 12516 See Monoazo				
[Permanent Carmine]	Fig. Red 185, 12516 See Monoazo				

(Continued)

TABLE C-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
RED (Continued)					
B.O.N. Rubine (Na Salt) (Ca Salt)	Fig. Red 52, 15860 Fig. Red 200, 15867				
B.O.N. Maroon [Monoazo] [Sodium salt of acid dye]	Fig. Red 63, 15880				
Chlorinated Para (light red) [1-(2-chloro-4-Nitrophenyl)azo] 2-Naphthol] [Monoazo]	Fig. Red 4, 12085 Fig. Red 6		Mutagen		[2814-77-9]
Cromophtal Scarlet R [Azo]	Fig. Red 166				[12225-04-6]
Cromophtal Red BR [Disazo] [Disazo Condensation Red]	Fig. Red 144				[5280-78-4]
Cromophtal Red 3B [Anthraquinone]	Fig. Red 177 See Anthraquinone Red				
Cromophtal Red G [Disazo]	Fig. Red 220				
Cromophtal Red GR [Disazo]	Fig. Red 139				
Cromophtal Red 2RS					
Cromophtal Rubine B					
Dianisidine (medium red)	Fig. Red 41, 21200				[6505-29-9]
Disazo Condensation Red	Fig. Red 144 See Cromophtal Red BR				
Disazo Reds	Fig. Red 146 Fig. Red 166 Fig. Red 214 Fig. Red 220 Fig. Red 221				
Dichlorobenzidine Red	See Pyrazolone Red				
FD&C Red 3 Aluminum Lake (food red 14) [2',4',5',7' Tetra-bromo-4,5,6,7- tetrachloro fluorescein, disodium salt]	45430	Oral, mouse LD <sub>50</sub> : 2500 mg/kg			[16423-68-0]

(Continued)

TABLE C-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>RED (Continued)</u>					
FD&C Red 40 Aluminum Lake	16035				
Helio Bordeaux (maroon)	Pig. Red 54, 14830				
Irgazin Red 2BLT [Isoindolinone Red]	Pig. Red 180				
Lake Red C (light red) [5-chloro-2-((2-Hydroxy-1-Naphthyl)Azo)4-methylbenzene-sulfonic acid, barium salt]	Pig. Red 53:1, 15585:1	Oral, rat TD <sub>50</sub> :130 gm/kg/2Y Toxic Effect: Tumorigen	Indefinite Animal Carcinogen		[5160-02-1]
Lithol Red (Ba of acid dye) [Monoazo]	Pig. Red 49, 15630		Mutagen		[1248-18-6]
Lithol Rubine (Na salt of acid dye) (bluish red) [Monazo]	Pig. Red 57, 15850				
Lithol Rubine, Sr [Monoazo]	Pig. Red 52, 15850				
Madder Lake (alizarine red) [1,2-dihydroxy-anthraquinone]	Pig. Red 83, 58000	Eye, rabbit 500 mg/24 Hours Toxic Effect: Severe Irritation	Primary Irritant Mutagen		[72-48-0]
Monoazo Red (blue and yellow shade reds)	Pig. Red 187 Pig. Red 188, 12467 Pig. Red 246 Pig. Red 247 Pig. Red 175, 12513 Pig. Red 171, 12521				
Monoazo Red (blue shade red)	Pig. Red 176, 12515 Pig. Red 185, 12516				
Na, Ca Lithols (light red-maroon)	Pig. Red 49, 15630				
Naphthol Red (blue shade red Ba salt)	Pig. Red 151				
Naphthol Red (blue shade red Ca salt)	Pig. Red 68, 15525				
Naphthol Red (bluish red)	Pig. Red 150 Pig. Red 210				[56396-10-2] [61932-63-6]
Naphthol Red (bordeaux shade)	Pig. Red 14, 12380				
Naphthol Red (dark red)	Pig. Red 23, 12355				[6471-49-4]

(Continued)

TABLE C-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>RED (Continued)</u>					
Naphthol Red (light red)	Fig. Red 17, 12390 Fig. Red 22, 12315				
Naphthol Red (medium red)	Fig. Red 170 Fig. Red 210 Fig. Red 7, 12420				[12236-67-8] [61932-63-6]
Naphthol Red (yellow shade)	Fig. Red 9, 12460				
Naphthol Red (yellow shade red Ca salt)	Fig. Red 68, 15525				
Oracet Red 3B					[116-85-8]
Para Red (medium to deep red)	Fig. Red 1, 12070		Mutagen		[6410-10-2]
Permanent Carmine HF4C	Fig. Red 185 See Monoazo				
Permanent Red HPT	Fig. Red 175 See Monoazo Red				
Permanent Red BL	Fig. Red 149 See Perylene Scarlet				
Permanent Red HPM	Fig. Red 171 See Monoazo				
Permanent Red 2B-Ba Salt (light red)	Fig. Red 48:1, 15865:1				[7585-41-3] [3564-21-4]
Permanent Red 2B-Ca Salt (medium red)	Fig. Red 48:2, 15865				[7585-41-3] [3564-21-4]
Perinone Red FTG	Vat Red 15				
Perinone Red [Anthraquinone]	Fig. Red 194, 71100 See Vat Red				
Perylene, nitrogen free	Fig. Red 175				
Perylene Vermillion	Fig. Red 123, 71145, 71140				[23108-89-2]

(Continued)



TABLE C-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>RED (Continued)</u>					
Perylene Maroon	Fig. Red 179, 71130				[5521-31-3]
Perylene	Fig. Red 224		Mutagen		[198-55-0]
Perylene Scarlet	Fig. Red 149, 71137				[12225-02-4]
Perylene Medium Red	Fig. Red 190, 71140				[6424-77-7]
Pigment Scarlet 3B Lake (bluish red) [Mordant Red 9 and Al <sub>2</sub> (OH) <sub>3</sub> ] [Monoazo]	Fig. Red 60, 16105				[1836-22-2]
Pigment Scarlet-Ba Salt [Monoazo]	Fig. Red 60:1, 16105:1 See Fig. Scarlet 3B				
Pyranthrone Orange	Fig. Red 197, 59710				[1324-33-0]
Pyrazolone (medium red) [Disazo]	Fig. Red 38, 21120				
Pyrazolone Red (yellow shade) [Disazo]	Fig. Red 37, 21205				
Quinacridone Magenta [Quindo Magenta]	Fig. Red 122, 73915 Fig. Red 202				[980-26-7]
R.K. Anthranthrone [Anthraquinone]	Fig. Red 168 See Vat Orange				
Red Lake R (light red)	Fig. Red 64				
Thioindigo Red	Fig. Red 86, 73375 Fig. Red 88, 73312 Fig. Red 198, 73390				
Thioindigo Maroon	Not assigned, 73390				
Thioindigo Pink	Fig. Red 181, 73360				
Thioindigoid	Fig. Red 131, 73360				
Toluidine Maroon (light red) [Monoazo]	Fig. Red 3, 12120		Tumorigen		[2425-85-6]

(Continued)

TABLE C-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>RED (Continued)</u>					
Toluidine Maroon (Continued) [Substituted amines coupled to naphthol]	Fig. Red 13, 12395 Fig. Red 5, 12490				
Vat Orange [Anthraquinone]	Fig. Red 168, 59300				
Vat Pink	Fig. Red 181, 73360 See Thioindigo Pink				
Vat Red (medium red)	Fig. Red 194, 71100				
<u>ORANGE</u>					
Anthanthrone Orange (brominated)	Fig. Orange 168, 59300				[4378-61-4]
Anthramide Orange [Vat pigment]	Vat Orange 15, 69025				[2379-78-4]
Benzidine Orange	Fig. Orange 13, 21110 See Diarylide Orange				[3520-72-7]
Benzimidazolone Orange	Fig. Orange 36, 11780 See Monoazo Orange				[1324-33-0]
Brominated Pyranthrone	Vat Orange 14, 59710				
Cromophtal Orange 4R					
Dianisidine Orange	Fig. Orange 16, 21160				[6837-37-2]
Dianisidine Orange GG	Fig. Orange 14				
Diarylide Orange	Fig. Orange 13, 21110				
Diarylide Orange RL	Fig. Orange 34				[15793-73-4]
Dinitroaniline Orange [Monoazo] [1-((2,4-Dinitrophenyl)Azo)-2- Naphthol]	Fig. Orange 5, 12075		Mutagen		[3468-63-1]
Disazo Orange 4R	Fig. Orange 31				[12286-58-7]
GR Perinone Orange [vat pigment] [Anthraquinone]	Fig. Orange 43, 71105 Vat Orange 7, 71105				[42612-21-5]
Homolog-Red Lake C (yellowish red)	Fig. Orange 46, 15602				

(Continued)

TABLE C-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>ORANGE</u> (Continued)					
Indofast Double Scarlet	Vat Orange 4, 59710				
Irgazin Orange RLT					
Isoindolinone Orange	Fig. Orange 61 Fig. Orange 42				
Modified Azo Orange					
Monoazo Red (Orange)	Fig. Orange 38, 77878				
Monoazo Orange [C <sub>17</sub> H <sub>3</sub> N <sub>6</sub> O <sub>5</sub> Cl]	Fig. Orange 36, 11780 Fig. Orange 60 Fig. Orange 62				
Orange RK	Vat Orange 3, 59300				
Perinone Orange GR [Anthraquinone]	Vat Orange 7, 71105 Fig. Orange 43 See GR Perinone Orange				
Pyranthrone Orange [Vat Pigment]	Vat Orange 9, 59700 Fig. Orange 40				[128-70-1]
Pyrazolone Orange [Disazo]	Fig. Orange 13, 21110 See Diarylide Orange				
Tolyl Orange	Fig. Orange 30				
Quinacridone Gold	Fig. Orange 48				
<u>YELLOW</u>					
8-Amino Anthraquinone (yellow)					
Anthrapyrimidine (yellow) [Anthraquinone]	Fig. Yellow 108, 68420 Vat Yellow 20, 68420				[4216-01-7]
Anthrapyrimidine (yellow, medium yellow)	Fig. Yellow 108				
Anthraquinone Yellow					

(Continued)

TABLE C-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>YELLOW (Continued)</u>					
Azo Yellow	Dis. Yellow 3, 11855				
Azoic Yellow (light yellow)	Fig. Yellow 81, 21127 Fig. Yellow 113, 21126 Fig. Yellow 16, 20040				
Azoic Yellow (medium yellow)	Fig. Yellow 120, 11783				
Azoic Yellow, specialty (light yellow)	Fig. Yellow 151 Fig. Yellow 154				
Azomethine Yellow [Irgazin yellow SGLT]	Fig. Yellow 129				
Benzidine Yellow [Disazo] [2,2'-((3,3'-Di-chloro-4,4'-bi- phenylene)diazo)bis-acetoacetanilide] [Diarylide Yellow Anilide]	Fig. Yellow 12, 21090		Negative Carcinogen		[6358-58-6]
Benzidine Yellow HR					[20139-68-9]
Benzidine Yellow AAMX [Disazo]	Fig. Yellow 13 See Diarylide Yellow Xylidide				[5102-83-0]
Benzidine Yellow AAOA	Fig. Yellow 17 See Diarylide Yellow Anisidine				[4531-49-1]
Benzidine Yellow AAOT	Fig. Yellow 14 See Diarylide Yellow Ortho Toluidide				[5468-75-7]
Cromophtal Yellow 3G (yellow) [Disazo Condensation Yellow]	Fig. Yellow 93				[5580-57-4]
Cromophtal Yellow 6G [Disazo]	Fig. Yellow 94				[5580-58-5]
Cromophtal Yellow GR [Disazo]	Fig. Yellow 95				[5280-80-8]
Diarylide Yellow	Fig. Yellow 106				
Diarylide Yellow AAMX (light transparent)	Fig. Yellow 127				

(Continued)

TABLE C-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>YELLOW (Continued)</u>					
Diarylide Yellow NCG	Pig. Yellow 16, 20040 See Azoic Yellow				
Diarylide Yellow Anilide (light yellow) [Diarylide Yellow AAA]	Pig. Yellow 12, 21090 [See Benzidine Yellow]				[6358-85-6]
Diarylide Yellow Anisidide (light yellow) [Diarylide Yellow AAOA]	Pig. Yellow 17, 21105				
Diarylide Yellow, HR (medium yellow)	Pig. Yellow 83, 21108, 21118				
Diarylide Yellow Ortho Toluidide (yellow)	Pig. Yellow 14, 21095				
Diarylide Yellow Xylidide (light yellow)	Pig. Yellow 13, 21100				
Disazo Yellows (other)	Pig. Yellow 155 Pig. Yellow 128				
FD&C Yellow #5 Aluminum Lake (food yellow 4) [Monoazo Aluminum Salt]	Pig. Yellow 100, 19140:1	Oral, mouse LD <sub>50</sub> :12750 mg/kg			[1934-21-0]
FD&C Yellow #6 Aluminum Lake (food yellow 3) [Monoazo Aluminum Salt]	Pig. Yellow 104, 15985:1	Intraperitoneal, rat LD <sub>50</sub> :3800 mg/kg	Indefinite Carcinogen		[2783-94-0]
Flavanthrone (yellow) [Anthraquinone]	Pig. Yellow 24, 70600				[475-71-2]
Hansa Yellow 10G (primrose, light medium yellow)	Pig. Yellow 3, 11710				
Hansa Yellow R	Pig. Yellow 10, 12710				
Hansa Yellow 4R	Pig. Yellow 60, 12702				[6407-74-5]
Hansa Yellow G [Monoazo]	Pig. Yellow 1, 11680, 11860				[2512-29-0]
Irgazin Yellow 5GLT	Pig. Yellow 129 See Azomethine Yellow				
Irgazin Yellow 2GRT	Pig. Yellow 109 See Isoindolinone Yellow				

(Continued)

TABLE C-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>YELLOW (Continued)</u>					
Irgazin Yellow 2RLT, 3RLT (isoindolinone)	Fig. Yellow 110 See Isoindolinone Yellow				
Isoindoline Yellow	Fig. Yellow 139				
Isoindolinone Yellow [Irgazin Yellow 2GRT]	Fig. Yellow 109				
Isoindolinone Yellow [Irgazin Yellow 2RLT, 3RLT]	Fig. Yellow 110				
Modified Azo (light yellow)					
Monoazo Yellow (light yellow) [Permanent Yellow FGL]	Fig. Yellow 97, 11797, 11767				[12225-18-2]
Permanent Yellow FGL	Fig. Yellow 97 See Monoazo Yellow				
Permanent Yellow HR	Fig. Yellow 83 See Diarylide Yellow HR				
Permanent Yellow H2G	Fig. Yellow 120 See Azoic Yellow				
Permanent Yellow H10GH [Disazo]	Fig. Yellow 113 See Azoic Yellow				
Quinophtalone Yellow	Fig. Yellow 138				
Sandorin Yellow GGL [Isoindolinone]	Fig. Yellow 109				
Palitol Yellow 1090	Fig. Yellow 138 See Quinophtalone				

(Continued)

TABLE C-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>DYES (SOLUBLE)</u>					
Acetate (wide color range)					
Acid Chrome and Direct (wide color range)					
Basic Dyes (wide color range)					
Anthraquinone (yellow-red, green, blue, brown)					
<u>BROWN-BLACK</u>					
Azo Dyes [4-(1-Naphthylazo) m-phenylenediamine]	Sol. Brown 1, 11285	Oral, rat TD <sub>LO</sub> : 34 gm/kg Toxic Effect: Carcinogen	Indefinite Carcinogen		[646-57-5]
[2,3-dihydro-2,2-dimethyl-6-((4 (phenylazo)-1-Naphthyl)azo)- perimidine]	Sol. Black 3	Intravenous, mouse LD <sub>50</sub> : 63 mg/kg			[4197-25-5]
	Sol. Brown 11				
Azo Metal Complex Dyes	Sol. Black 27				
	Sol. Black 28				
Nigrosine	Sol. Black 5, 50415				
Induline					
<u>YELLOW</u>					
Anthraquinone Yellow Dyes	Dis. Yellow 64				
MonoAzo Dyes	Sol. Yellow 2, 11020	Oral, rat LD <sub>50</sub> : 200 mg/kg	Positive Animal Carcinogen Mutagen		[60-11-7]
[N,N-dimethyl-p-phenylazo aniline]	Sol. Yellow 16, 12700 Sol. Yellow 56, 11021				
[1-phenylazo)-2-naphthol]	Sol. Yellow 14, 12055	Subcutaneous, mouse TD <sub>LO</sub> : 6,000 mg/kg/57W-1 Toxic Effect: Equivocal Tumorigenic Agent	Positive Animal Carcinogen		[842-07-9]

(Continued)

TABLE C-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>YELLOW (Continued)</u>					
Disazo Dyes (Disazo)	Sol. Yellow 30, 21240				
	Sol. Yellow 71				
	Sol. Yellow 72				[61813-98-7]
	Sol. Yellow 29				
	Dis. Yellow 23				
Azo [N-(4((2-Hydroxy-5-methyl phenyl) azo)phenyl) acetamide]	Dis. Yellow 3	Oral, rat LD <sub>50</sub> : 180 gm/kg/2Y-C Toxic Effect: Carcinogen	Indefinite Carcinogen Mutagen		[2832-40-8]
	Dis. Yellow 34				
Azo Metal Complex Dyes	Sol. Yellow 65				
	Sol. Yellow 79				
	Sol. Yellow 81				
	Sol. Yellow 82				
	Sol. Yellow 48				
	Sol. Yellow 89				
	Sol. Yellow 95				
Brilliant Sulfofavin [2,3-dihydro-6-amino-1,3-dioxo-2-p-tolyl]-1H Benz-(de)iso-quinoline-5-sulfonic acid, monosodium salt]	Acid Yellow 7	Intravenous, mouse LD <sub>50</sub> : 110 mg/kg			[2391-30-2]
Metanil Yellow	Acid Yellow 36	Intraperitoneal, mouse LD <sub>50</sub> : 1000 mg/kg	Negative Animal Carcinogen		[587-98-4]
Monomethine	Sol. Yellow 93				
Palacet Yellow SF7861	Dis. Yellow 13, 58900				[3688-79-1]
Palacet Yellow SF7862	Dis. Yellow 116		Negative Animal Carcinogen		
Quinoline Yellow	Sol. Yellow 33, 47000				
<u>ORANGE</u>					
Anthraquinone Dyes Perinone [Turn Signal Color]	Sol. Orange 60				[61969-47-9]

(Continued)



TABLE C-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>ORANGE</u> (Continued)					
Azo Dyes [1-(2,4-xylylazo)-2-naphthol]	Sol. Orange 1, 11920 Sol. Orange 7	Implant, mouse TD <sub>Lo</sub> : 80 mg/kg Toxic Effect: Carcinogen	Conflicting Data Positive Animal Carcinogen		[3118-97-6]
Azo Metal Complex Dyes	Sol. Orange 54 Sol. Orange 56 Sol. Orange 59				
Xanthene Dyes	Sol. Orange 63				[54578-43-7]
<u>RED</u>					
Anthraquinone Reds Perinone	Sol. Red 135 Sol. Red 195				
[Taillight Red]	Sol. Red 111, 60505				[82-38-2]
Amaplast Rubinol R	Sol. Red 52, 68210				
Azo Dyes Disazo	Sol. Red 1, 12150 Sol. Red 27, 26125 Sol. Red 23, 26100				[1229-55-6]
[1-((4-(phenylazo) phenyl)azo)-2-naphthalenol]	Sol. Red 23, 26100	Intraperitoneal, rabbit LD <sub>Lo</sub> : 250 mg/kg	Indefinite Carcinogen		[85-86-9]
[1-((4-(o-tolylazo)-o-tolyl)azo)-2-naphthol]	Sol. Red 24, 26105	Subcutaneous, rat TD <sub>Lo</sub> : 512 mg/kg/58W-1 Toxic Effect: Carcinogen	Positive Animal Carcinogen		[85-83-6]
	Sol. Red 3, 12010		Negative Animal Carcinogen		
[N-ethyl-1-((p-(phenylazo)phenyl)azo)-2-naphthylamine]	Sol. Red 19 Sol. Red 22	Oral, rat TD <sub>Lo</sub> : 15 gm/kg/50W-C Toxic Effect: Equivocal Tumorigenic Agent	Indefinite Carcinogen Mutagen		[6368-72-5]
	Sol. Red 40				
	Sol. Red 26				[4477-79-6]
Azo Metal Complex Dyes	Sol. Red 118 Sol. Red 119 Sol. Red 122 Sol. Red 125				

(Continued)

TABLE C-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>RED (Continued)</u>					
Congo Red [Sodium diphenyl-bis-alpha-naphthalamine sulfonate]	Direct Red 28	Toxic Intravenous, rat LD <sub>50</sub> :190 mg/kg	Possible Carcinogen Allergen Mutagen		[573-58-0]
Palacet Pink SF-7867 [1,5-Diamino-anthraquinone]	Dis. Red 4, 60755	Intraperitoneal, rat LD <sub>50</sub> :2600 mg/kg			[2379-90-0]
	Dis. Red 11, 62015	Intraperitoneal, rat LD <sub>50</sub> :1300 mg/kg	Primary Irritant		[129-44-2]
Palacet Red SF-7874	Dis. Red 60	Eye, rabbit 500 mg/24 Hr. Toxic Effect: Mild Irritation	Primary Irritant		[17418-58-5]
Rhodamine B Base	Sol. Red 49, 451708				
Vat Red	Vat Red 1, 73360				
Xanthene [o-(6-(ethylamino)-3(ethylimino)-2,7-dimethyl-3H-xan-thene-9-yl)-Benzoic acid, ethyl ester, monohydrochloride]	Acid Red 52	Intravenous, mouse LD <sub>50</sub> :310 mg/kg			[3520-42-1]
	Basic Red 1	Intraperitoneal, mouse LD <sub>50</sub> :2 mg/kg	Positive Animal Carcinogen Mutagen		[989-38-8]
<u>VIOLET</u>					
Anthraquinone [1-Hydroxy-4-(p-Toluidino)anthraquinone]	Dis. Violet 31 Sol. Violet 13, 60721 Sol. Violet 14, 61705				[81-48-1]
Carbazole Dioxazine	Sol. Violet 23, 51319				
Palacet Red Violet SF-7868 [1,4 Diaminoanthraquinone]	Dis. Violet 1, 61100	Intraperitoneal, rat LD <sub>50</sub> :1300 mg/kg	Primary Irritant Mutagen		[128-95-0]
Palacet Violet SF-7870	Dis. Violet 4, 61105	Intraperitoneal, rat LD <sub>50</sub> :1000 mg/kg			[1220-94-6]
Palacet Blue SF-7872	Sol. Violet 13, 60725 See Anthraquinone dye	Intraperitoneal, mouse LD <sub>50</sub> :512 mg/kg			[81-48-1]

(Continued)

TABLE C-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>VIOLET (Continued)</u>					
Rhodamine B [Xanthene] [9-(o-Carboxyphenyl)-6-(Diethyla- mino)-3H-Xanthen-3-ylidene]diethyl ammonium chloride]	Basic Violet 10	Intravenous, rat LD <sub>50</sub> : 89 mg/kg	Positive Animal Carcinogen Mutagen		[81-88-9]
<u>BLUE AND GREEN</u>					
Anthraquinone	Sol. Blue 56				[14233-37-5]
(Alizarine)	Sol. Blue 58				
	Sol. Blue 59				
	Sol. Green 3, 61565	Oral, rat LD <sub>50</sub> : 3060 mg/kg	Primary Irritant		[128-80-3]
	Sol. Green 28				
Amplast Blue RJK [Anthraquinone]	Sol. Blue 16				
Amplast Bordeaux BPS					
Azo Dyes	Sol. Blue 35				
Azo Metal Complex Dyes	Sol. Blue 67				
	Sol. Blue 53				
Phthalocyanine	Sol. Blue 70				
Palacet Blue SF-7871 [1-((2-Hydroxy- ethyl)amino)-4-(methylamino) anthraquinone]	Dis. Blue 3	Oral, rat LD <sub>50</sub> : 3000 mg/kg	Primary Irritant		[2475-46-9]
Thermoplast Brilliant Yellow 10G [Anthraquinone]	Sol. Green 5, 59075				
Triphenylmethane Dye	Victoria Blue B				[6786-83-0]
Unspecified	Sol. Blue 3, 61505				
Xanthene Dyes	Sol. Green 4				[81-37-8]
<u>FLUORESCENTS</u>					
Bisazoles					
Vinylenebisbenzooazoles					

(Continued)

TABLE C-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>FLUORESCENTS (Continued)</u>					
Coumarins MDAC [4-methyl-7-diethylamino coumarin] [3 phenyl-7-amino coumarins]		Oral, rat LD <sub>50</sub> : 5 mg/kg			[91-44-1]
Stilbenes Derivatives of stilbene-naphthotriazole (4-naphtho-triazolylstilbene)					
Fluorescent (dyed organic glass particles, full color range)					
Fluorescent					
(Pure dye, assorted color range)					
(Sulfides)					
<u>PHOSPHORESCENT</u>					
[zinc sulfide]		Toxic			
[zinc cadmium sulfide or calcium strontium sulfide]		Low (ZnS) Toxic (SrS), (CdS)	Irritant	0.5 mg(Cd)/m <sup>3</sup> TWA	
<u>PEARLESCENTS</u>					
Bismuth Coated Mica (pearly luster)			Inhalation Silicosis	20 mppcf	[12001-26-2] (mica)
Bismuth Coated Talc (pearly luster)					
Bismuthoxychloride (pearly luster) [BiOCl]					
Lead Carbonate I (brilliant pearl) [xPbCO <sub>3</sub> ·yPb(OH) <sub>2</sub> ]		Toxic Oral, guinea pig LD <sub>50</sub> : 1000 mg/kg		50 ug(Pb)/m <sup>3</sup> TWA	[598-63-0]
Lead Carbonate II (opaque pearl) [xPbCO <sub>3</sub> ·yPb(OH) <sub>2</sub> ]		Oral, guinea pig LD <sub>50</sub> : 1000 mg/kg		50 ug(Pb)/m <sup>3</sup> TWA	[598-63-0]

(Continued)

TABLE C-5 (Continued)

<u>Colorant</u>	<u>Color Index</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>PEARLESCENTS</u> (Continued)					
Metallic Oxide Brown-FDA (high heat stable) [x-Ferric oxide crystallized from a borox melt] and other compositions					
Metallic Oxide Browns (high heat stable)					
Titanium Dioxide/Mica Composite (pearly luster)		Nontoxic		10 mg(TiO <sub>2</sub> )/m <sup>3</sup> TWA	
Titanium Dioxide/Mica/Inorganic Pigment				10 mg(TiO <sub>2</sub> )/m <sup>3</sup> TWA	
<u>METALLICS</u>					
Aluminum; Plastic Grades (silver)	Pig. Metal 1, 77000, 77001	Nontoxic	Fine Powders - Fire Risk	10 mg/m <sup>3</sup> TWA (recommended)	[7429-90-8]
Bronze; Plastic Grades (red gold to yellow gold) [pale gold bronze (92% Cu, 6% Sn, 2% Al)] [rich pale gold bronze (90% Cu, 9.25% Zn, 0.75% Al)] [rich gold bronze (77% Cu, 22% Zn, 1% Al)] [green gold bronze (68.75% Cu, 31% Zn, 0.25% Al)]	Pig. Metal 2, 77400			1 mg(Cu)/m <sup>3</sup> TWA	
Copper; Plastic Grades (coppery red)		Toxic (powders) Oral, rat TD <sub>Lo</sub> : 152 mg/kg Toxic Effect: Reproductive; Embryotoxicity; Developmental	Mutagen Teratogen Inhalation Powder is Flammable	1 mg/m <sup>3</sup> TWA 2 mg/m <sup>3</sup> STEL (recommended)	[7440-50-8]

TABLE C-6. COUPLING AGENTS  
TOXICOLOGICAL AND WORKER EXPOSURE CONCERNS

<u>Coupling Agent</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>SILANES</u>				
N-β-Aminoethylaminomethylphenylethyltrimethoxysilane				
N-β-Aminoethyl-γ-aminopropyltrimethoxysilane [A-1120]	Oral, rat LD <sub>50</sub> : 7460 mg/kg	Primary Irritant		[1760-24-3]
Aminophenyltriethoxysilane				
γ-Aminopropyltriethoxysilane [A-1100, A-1112, A-1114]	Oral, rat LD <sub>50</sub> : 1780 mg/kg	Primary Irritant		[919-30-2]
Amyltrimethoxysilane	Oral, rat LD <sub>50</sub> : 4920 mg/kg			[299-95-4]
Bis(β-Hydroxyethyl)-γ-aminopropyltriethoxysilane				[7538-44-5]
γ-Chloroisobutyltriethoxysilane				
Chloromethylphenylethyltrimethoxysilane				
γ-Chloropropyltrimethoxysilane [Z-6076]				[2530-87-2]
β-Cyclohexylethyltrimethoxysilane				
β-(3,4-Epoxy-cyclohexyl)ethyltrimethoxysilane [A-186]	Oral, rat LD <sub>50</sub> : 12300 mg/kg	Primary Irritant		[3388-04-3]
γ-Glycidoxypropyltrimethoxysilane [A-187]	Oral, rat LD <sub>50</sub> : 23 gm/kg	Primary Irritant		[2530-83-8]
γ-Mercaptopropyltrimethoxysilane	Oral, rat LD <sub>50</sub> : 2830 mg/kg	Primary Irritant		[4420-74-0]
γ-Methacryloxypropyltrimethoxysilane [A-174]	May Be Toxic Oral, rat LD <sub>50</sub> : 23 gm/kg	Fire Risk Primary Irritant		[2530-85-0]
Methylphenyltrimethoxysilane				
Methoxyphenyltrimethoxysilane				None

(Continued)

TABLE C-6 (Continued)

<u>Coupling Agent</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>SILANES</u> (Continued)				
Octyltriethoxysilane				
Phenyltriethoxysilane	Oral, rat LD <sub>50</sub> : 2830 mg/kg			[780-69-8]
Sulfonyl azide silane (proprietary)				
γ-Ureidopropyltriethoxysilane [A-1160]				[23779-32-0]
Vinylbenzyl cationic silane				
Vinylbenzylpropyltrimethoxysilane				
Vinyltriethoxysilane [A-151]	Oral, rat LD <sub>50</sub> : 23 gm/kg	Primary Irritant		[78-08-0]
Vinyltrimethoxysilane	Oral, rat LD <sub>50</sub> : 11300 mg/kg			[2768-02-7]
Vinyl-tris-(2-methoxyethoxy)silane [A-172]	Oral, rat LD <sub>50</sub> : 2960 mg/kg	Primary Irritant		[1067-53-4]
<u>TITANATES</u>				
Acrylamino pyrophosphate titanate [KR-262A]				
Acrylojunctional organotitanate pyrophosphate [KR-238A]		Ingestion		
4-Aminobenzenesulfonyl dodecylbenzene- sulfonyl ethylene titanate [KR-226S]				
4-Aminobenzoyl, isostearoyl ethylene titanate [KR-237BS]		Skin Contact Ingestion		
Di(butyl, methyl pyrophosphato) ethylene titanate [KR-262S]				
Di(butyl, methyl pyrophosphato) ethylene titanate mono(dioctyl, hydrogen phosphate) [KR-262ES]				

(Continued)

TABLE C-6 (Continued)

<u>Coupling Agent</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>TITANATES (Continued)</u>				
Di(butyl, methyl pyrophosphato) isopropyl titanate mono(dioctyl, hydrogen) phosphite [KR-62ES]				
Di(dioctyl phosphato)ethylene titanate [KR-212]		Skin Contact		
Di(dioctyl pyrophosphato) ethylene titanate [KR-238S]		Skin Contact		
Diisostearyl ethylene titanate [KR-201]		Skin Contact		
Dodecylbenzenesulfonyl (4-aminobenzene sulfonyl), ethylene titanate [KR-226S]				
Ethylene, di(dioctyl)pyrophosphato titanate [KR-238J]				
Ethylene, di(dioctyl pyrophosphato) titanate dimethylamino-i-butanol adduct				
Isopropyl, 4-aminobenzenesulfonyl, di(dodecylbenzenesulfonyl) titanate [KR-26S]		Moderately Severe Skin Irritant		
Isopropyl diacryl isostearoyl titanate [KR-11]		Moderately Severe Skin Irritant		
Isopropyl (di-4-aminobenzoyl)isostearoyl titanate [KR-37BS]		Moderately Severe Skin Irritant		
Isopropyl diisostearoyl acryl titanate [KR-10]		Moderately Severe Skin Irritant		
Isopropyl diisostearoyl methacryl titanate [KR-6]		Moderately Severe Skin Irritant		
Isopropyl, dimethacryl, isostearoyl titanate [KR-7]		Moderately Severe Skin Irritant		

(Continued)



TABLE C-6 (Continued)

<u>Coupling Agent</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>TITANATES (Continued)</u>				
Isopropyl di(methyl, butyl pyrophosphate) titanate [KR-62S]				
Isopropyl isostearoyl diacryl titanate [KR-11]		Moderately Severe Skin Irritant		
Isopropyl methacryl diisostearoyl titanate [KR-6]				
Isopropyl octyl, butyl pyrophosphate titanate [KR-58DS]				
Isopropyl, triacryl titanate [KR-39BS], [KR-39CS]		Moderately Severe Skin Irritant		
Isopropyl tri(2-aminobenzoyl) titanate [KR-52S]				
Isopropyl triaminoethylethylamino titanate [XKR-44U]		Ingestion		
Isopropyl tri(butyl, octyl pyrophosphato) titanate di(dioctyl, hydrogen) phosphate [KR-58FS]				
Isopropyl tricumylphenyl titanate [KR-34BS], [KR-34S]				
Isopropyl, tri(dioctyl phosphato) titanate [KR-12]		Moderately Severe Skin Irritant		
Isopropyl tri(dioctyl pyrophosphato) titanate [KR-38S]		Ingestion Inhalation Skin Irritant		
Isopropyl, tridodecylbenzenesulfonyl titanate [KR-9S]		Moderately Severe Skin Irritant		[61417-55-8]
Isopropyl, tri(N-ethylaminoethylamino) titanate [KR-44]		Moderately Severe Skin Irritant		

(Continued)

TABLE C-6 (Continued)

<u>Coupling Agent</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>TITANATES (Continued)</u>				
Isopropyl, trisostearoyl titanate [KR-TTS], [KR-15]		Moderately Severe Skin Irritant		[61417-49-0]
Isopropyl tri(3-mercaptopropionyl) titanate [KR-66S]				
Isopropyl trimethacryl titanate [KR-33BS], [KR-33CS]		Moderately Severe Skin Irritant		
Isopropyl triricinoyl titanate [TTR-27]		Moderately Severe Skin Irritant		
Isopropyl tri(tetraethylenetriamine) titanate [KR-63S]				
Oxoethylene di(butyl, octyl pyrophos- phato) titanate dimethylamino-i-butanol adduct [KR-158D]				
Oxoethylene di(dioctyl pyrophosphato) titanate dimethylamino-i-butanol adduct [KR-138D]				
Oxoethylene di(dioctyl) pyrophosphato titanate di(dimethylaminopropyl meth- acrylamide) [KR-138J]				
Oxoethylene di(dioctyl) pyrophosphate titanate triethylamine complex [KR-138T]		Eye Contact		
Proprietary [KR-9T]				
Proprietary [KR-238T]				
Pyrophosphato titanium ammonium meth- acrylate [KR-238M]				
Tetra(2,2-diallyloxymethyl-1-butoxy- titanium di(ditridecyl) phosphite [KR-55]		Moderately Severe Skin Irritant		[6157-14-8]
Tetraisopropyl, di(dioctyl phosphito) titanate [KR-41B]		Skin Irritant		

(Continued)

TABLE C-6 (Continued)

<u>Coupling Agent</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>TITANATES</u> (Continued)				
Tetraisopropyl di(tridecyl phosphito) titanate [KR-36C]		Moderately Severe Skin Irritant		
Tetraoctyloxytitanium di(dilauryl-phosphite) titanate [KR-46B]				
Tetraoctyloxytitanium di(ditridecyl phosphite) [KR-46B]				
Titanium acrylate isostearate oxyacetate [KR-110S]				
Titanium 4-aminobenzoate, isostearate, oxyacetate [KR-137BS]		Skin Contact		
Titanium 4-aminobenzene sulfonate, dodecylbenzenesulfonate, oxyacetate [KR-126S]				
Titanium diacrylate, oxyacetate [KR-139BS], [KR-139CS]				[65345-30-4]
Titanium di(butyl, octyl pyrophosphate) di(dioctyl, hydrogen phosphite) oxyacetate [KR-158FS]				
Titanium di(butyl, octyl pyrophosphate) oxyacetate [KR-158DS]				
Titanium di(cumylphenolate) oxyacetate [KR-134BS], [KR-134CS]		Skin Contact		
Titanium di(dioctyl phosphate) oxyacetate [KR-112S]				
Titanium di(dioctyl pyrophosphate) oxyacetate [KR-138S]				

(Continued)

TABLE C-6 (Continued)

<u>Coupling Agent</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>TITANATES (Continued)</u>				
Titanium dimethacrylate, oxyacetate [KR-133BS], [KR-133CS]				[63735-11-5]
Titanium isostearate methacrylate oxyacetate [KR-106], [KR-106S]				
Titanium (IV) bismethacrylate, oxoethylene diolato [KR-133DS]		Ingestion		
Titanium (IV) bis(methyl, butyl) pyro- phosphato, ethylenediol bis 3-N-dimethyl- amino isobutanol [KR-262D]		Ingestion Skin Contact		
Titanium (IV) trisacrylate methoxy- diglycolate [XKR-39DS]		Skin Contact		
Titanium (IV) trimethacrylate methoxy- glycolate [XKR-33DS]		Ingestion		
Tri(butyl, octyl pyrophosphato) iso- propyl titanate mono(dioctyl, hydrogen phosphite) [KR-58FS], [KR-58S]				
Tris(dioctyl)pyrophosphato, isopropyl titanate				
<u>ESTERS</u>				
Calcium stearate	Low			
Stearic acid	Nontoxic Skin, humans 75 mg/3D Toxic Effect: Mild Irritation	Tumorigen Primary Irritant		[57-11-4]
<u>PROPRIETARY ESTERS</u>				
Anti-Terra U-80 [Unsaturated acid ester neutralized with polyaminoamine; electroneutral]				
Surfaid-90 (fatty acid ester)				

(Continued)

TABLE C-6 (Continued)

<u>Coupling Agent</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>PROPRIETARY ESTERS</u> (Continued)				
VP-109 [Unsaturated fatty acid, anionic]				
VP-900 [Polymeric ester, anionic]				
VP-905 [Polymeric esters, unsaturated, combination of anionic and cationic]				
W-900 [Low molecular weight polymeric salt]				
W-905 [Low and medium molecular weight polymeric salt and anionic polymeric salt]				
W-910 [Medium molecular weight fatty acid based anionic]				
W-980 [Medium molecular weight unsaturated acid ester neutralized with polyamino amine]				
W-960 [Medium molecular weight unsaturated acid ester]				
<u>MISCELLANEOUS PROPRIETARY</u>				
<u>PROPRIETARY ORGANOSILICONS</u>				
Union Carbide Y-9578				
Union Carbide Y-9602				
Union Carbide Y-7676				
Union Carbide Y-9674				
Union Carbide Y-4935				
Union Carbide Y-9682				

(Continued)

TABLE C-6 (Continued)

<u>Coupling Agent</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>CHLORINATED PARAFFINS</u>				
Chlorez 700 [Chlorinated paraffins, 70% Cl]				
Chlorez 720 [Chlorinated paraffins, 70+% Cl]				
Chlorez 760 [Chlorinated paraffins, 70+% Cl]				
<u>CHROME-CONTAINING</u>				
Methacrylate chromic				

TABLE C-7. CURING AGENTS AND CATALYSTS FOR THERMOSETTING RESINS  
TOXICOLOGICAL AND WORKER EXPOSURE CONCERNS

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>AMINES</u>				
Alkanolamine [See Ethanolamine, Triethanolamine]				
m-Aminobenzylamine				
p-Aminobenzylaminoaniline				
N-Aminoethylethanolamine	Low Oral, rat LD <sub>50</sub> : 3000 mg/kg			[111-41-1]
N-Aminoethyl piperazine	Oral, rat LD <sub>50</sub> : 2140 mg/kg	Corrosive Tissue Irritant		[140-31-8]
Benzyl dimethylamine	Oral, rat LD <sub>50</sub> : 256 mg/kg	Combustible		[103-83-3]
Bis(dimethylaminoethyl) ether	Oral, rat LD <sub>50</sub> : 1230 mg/kg	Primary Irritant		[3033-62-3]
Bis(hexamethylene)triamine				
4-Chloroorthophenylene diamine	Oral, rat TD <sub>Lo</sub> : 136 gm/kg	Positive Carcinogen (Animal)		[95-83-0]
N-Cocomorpholine				
Cyclohexylpropylene diamine				
Diallyltetrahydriodipridyl				
Diaminocyclohexane	Oral, rat LD <sub>50</sub> : 390 mg/kg			[3385-21-5]
Diaminodiphenyl methane	Subcutaneous, rat LD <sub>50</sub> : 3300 mg/kg	Causes Toxic Hepatitis		[1208-52-2]
Diaminodiphenyl sulfone [DDS] [Sulfonyl dianiline]	Toxic Oral, humans LD <sub>Lo</sub> : 18 gm/kg/15 years Toxic Effect: Systemic Oral, rat LD <sub>Lo</sub> : 1000 mg/kg	Positive Carcinogen (Animal) Ingestion Tumorigen Mutagen		[80-08-2]

(Continued)

TABLE C-7 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>AMINES (Continued)</u>				
3,5(Diaminomethyl) aniline				
2,6-Diaminopyridine	Intraperitoneal, mouse LD <sub>50</sub> :100 mg/kg			[141-86-6]
Dicyanodiamine				
Diethanolamine	Low Oral, rat LD <sub>50</sub> :710 mg/kg		3 ppm (TLV) (proposed)	[111-42-42-2]
Diethylamine	Oral, rat LD <sub>50</sub> :540 mg/kg		25 ppm (air)	[109-89-7]
Diethylaminoethanol	Low Oral, rat LD <sub>50</sub> :1300 mg/kg	Primary Irritant	10 ppm TWA (skin)	[100-37-8]
Diethylaminopropylamine [DEAPA]	Oral, rat LD <sub>50</sub> :1410 mg/kg	Skin Irritant		[104-78-9]
Diethylenetriamine [DETA]	Toxic Oral, rat LD <sub>50</sub> :1080 mg/kg	Ingestion Inhalation Irritant (skin and eyes)	1 ppm (TLV) (recommended)	[111-40-0]
Dimethylamine	Toxic Oral, rat LD <sub>50</sub> :698 mg/kg	Fire Risk Irritant	10 ppm TWA	[124-40-3]
Dimethylaminoethanol	Low Oral, rat LD <sub>50</sub> :2340 mg/kg	Primary Irritant Moderate Fire Risk		[108-01-0]
Dimethylaminoethyl piperazine				
Dimethylaminomethyl phenol	May be toxic			
N,N-Dimethylaminopropylamine	Toxic Oral, rat LD <sub>50</sub> :1870 mg/kg	Ingestion Inhalation Irritant Fire Risk		[109-55-7]
1,1'(3(Dimethylamino)propyl) imino bis(2-propanol)				

(Continued)



TABLE C-7 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>AMINES</u> (Continued)				
Dimethylaminopyridine	Intravenous, mouse LD <sub>50</sub> : 182 mg/kg			[5683-33-0]
N,N-Dimethylbenzylamine	Oral, rat LD <sub>50</sub> : 265 mg/kg			[103-83-3]
Dimethylcyclohexylamine		Moderate Fire Risk		
Dimethylethanolamine	Low Oral, rat LD <sub>50</sub> : 2340 mg/kg	Moderate Fire Risk		[108-01-0]
N,N-Dimethylhexadecylamine				
N,N-Dimethylpiperazine	Presumed Low Oral, rat LD <sub>50</sub> : 3160 mg/kg			[106-55-8]
Di(morpholinoethyl)ether				
Ethyldiethanolamine	Low			
N-Ethylenediamine	Toxic Oral, rat LD <sub>50</sub> : 1200 mg/kg	Irritant to skin and eyes Inhalation Skin Absorption Tumorigen	10 ppm	[107-15-3]
N-Ethylmorpholine	Toxic Inhalation, humans TC <sub>LO</sub> : 100 ppm/2.5 months Toxic Effect: Irritation Oral, rat LD <sub>50</sub> : 1200 mg/kg	Irritant to skin and eyes Skin absorption Fire Risk	20 ppm TWA	[100-74-3]
Glycidylether polyamine adducts				
Heptamethylisobiguamide				
Hexamethylenediamine	Toxic Oral, rat LD <sub>50</sub> : 750 mg/kg	Corrosive Ingestion Irritant		[124-09-4]

(Continued)

TABLE C-7 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>AMINES (Continued)</u>				
Hexamethylenetetramine	Moderately toxic Oral, mouse LD <sub>Lo</sub> : 512 mg/kg	Skin Irritant Fire Risk		[100-97-0]
N-(8-Hydroxyethyl)piperazine	Low Oral, rat LD <sub>50</sub> : 4920 mg/kg			[103-76-4]
N(2-Hydroxypropyl)ethylenedi- amine				
3,3'-Iminobispropylamine	Moderately Toxic Oral, rat LD <sub>50</sub> : 810 mg/kg	Corrosive Ingestion Inhalation Irritant		[56-18-8]
Menthane diamine	Oral, rat LD <sub>50</sub> : 770 mg/kg	Irritant to skin and eyes		[80-52-4]
N-Methoxyethylmorpholine				
α-Methylbenzyl dimethylamine	Low			
p,p'-Methylenedianiline [p,p'-diaminodiphenylmethane]	Toxic Oral, rat LD <sub>50</sub> : 347 mg/kg	May Cause Toxic Hepatitis	0.1 ppm TLV	[101-77-9]
N-Methylmorpholine	Toxic Oral, rat LD <sub>50</sub> : 600 mg/kg	Fire Risk Skin Irritant		[76-57-3]
Methylpiperazine	Oral, rat LD <sub>50</sub> : 2830 mg/kg	Fire Risk		[109-01-3]
Monomethylamine [Methylamine]	Toxic Subcutaneous, rat LD <sub>Lo</sub> : 200 mg/kg	Irritant to Skin Fire Risk	10 ppm TWA	[74-89-5]
Monoethanolamine [2-Aminoethanol]	Toxic Oral, rat LD <sub>50</sub> : 2100 mg/kg	Irritant to Skin	3 ppm TWA	[141-43-5]
Monoethylamine	Toxic Oral, rat LD <sub>Lo</sub> : 400 mg/kg	Strong Irritant Fire Risk	10 ppm TWA	[75-04-7]

(Continued)

TABLE C-7 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>AMINES</u> (Continued)				
Olefin oxide-polyamine adduct				
Pentaethylenhexamine	Oral, rat LD <sub>50</sub> : 1600 mg/kg			[4067-16-7]
m-Phenylenediamine	Toxic Oral, rat LD <sub>50</sub> : 650 mg/kg	Inhalation Irritant to Skin Tumorigen Mutagen		[108-45-2]
Piperidine	Toxic Oral, rat LD <sub>50</sub> : 30 mg/kg	Irritant Ingestion Inhalation Fire Risk Tumorigen Mutagen Teratogen		[110-89-4]
Polyoxyalkylenepolyamine				
Pyridine	Oral, rat LD <sub>50</sub> : 891 mg/kg		5 ppm TWA	[110-86-1]
Pyrrolidine	Moderately Toxic Oral, rat LD <sub>50</sub> : 300 mg/kg	Ingestion Inhalation Fire Risk		[123-75-1]
Quinuclidine				[100-76-5]
Silicone amine				
Tetraethylenepentamine	Toxic Oral, rat LD <sub>50</sub> : 3990 mg/kg	Irritant to Skin and Eyes		[112-57-2]
N-Tetramethylethylenediamine	Oral, rat LD <sub>50</sub> : 1580 mg/kg			[110-18-9]
N-Tetramethyl-1,3-butanediamine	Oral, rat LD <sub>50</sub> : 750 mg/kg	Primary Irritant		[97-84-7]
Tetramethylguanidine				
Triaminomethylbenzene				
Tri(dimethylaminomethyl) phenol	May be Toxic Oral, rat LD <sub>50</sub> : 1200 mg/kg	Primary Irritant		[90-72-2]

(Continued)

TABLE C-7 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>AMINES (Continued)</u>				
Triethanolamine borate	Oral, mouse LD <sub>50</sub> : 6200 mg/kg			[283-56-7]
Triethylamine	Toxic Oral, rat LD <sub>50</sub> : 460 mg/kg	Inhalation Ingestion Irritant to Tissue Fire Risk	25 ppm TWA	[121-44-8]
Triethylenediamine	Oral, rat LD <sub>50</sub> : 1870 mg/kg			[280-57-9]
Triethylenetetramine	Oral, rat LD <sub>50</sub> : 2500 mg/kg	Irritant to Skin and Eyes Mutagen Teratogen		[112-24-3]
1,2,4-Trimethylpiperazine				
2,4,6-Tris(dimethylaminoethyl) phenol				
2,4,6-Tris(dimethylaminomethyl) phenol	Oral, rat LD <sub>50</sub> : 1200 mg/kg			[90-72-2]
1,3,5-Tris((N,N-dimethyl-3- amino)propyl)- 5-hexahydro- triazine	Oral, rat LD <sub>50</sub> : 3250 mg/kg			[15875-13-5]
m-Xylidenediamine				
<u>AMINE OXIDES</u>				
Dimethyldodecylamine-N-oxide	Oral, rat LD <sub>50</sub> : 1000 mg/kg			[1643-20-5]
Pyridine-N-oxide	Intravenous, mouse LD <sub>50</sub> : 180 mg/kg			[694-59-7]
Trimethylamine-N-oxide	Oral, rat LD <sub>50</sub> : 8700 mg/kg			[62637-93-8]
<u>AMIDES</u>				
1,1-Dimethylurea				

(Continued)

TABLE C-7 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>AMIDES (Continued)</u>				
1,3-Dimethylurea	Unknown, rat TD <sub>Lo</sub> : 1000 mg/kg/ 13 D preg			[96-31-3]
1,3-Diphenylurea [carbanilide]	Oral, rat LD <sub>Lo</sub> : 500 mg/kg			[102-07-8]
1-Methylurea	Oral, rat LD <sub>Lo</sub> : 500 mg/kg			[598-50-5]
1-Phenylurea	Oral, mouse LD <sub>50</sub> : 1580 mg/kg			[64-10-8]
Urea [carbamide]	Low Oral, rat TD <sub>Lo</sub> : 821 gm/kg/1Y Toxic Effect: Carcinogen	Primary Irritant Tumorigen Mutagen		[57-13-6]
<u>IMIDAZOLES</u>				
Benzimidazole	Oral, rat LD <sub>50</sub> : 500 mg/kg			[51-17-2]
1-N-Butylimidazole				
1-N-Cyclohexylimidazole				
2-Ethyl-4-methylimidazole				
N-Propylimidazole				
<u>METAL COMPOUNDS</u>				
<u>ANTIMONY</u>				
Antimony pentachloride	Toxic Oral, rat LD <sub>50</sub> : 1115 mg/kg	Corrosive Mutagen	500 ug(Sb)/m <sup>3</sup> TWA	[7647-18-9]
Antimony trichloride	Oral, rat LD <sub>50</sub> : 525 mg/kg	Corrosive Irritant to skin and eyes	500 ug(Sb)/m <sup>3</sup> TWA	[10025-91-9]

(Continued)

TABLE C-7 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>CALCIUM</u>				
Calcium acetate	Nontoxic Intravenous, rat LD <sub>50</sub> :147 mg/kg			[62-54-4]
Calcium carbonate	Nontoxic		10 mg/m <sup>3</sup> TLV (recommended)	[1317-65-3]
Calcium naphthenate				
Tricalcium phosphate [Calcium phosphate, tribasic]	Nontoxic			
<u>CHROMIUM</u>				
Chromium (III) triacetyl acetate				
Chromium (III) tri-2-acetylcyclohexanoate				
Chromium (III) tri(dibenzoylmethane)				
Chromium (III) tri(1,3-diphenyl-1,3-pentanedioate)				
Chromium (III) tri(1,3-diphenyl-1,3-propanedioate)				
Chromium (III) tri-2-ethylhexanoate				
Chromium (III) tri(1-phenyl-1,3-butane-dione)	Intravenous, mouse LD <sub>50</sub> :180 mg/kg			[16432-36-3]
Chromium (III) tripicolinoate				
<u>COBALT</u>				
Cobalt benzoate				
Cobalt 2-ethylhexoate [Cobalt octoate]				
Cobalt naphthenate [Indefinite]	Oral, rat LD <sub>50</sub> :3900 mg/kg			[61789-51-3]

(Continued)

TABLE C-7 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>LEAD</u>				
Lead benzoate				
Lead 2-ethylhexoate				
Lead naphthenate [Indefinite]	Toxic Oral, rat LD <sub>50</sub> : 5100 mg/kg	Skin Absorption		[61790-14-5]
Lead oleate	Toxic Oral, guinea pig LD <sub>10</sub> : 4000 mg/kg	Skin Absorption	0.10 mg(Pb)/m <sup>3</sup> (recommended)	[1120-46-3]
Litharge, sublimed	Toxic Oral, dog LD <sub>10</sub> : 1400 mg/kg	Ingestion Inhalation	200 ug(Pb)/m <sup>3</sup> TWA	[1317-36-8]
<u>MANGANESE</u>				
Manganese 2-ethylhexoate [Manganese octoate]				
Manganese linoleate				
Manganese naphthenate [Indefinite]				
<u>PHOSPHORUS</u>				
Hexamethylphosphoric triamide [Hempa]	Toxic Oral, rat LD <sub>50</sub> : 2525 mg/kg	Positive Carcinogen (Animal)		[680-31-9]
Tri-n-butylphosphine				
Tributyldodecylphosphonium iodide				
Trioctylphosphine oxide				
Triphenyl phosphine oxide				

(Continued)

TABLE C-7 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>TIN</u>				
Dibutyltindiacetate	Toxic Oral, rat LD <sub>50</sub> :32 mg/kg		100 ug(Sn)/m <sup>3</sup> TWA (skin)	[1067-33-0]
Dibutyltindilaurate	Toxic Oral, rat LD <sub>50</sub> :175 mg/kg	Primary Irritant	0.1 mg(Sn)/m <sup>3</sup> TWA (recommended)	[77-58-7]
Dibutyltindioctate [Dibutyltindi-2-ethylhexoate]	Toxic Oral, rat LD <sub>50</sub> :200 mg/kg		0.1 mg(Sn)/m <sup>3</sup> TWA (recommended)	[2781-10-4]
Dibutyltinbisisoctylmaleate			100 ug(Sn)/m <sup>3</sup> TWA (recommended)	
Dibutyltinbisisoctylmercapto- acetate			100 ug(Sn)/m <sup>3</sup> TWA (recommended)	
Dibutyltinbislaurylmercaptide	Toxic		100 ug(Sn)/m <sup>3</sup> TWA (recommended)	
Dimethyltinbisisoctylmaleate			100 ug(Sn)/m <sup>3</sup> TWA (recommended)	
Dimethyltin isooctylmercapto- acetate			100 ug(Sn)/m <sup>3</sup> TWA (recommended)	
Dimethyltinbislaurylmercaptide			100 ug(Sn)/m <sup>3</sup> TWA (recommended)	
Stannous chloride	Toxic Oral, rat LD <sub>50</sub> :700 mg/kg	Skin Irritant	2 ug(Sn)/m <sup>3</sup> TWA	[7772-99-8]
Stannous octoate [Stannous-2-ethylhexoate]	Toxic		100 ug(Sn)/m <sup>3</sup> TWA (recommended)	
Stannous oleate	Toxic Intravenous, mouse LD <sub>50</sub> :100 mg/kg	Skin Absorption	100 ug(Sn)/m <sup>3</sup> TWA (recommended)	[1912-84-1]

(Continued)



TABLE C-7 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>ZINC</u>				
Zinc acetate	Low Oral, rat LD <sub>50</sub> : 2510 mg/kg			[557-34-6]
Zinc-2-ethylhexoate [Zinc octoate]	Low			
Zinc naphthenate	Low Oral, rat LD <sub>50</sub> : 4920 mg/kg			[12001-85-3]
Zinc oxide [ZnO]	Nontoxic		5 mg/m <sup>3</sup> TWA (fume)	[1314-13-2]
<u>ZIRCONIUM</u>				
Zirconium 2-ethylhexoate				
Zirconium naphthenate	Toxic	Inhalation		
Zirconium toluene				
<u>MISCELLANEOUS METAL COMPOUNDS</u>				
Aluminum isopropoxide				[555-31-7]
Aluminum-sec-butoxide				
Barium carbonate	Toxic Oral, humans LD <sub>50</sub> : 57 mg/kg	Ingestion	500 ug(Ba)/m <sup>3</sup> TWA	[513-77-9]
Cerium naphthenate				
Lanthanum naphthanate				
Lithium acetate				
Magnesium acetate	Intravenous, mouse LD <sub>50</sub> : 16 mg/kg			[142-72-3]
Magnesium oxide	Toxic	Inhalation (fume)		[1309-48-4]

(Continued)

TABLE C-7 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>MISCELLANEOUS METAL COMPOUNDS</u> (Continued)				
Monopotassium glycoxide				
Potassium acetate	Low Oral, rat LD <sub>50</sub> : 3250 mg/kg			[127-08-2]
Potassium octoate				[164-71-6]
Potassium oleate		Primary Irritant		[143-18-0]
Sodium propionate	Low Subcutaneous, mouse LD <sub>50</sub> : 2100 mg/kg			[137-40-6]
Strontium carbonate	Low			
Tri-n-butylarsine				
<u>MISCELLANEOUS</u>				
Aminodiboron				
Benzyltrimethylammonium chloride	Oral, rat LD <sub>50</sub> : 250 mg/kg			[56-93-9]
Cresylic acid	Oral, rat LD <sub>50</sub> : 1454 mg/kg	Corrosive Skin Absorption		[1319-77-3]
Dicyandiamide				[461-58-5]
Dimethyldilauryl ammonium chloride				
8-Hydroxyethyltrimethyl ammonium hydroxide				
Paraformaldehyde	Toxic Oral, rat LD <sub>50</sub> : 800 mg/kg	Ingestion Primary Irritant		[110-88-3]
Tetrahydroxydiboron				
Tetrapropylammonium chloride				
Trimethylboroxine				
Trioxane	Oral, rat LD <sub>50</sub> : 800 mg/kg	Fire Risk		[110-88-3]

(Continued)

TABLE C-7 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>ACIDS</u>				
Acetic acid	Toxic Inhalation, humans TC <sub>Lo</sub> : 816 ppm/3M Toxic Effect: Irritation	Ingestion Inhalation Irritant	10 ppm TWA	[64-19-7]
Ammonium chloride	Toxic Oral, rat LD <sub>50</sub> : 1650 mg/kg	Inhalation	10 mg/m <sup>3</sup> TWA	[12125-02-9]
Ammonium fluoride	Toxic Intraperitoneal, rat LD <sub>50</sub> : 32 mg/kg	Inhalation Corrosive	2500 ug(F)/m <sup>3</sup> TWA	[12125-01-8]
Boric acid	Toxic Oral, humans LD <sub>Lo</sub> : 214 mg/kg	Ingestion Irritant		[10043-35-3]
Boron trifluoride	Toxic Inhalation, rat LC <sub>Lo</sub> : 750 ppm/5.5H	Inhalation Corrosive	1 ppm Ceiling	[7637-07-2]
Carbon dioxide	Inhalation, humans LC <sub>Lo</sub> : 100,000 ppm/1M		5000 ppm TWA	[124-38-9]
Cinnamic acid	Oral, rat LD <sub>50</sub> : 2500 mg/kg			[621-82-9]
N-Cyclohexyl sulfamate				
Hydrochloric acid	Toxic Inhalation, humans LC <sub>Lo</sub> : 1300 ppm/30M	Ingestion Inhalation Irritant to Skin and Eyes	5 ppm Ceiling	[7647-01-0]
Oxalic acid	Toxic Oral, humans LD <sub>Lo</sub> : 71 mg/kg	Inhalation Ingestion Strong Irritant	1 mg/m <sup>3</sup> TWA	[144-62-7]
Phosphogypsum				[13397-24-5]
Phosphoric acid	Toxic Inhalation, humans TC <sub>Lo</sub> : 100 mg/m <sup>3</sup> Toxic Effect: Irritation	Corrosive Ingestion Inhalation Irritant	1 mg/m <sup>3</sup> TWA	[7664-38-2]

(Continued)

TABLE C-7 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>ACIDS (Continued)</u>				
Phthalic anhydride	Toxic Oral, rat LD <sub>50</sub> :4020 mg/kg	Skin Irritant Negative Animal Carcinogen	2 ppm TWA	[85-44-9]
Succinic anhydride	Toxic Subcutaneous, rat TD <sub>Lo</sub> :2600 mg/kg/ 65W-1 Toxic Effect: Tumorigen	Irritant Suspected Carcinogen		[108-30-5]
Sulfuric acid	Highly Toxic Oral, rat LD <sub>50</sub> :2140 mg/kg	Strong Irritant	1 mg/m <sup>3</sup> TWA	[7664-93-9]
p-Toluenesulfonic acid	Moderately Toxic Oral, rat LD <sub>50</sub> :2480 mg/kg	Skin Irritant		[104-15-4]
Thioglycolic acid	Oral, rat LD <sub>50</sub> :250 mg/kg	Corrosive		[68-11-1]
<u>BASES</u>				
Ammonia	Toxic Oral, rat LD <sub>50</sub> :350 mg/kg	Inhalation Irritant Moderate Fire Risk	50 ppm	[7664-41-7]
Barium hydroxide	Toxic Subcutaneous, mouse LD <sub>50</sub> :50 mg/kg	Ingestion	500 ug(Ba)/m <sup>3</sup> TWA	[1304-28-5]
Calcium hydroxide		Skin Irritant Inhalation	5 mg/m <sup>3</sup> TWA	[1305-78-8]
Lime	See Calcium Oxide			
Lithium carbonate	Low Oral, rat LD <sub>Lo</sub> :710 mg/kg	Irritant		[554-13-2]
Lithium hydroxide		Strong Irritant		[1310-65-2]
Magnesium hydroxide	Nontoxic			[1309-42-9]
Monosodium phosphate	Low			[7558-80-7]

(Continued)

TABLE C-7 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>BASES (Continued)</u>				
Potassium hydroxide	Toxic Skin, humans 50 ug/24H Toxic Effect: Severe	Ingestion Inhalation Strong Irritant	2 mg/m <sup>3</sup> TWA (recommended)	[1310-58-3]
Sodium aluminate	Toxic	Strong Irritant		[11138-49-1]
Sodium bicarbonate	Low Oral, rat LD <sub>50</sub> : 4220 mg/kg	Primary Irritant		[144-55-8]
Sodium hydroxide	Toxic Eye, rabbit 1% Toxic Effect: Severe	Corrosive Strong Irritant	2 mg/m <sup>3</sup> TWA	[1310-73-2]
Strontium hydroxide	Low			[18480-07-4]
<u>CATALYST NEUTRALIZERS</u>				
<u>Amines</u>				
Phosphorous pentoxide [phosphoric anhydride]		Corrosive Strong Irritant Reacts Violent with Water Dangerous Fire Risk		[1314-56-3]
Sodium hydroxide [See Bases]	See Bases			
Tricalcium phosphate	See Metal Compounds			
Triethanolamine	Low Oral, rat LD <sub>50</sub> : 8680 mg/kg			[102-71-6]
<u>RESIN STABILIZERS</u>				
2-Amino-2-methyl-1-propanol	Oral, rabbit LD <sub>Lo</sub> : 1000 mg/kg			[124-68-5]
Dimethylaminoethanol	See Amines			
$\alpha$ -Phenylenediamine [See Amines]	See Amines			
Triethylamine [See Amines]	See Amines			

TABLE C-8. FILLERS AND REINFORCERS FOR PLASTICS  
TOXICOLOGICAL AND WORKER EXPOSURE CONCERNS

<u>Fillers</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>INORGANIC EXTENDERS</u>				
Alumina, hydrated [Al <sub>2</sub> O <sub>3</sub> ·3H <sub>2</sub> O]	Practically Nontoxic Oral, humans TD <sub>Lo</sub> :122 gm/kg/4D Toxic Effect: Gastrointestinal Tract	Mutagen	10 mg/m <sup>3</sup> TWA (recommended)	[21645-51-2]
Aluminum, powder [Al]	Nontoxic	Flammable Explosive	10 mg/m <sup>3</sup> TWA (recommended)	[7429-90-5]
Aluminum hydroxide [See Alumina, hydrated]				
Aluminum oxide [Al <sub>2</sub> O <sub>3</sub> ] [Emery], [Sapphire]	Nontoxic Intrapleural, rat TD <sub>Lo</sub> :90 mg/kg Toxic Effect: Equivocal Tumorigenic Agent	Inhalation Tumorigen	10 mg/m <sup>3</sup> TWA (recommended)	[1344-28-1]
Aluminum silicate [See Clay]				
Antimony trioxide	Oral, rat LD <sub>50</sub> :>34.6 g/kg	May Cause Dermatitis	0.5 mg/m <sup>3</sup> TWA	[1327-33-9]
Barium carbonate, precipitated [BaCO <sub>3</sub> ], [Witherite]	Toxic Oral, human LD <sub>Lo</sub> :57 mg/kg	Ingestion	500 ug(Ba)/m <sup>3</sup> TWA	[513-77-9]
Barium ferrite				
Barium titanate [BaTiO <sub>3</sub> ]				
Barium sulfate [BaSO <sub>4</sub> ]	Nontoxic Intrapleural, rat TD <sub>Lo</sub> :200 mg/kg Toxic Effect: Equivocal Tumorigenic Agent	Tumorigen		[13462-86-7]
Barytes				
Blanc fixe [Barium Sulfate, precipitated]	See Barium Sulfate			[7727-43-7]

(Continued)

TABLE C-8 (Continued)

<u>Fillers</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>INORGANIC EXTENDERS</u> (Continued)				
Barium sulfide	Toxic Oral, humans TD <sub>Lo</sub> : 226 mg/kg Toxic Effect: Peripheral Nervous System; Behavioral Symptoms; Pulmonary System	Ingestion	0.5 mg(Ba)/m <sup>3</sup> TWA	[50864-67-0]
Bentonite clay	Nontoxic Intravenous, rat LD <sub>50</sub> : 35 mg/kg	Inhalation		[1302-78-9]
Beryllium oxide [BeO]	Highly Toxic Inhalation, rat TC <sub>Lo</sub> : 28 mg/m <sup>3</sup> /17W Toxic Effect: Tumorigen	Inhalation Positive Animal Carcinogen	2 ug/m <sup>3</sup> TWA	[1304-56-9]
Bronze [1-10% Sn in Cu]	Toxic Oral, humans TD <sub>Lo</sub> : 120 ug/kg Toxic Effect: Gastrointestinal	Inhalation Powder is Flammable	1 mg(Cu)/m <sup>3</sup> TWA (dust) (recommended)	[12597-70-5]
Cadmium sulfide [CdS]	Highly Toxic Subcutaneous, rat TD <sub>Lo</sub> : 90 mg/kg Toxic Effect: Carcinogen	Tumorigen Mutagen Inhalation Ingestion	40 ug/m <sup>3</sup> TWA (recommended)	[1306-23-6]
Calcium carbonate [CaCO <sub>3</sub> ]	Nontoxic		10 mg/m <sup>3</sup> TWA (recommended)	[471-34-1] precipitated [1317-65-3] limestone [13397-26-7] whiting
Calcium fluoride [CaF <sub>2</sub> ]	Toxic Oral, rat LD <sub>50</sub> : 4250 mg/kg	Irritant Inhalation	2.5 mg(F)/m <sup>3</sup> TWA (recommended)	[7789-75-5]
Calcium hydroxide [lime] [Ca(OH) <sub>2</sub> ]	Oral, rat LD <sub>50</sub> : 7340 mg/kg	Skin Irritant Inhalation Mutagen	5 mg/m <sup>3</sup> TWA (recommended)	[1305-62-0]
Calcium silicate, precipitated [CaSiO <sub>3</sub> ]	Nontoxic	Irritant Dust	10 mg/m <sup>3</sup> TWA (recommended)	[1344-96-3]

(Continued)

TABLE C-8 (Continued)

<u>Fillers</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>INORGANIC EXTENDERS</u> (Continued)				
Calcium sulfate [CaSO <sub>4</sub> ]	Nontoxic Intraperitoneal, rat TD <sub>Lo</sub> : 450 mg/kg/3W Toxic Effect: Carcinogen	Tumorigen	10 mg/m <sup>3</sup> TLV (recommended)	[10101-41-4] [7778-18-9] gypsum [14798-04-0] anhydrite [23296-15-3] precipitated
Clay [Kaolin], [Aluminum silicate] [Al <sub>2</sub> O <sub>3</sub> ·2SiO <sub>2</sub> ·2H <sub>2</sub> O] Calcined		Irritant Inhalation	10 mg/m <sup>3</sup> TWA (recommended)	[1327-36-2]
Copper, powder [Cu]	Toxic (powders) Oral, rat TD <sub>Lo</sub> : 152 mg/kg	Inhalation Powder is Flammable	1 mg/m <sup>3</sup> TWA (dust) (recommended)	[7440-50-8]
Emery [See Aluminum Oxide]			10 mg/m <sup>3</sup> TWA (recommended)	[112-62-9]
Feldspar [Potassium aluminosilicate] [KAlSi <sub>3</sub> O <sub>8</sub> ]	Nontoxic			
Glass	Nontoxic			
Graphite	Low	Fire Risk	15 mppcf	[7782-42-5]
Iron, powder [Fe]	Toxic Intratracheal, rat TD <sub>Lo</sub> : 50 mg/kg/15W Toxic Effect: Tumorigen	Inhalation Explosion Hazard		
Iron oxide [Fe <sub>2</sub> O <sub>3</sub> ]	Subcutaneous, rat LD <sub>Lo</sub> : 135 mg/kg Toxic Effect: Equivocal Tumorigenic Agent	Tumorigen Inhalation	5 mg(Fe)/m <sup>3</sup> TWA (recommended)	[1309-37-1]
Kieselguhr [See Diatomaceous Earth]				
Kryolite [Sodium Fluoroaluminat]	Oral, rat LD <sub>50</sub> : 200 mg/kg		2500 ug(F)/m <sup>3</sup> TWA	[15096-52-3]

(Continued)



TABLE C-8 (Continued)

<u>Fillers</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>INORGANIC EXTENDERS</u> (Continued)				
Lead, powder [Pb]	Toxic Intraperitoneal, rat LD <sub>50</sub> :1000 mg/kg	Ingestion Inhalation	200 ug/m <sup>3</sup> TWA	[7439-92-1]
Lead oxide [PbO]	Toxic Intraperitoneal, rat LD <sub>50</sub> :430 mg/kg	Inhalation Primary Irritant Tumorigen Mutagen	50 ug(Pb)/m <sup>3</sup> TWA	[1317-36-8]
Lithium aluminum silicate			2 mg(Al)/m <sup>3</sup> TWA (recommended)	[1302-66-5]
Lithopone [72% BaSO <sub>4</sub> + 28% ZnS]	See Barium Sulfate and Zinc Sulfide			[1345-05-7] [8006-32-4]
Magnesium carbonate, precipitated [MgCO <sub>3</sub> ]		Inhalation Ingestion		[546-93-0]
Magnesium hydroxide	Nontoxic Oral, humans LD <sub>50</sub> :5000 mg/kg			[1309-42-8]
Magnesium oxide	Toxic Inhalation, humans TC <sub>LO</sub> :400 mg/m <sup>3</sup> Toxic Effect: Unspecified	Inhalation Tumorigen	15 mg/m <sup>3</sup> TWA	[1309-48-4]
Magnesium silicate, precipitated [3MgSiO <sub>3</sub> ·5H <sub>2</sub> O]	Toxic Skin, humans 300 ug/3D Toxic Effect: Mild Irritation	Inhalation Primary Irritant		[1343-90-4]
Magnetite [Ferrous-ferric Oxide], [See Iron Oxide]				
Mica [Potassium Aluminum Silicate]		Inhalation Irritant	20 mppcf	[1327-44-2] [1200-26-2]
Molybdenum disulfide	Low	Inhalation	10 mg/m <sup>3</sup> TWA (recommended)	[1317-33-5]
Nepheline [(Na,K)(Al,Si) <sub>2</sub> O <sub>4</sub> ]				[14797-52-5]

(Continued)

TABLE C-8 (Continued)

<u>Fillers</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>INORGANIC EXTENDERS</u> (Continued)				
Nickel, powder [Ni]	Intravenous, mouse LD <sub>50</sub> : 50 mg/kg	Flammable Positive Animal Carcinogen	1.0 mg/m <sup>3</sup> TWA (skin)	[7440-02-0]
Perlite [See Silica]			30 mppcf	
Pumice [67-75% SiO <sub>2</sub> + 10-20% Al <sub>2</sub> O <sub>3</sub> ]				
Pyrophyllite [Al <sub>2</sub> Si <sub>4</sub> O <sub>10</sub> (OH)]				[12269-78-2]
Rottenstone				
Silica	Toxic Oral, rat LD <sub>50</sub> : 3160 mg/kg	Inhalation (Silicosis)	80 mg/m <sup>3</sup> TWA	[7631-86-9]
Amorphous, fumed	Intraperitoneal, rat LD <sub>50</sub> : 50 mg/kg		80 mg/m <sup>3</sup> /ZSiO <sub>2</sub>	[7631-86-9]
Amorphous, fused	Intraperitoneal, rat LD <sub>50</sub> : 400 mg/kg		8 mg/m <sup>3</sup> /ZSiO <sub>2</sub>	[60676-86-0]
Diatomaceous earth			1.5 mg/m <sup>3</sup> (respira- ble) (recommended)	[60676-86-0]
Quartz	Intraperitoneal, rat TD <sub>50</sub> : 45 mg/kg Toxic Effect: Carcinogen	Tumorigen	10 mg/m <sup>3</sup> /ZSiO <sub>2</sub> +2 (respirable) or 30 mg/m <sup>3</sup> TWA (recommended)	[14808-60-7]
Amorphous, hydrated [H <sub>2</sub> SiO <sub>3</sub> ]			80 mg/m <sup>3</sup> /ZSiO <sub>2</sub>	[7631-86-9]
Silicon carbide [SiC]		Inhalation	10 mg/m <sup>3</sup> TWA 20 mg/m <sup>3</sup> STEL (recommended)	[409-21-2]
Slate flour				

(Continued)

TABLE C-8 (Continued)

<u>Fillers</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>INORGANIC EXTENDERS</u> (Continued)				
Sodium aluminum hydroxy-carbonate [Dawsonite]				
Sodium aluminosilicate	Low			[1344-00-9]
Sodium aluminum fluoride	Oral, rat LD <sub>50</sub> : 200 mg/kg		2500 ug(F)/m <sup>3</sup> TWA	[15096-52-3]
Steel, stainless				
Talc [magnesium silicate] [Mg <sub>3</sub> Si <sub>4</sub> O <sub>10</sub> (OH) <sub>2</sub> ] Canadian	Moderate Skin, humans 300 ug/3D-I Toxic Effect: Mild Irritation	Inhalation Primary Irritant	2 mppcf TWA (non-fibrous)	[14807-96-6]
Titanium dioxide, rutile, anatase	Nontoxic Skin, humans 300 ug/3D Toxic Effect: Mild Irritation	Primary Irritant Tumorigen	15 mg/m <sup>3</sup> TWA	[1317-70-0] [13463-67-3]
Zinc, powder	Low Skin, humans 300 ug/3D Toxic Effect: Mild Irritation	Fire Risk		[7440-66-6]
Zinc oxide [ZnO]	Nontoxic Oral, rat TD <sub>Lo</sub> : 6846 mg/kg	Primary Irritant Inhalation Mutagen Teratogen	5 mg/m <sup>3</sup> TWA	[1314-13-2]
Zinc sulfide [ZnS]	Moderate	Mutagen Teratogen Primary Irritant	5 mg/m <sup>3</sup> TWA	[12402-34-5]
Zirconia [ZrO <sub>2</sub> ]	Toxic	Inhalation		
Zirconium silicate			5 mg(Zr)/m <sup>3</sup> TWA	[14940-68-2]

(Continued)

TABLE C-8 (Continued)

<u>Fillers</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>ORGANIC EXTENDERS</u>				
<u>NATURAL</u>				
Bagasse [From Sugar Cane]	Toxic	Inhalation		
Bark, ground				
Carbon black	Intravenous, mouse LD <sub>50</sub> : 440 mg/kg		3.5 mg/m <sup>3</sup> TWA	[1333-86-4] [7440-44-0]
Cherrystone flour				
Carbon hollow spheres [See Fly Ash]				
Casein	Nontoxic			
Coconut-shell flour				
Coffee, ground				
Cellulose, hydrated		Combustible		
Cellulose, oxidized		Combustible		
Cork dust	Nontoxic			[61789-98-8]
Fly Ash [C], [Soot]				
Gilsonite	Moderate	Inhalation Irritant to Skin and Eyes Skin Sensitizer Suspected Carcinogen		[12002-43-6]
Keratin [ground feathers]	Intravenous, mouse LD <sub>50</sub> : 45 mg/kg			[9008-18-8]
Lignin, processed		Mutagen		[9005-53-2]
Peanut shells, ground				
Pecan shell flour				

(Continued)

TABLE C-8 (Continued)

<u>Fillers</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>NATURAL EXTENDERS (Continued)</u>				
Petroleum coke				[64743-05-1]
Rice hull ash				
Rubber, natural [Gutta Percha]	Nontoxic			
Saw dust				
Soybean meal				
Starch	Skin, humans 300 ug/3D Toxic Effect: Mild Irritation		10 mg/m <sup>3</sup> TWA (recommended)	[9005-25-8]
Walnut-shell flour				
<u>SYNTHETIC EXTENDERS</u>				
Acrylic				
Cellophane	Impregnation, rat TD <sub>Lo</sub> : 18 mg/kg Toxic Effect: Tumorigen			[9005-81-6]
Phenol-Formaldehyde				[9003-35-4]
Polyfluoroethylene	See Organic Fibers			
Polyethylene	Impregnation, rat TD <sub>Lo</sub> : 33 mg/kg Toxic Effect: Tumorigen	Positive Animal Carcinogen		[9002-88-4]
Polystyrene	Inhalation, mouse LD <sub>50</sub> : 120 mg/m <sup>3</sup> /10M	Tumorigen Positive Animal Carcinogen		[9003-53-6]
<u>INORGANIC FIBERS</u>				
Alumina (ceramic) [Al <sub>2</sub> O <sub>3</sub> ]	See Inorganic Extenders			
Aluminum [Al]	See Inorganic Extenders			

(Continued)

TABLE C-8 (Continued)

<u>Fillers</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>INORGANIC FIBERS</u> (Continued)				
Aluminum nitride				
Aluminum oxide [Al <sub>2</sub> O <sub>3</sub> ]	See Inorganic Extenders			
Aluminum silicate [Al <sub>2</sub> O <sub>3</sub> ·SiO <sub>2</sub> ]	Intraleural, rat TD <sub>Lo</sub> :90 mg/kg Toxic Effect: Tumorigen			[1302-76-7]
Asbestos	Toxic Intraleural, rat TD <sub>Lo</sub> :100 mg/kg	Inhalation Tumorigen Carcinogen	2 fibers/cm <sup>3</sup> TWA 10 fibers/cm <sup>3</sup> Ceiling	[1332-21-4] [1343-90-4]
Amosite	Toxic	Inhalation	0.5 fibers > 5 um/cc	[12172-73-5]
Chrysotile	Toxic	Inhalation	2 fibers > 5 um/cc	[12001-29-5]
Crocidolite	Toxic	Inhalation	0.2 fibers > 5 um/cc	[12001-28-4]
Other forms	Toxic	Inhalation	2 fibers > 5 um/cc	
Beryllia (ceramic)	See Inorganic Extenders (Beryllium Oxide)			
Beryllium	Inhalation, humans TC <sub>Lo</sub> :300 mg/m <sup>3</sup> Toxic Effect: Metabolism and Nutrition, Pulmonary System	Ingestion Inhalation Mutagen Tumorigen	2 ug/m <sup>3</sup> TWA 5 mg/m <sup>3</sup> Ceiling 25 ug/m <sup>3</sup> /30 Min./ 8 Hr. Peak	[7440-41-7]
Beryllium carbide [Be <sub>2</sub> C]	Toxic	Inhalation		
Beryllium oxide	See Inorganic Extenders			
Boron	Oral, mouse LD <sub>50</sub> :2000 mg/kg			[7440-42-8]
Boron carbide [B <sub>4</sub> C]		Inhalation		
Boron nitride [BN]	Low			
Boron tungsten filament				

(Continued)

TABLE C-8 (Continued)

<u>Fillers</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>INORGANIC FIBERS (Continued)</u>				
Calcium sulfate [Franklin fiber]	See Inorganic Extenders			
Carbon				
Carbon-diamond				
Chromium	Toxic Intravenous, rat TD <sub>Lo</sub> : 260 ug/kg/6W Toxic Effect: Tumorigen	Inhalation Suspected Carcinogen	1 mg/m <sup>3</sup> TWA	[7440-47-3]
Copper	See Inorganic Extenders			
Fybex [See Potassium titanate]				
Glass	Inhalation, humans LC <sub>Lo</sub> : 300 ug/m <sup>3</sup> /10Y	Inhalation (Fibrosis)	5 mg/m <sup>3</sup> TWA (recommended)	[14808-60-7]
Graphite			10 mg/m <sup>3</sup> TWA (recommended)	
Hafia (ceramic) [HfO <sub>2</sub> ]				
Iron	See Inorganic Extenders			
Iron-nickel				
Magnesia [MgO]	See Inorganic Extenders (Magnesium Oxide)			
Magnesium	Oral, dog LD <sub>Lo</sub> : 230 mg/kg	Fire Risk		[7439-95-4]
Molybdenum	Nontoxic Intraperitoneal, rat LD <sub>Lo</sub> : 114 mg/kg		10 mg/m <sup>3</sup> TLV (recommended)	[7439-98-7]
Nickel	Toxic Oral, guinea pig LD <sub>Lo</sub> : 5 mg/kg	Inhalation Positive Animal Carcinogen	1 mg/m <sup>3</sup> TWA (skin)	[7440-02-0]

(Continued)

TABLE C-8 (Continued)

<u>Fillers</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>INORGANIC FIBERS (Continued)</u>				
Sapphire [See Aluminum Oxide]				
Processed mineral fiber			10 mg/m <sup>3</sup> (recommended)	
Potassium titanate [Fybex] [K <sub>2</sub> O·(TiO <sub>2</sub> ) <sub>n</sub> n=4-7]				
Quartz (ceramic)	See Inorganic Extenders (Silica)			
Silica	See Inorganic Extenders (Silica)			
Silicon carbide [Silag]	See Inorganic Extenders			
Silicon nitride				
Sodium aluminum hydroxycarbonate [Dawsonite]				
Steel	See Inorganic Extenders			
Tantalum	Toxic Impregnation, mouse TD <sub>Lo</sub> : 3760 mg/kg Toxic Effect: Tumorigen	Inhalation Fire Risk	5 mg/m <sup>3</sup> TWA	[7440-25-7]
Thoria (ceramic) [ThO <sub>2</sub> ]	Intramuscular, mouse TD <sub>Lo</sub> : 400 mg/kg Toxic Effect: Tumorigen		0.1 mg/m <sup>3</sup> TWA (skin) (recommended)	[1314-20-1]
Titanium	Low	Fire Risk		
Tungsten	Low Intraperitoneal, rat LD <sub>50</sub> : 5000 mg/kg	Flammable	5 mg(W)/m <sup>3</sup> TWA (recommended)	[7440-33-7]
Tungsten monocarbide				
Wollastonite [CaSiO <sub>3</sub> ]	Nontoxic	Irritant Dust	10 mg/m <sup>3</sup> TWA	[13983-17-0]

(Continued)



TABLE C-8 (Continued)

<u>Fillers</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>INORGANIC FIBERS</u> (Continued)				
Zirconia [ZrO <sub>2</sub> ]	See Inorganic Extenders			
Zircon [66% ZrO <sub>2</sub> + 33% SiO <sub>2</sub> ]	See Inorganic Extenders			[14940-68-2]
<u>ORGANIC FIBERS</u>				
<u>NATURAL</u>				
Abaca [Manila hemp]				
Broomroot				
$\alpha$ -Cellulose [Paper pulp]			10 mg/m <sup>3</sup> TWA (recommended)	[9004-34-6]
Coir				
Corn cobs and stalks				
Cotton flock	Inhalation, humans TC <sub>Lo</sub> : 10,000 mg/m <sup>3</sup> /10Y Toxic Effect: Pulmonary Irritation	Inhalation Flammable	1 mg/m <sup>3</sup> TWA	
Cotton linters	Moderate See Cotton flock	Inhalation Flammable	1 mg/m <sup>3</sup> TWA	
Cottonseed hulls				
Crin vegetal				
Flax [Bast fibers]		Combustible		
Hemp		Combustible		
Henequen		Combustible		
Istle [Tampico]				
Jute [Bast fibers]		Combustible		

(Continued)

TABLE C-8 (Continued)

<u>Fillers</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>NATURAL FIBERS (Continued)</u>				
Kapok		Combustible		
Palm				
Palmyra				
Paper		Combustible	10 mg/m <sup>3</sup> TWA (recommended)	
Piassava				
Ramie [Hemp]		Combustible		
Raffia				
Sisal	Moderate	Inhalation Combustible		
Sunn				
Wood flour [Wood flock]		Combustible	1 mg/m <sup>3</sup> TWA (hard- woods) 5 mg/m <sup>3</sup> TWA (soft- woods) (recommended)	
Wood cellulose [Paper pulp] [See -Cellulose]		Combustible	See above	
Wool				
<u>SYNTHETIC FIBERS</u>				
Acrylic		Combustible		[9003-01-4]
Aramid				
Carbon				
Fluorocarbon (PTFE)	Impregnation, rat TD <sub>Lo</sub> : 80 mg/kg Toxic Effect: Tumorigen	Positive Animal Carcinogen		[9002-84-0]

(Continued)

TABLE C-8 (Continued)

<u>Fillers</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>SYNTHETIC FIBERS (Continued)</u>				
Nylon				
Polyacrylonitrile [Dynel], [Orlon]				[9003-56-9] [9003-00-3] [9003-54-7]
Polyester	Impregnation, rat TD <sub>Lo</sub> : 116 mg/kg Toxic Effect: Tumorigen			[25038-59-4]
Polypropylene		Positive Animal Carcinogen		[9003-07-0]
Polyvinyl alcohol	Subcutaneous, rat TD <sub>Lo</sub> : 2500 mg/kg Toxic Effect: Carcinogen			[9002-89-5]
Polyvinyl chloride	Nontoxic	Suspected Human Carcinogen		[9002-86-2]
Rayon				

TABLE C-9. FLAME RETARDANTS  
TOXICOLOGICAL AND WORKER EXPOSURE CONCERNS

<u>Flame Retardant</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>INORGANICS</u>				
Alumina trihydrate	Intraperitoneal, rat LD <sub>50</sub> : 80 mg/kg	Mutagen	2 mg(Al)/m <sup>3</sup> TWA (recommended)	[21645-51-2]
Ammonium bromide	Moderately Toxic	Ingestion Inhalation Mutagen Toxic Fumes When Heated		[12124-97-9]
Ammonium fluoroborate			2.5 mg(F)/m <sup>3</sup> TWA	[13826-83-0]
Ammonium orthophosphate [Ammonium phosphate, dibasic]	Low	Inhalation Skin Contact		[7783-28-0]
Ammonium pentaborate				
Ammonium polyphosphate				
Ammonium sulfamate	Moderate Oral, rat LD <sub>50</sub> : 1600 mg/kg	Ingestion Can be Explosive	15 mg/m <sup>3</sup> TWA (recommended)	[7773-06-0]
Antimony pentoxide	Toxic Intraperitoneal, rat LD <sub>50</sub> : 4000 mg/kg	Inhalation Oxidizer Moderate Fire Risk	500 ug(Sb)/m <sup>3</sup> TWA	[1314-60-9]
Antimony trioxide	Toxic Intraperitoneal, rat LD <sub>50</sub> : 3250 mg/kg	May Cause Dermatitis Inhalation Mutagen	500 ug(Sb)/m <sup>3</sup> TWA	[1309-64-4]
Barium metaborate				[27043-84-1]
Borax	Moderate Oral, rat LD <sub>50</sub> : 5330 mg/kg	Ingestion	5 mg/m <sup>3</sup> TWA (skin) (recommended)	[1303-96-4]
Boric Acid	Oral, human LD <sub>50</sub> : 200 mg/kg	Primary Irritant		[10043-35-3]
Diammonium phosphate [See Ammonium Orthophosphate]				
Disodium octaborate	Oral, guinea pig LD <sub>50</sub> : 5300 mg/kg			[12008-41-2]

(Continued)

TABLE C-9 (Continued)

<u>Flame Retardant</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>INORGANICS (Continued)</u>				
Ferrocene	Oral, rat LD <sub>50</sub> : 1320 mg/kg	Toxic Fumes When Heated Equivocal Tumorigenic Agent	10 mg/m <sup>3</sup> TWA (recommended)	[102-54-5]
Magnesium sulfate heptahydrate	Low Intraperitoneal, rat Mutation: 450 mg/kg	Mutagen		Monohydrate [14567-64-7]
Molybdates				
Molybdenum oxide	Toxic			[1313-29-7]
Molybdenum complex				
Monoammonium phosphate [Ammonium phosphate, monobasic]	Low	Toxic Fumes When Heated		[7722-76-1]
Multi-metal complex				
Red phosphorus		May React Spontaneously		
Sodium antimonate	Toxic	Ingestion Inhalation Mutagen	0.5 mg(Sb)/m <sup>3</sup> TWA	[15593-75-6] [11112-10-0]
Zinc borate	Low			[13701-59-2] [14720-55-9] [12513-27-8]
[Zinc oxide + Boric oxide]				
<u>CHLORINATED COMPOUNDS</u>				
Chlorinated hydrocarbons				
Chlorinated paraffins	Low Skin, rat 100 mg/24h Toxic Effect: Mild Irritation	Primary Irritant		[63449-39-8]
Dechlorane Plus	Oral, rat TD <sub>Lo</sub> : 46 mg/kg Toxic Effect: Reproduc- tive, Developmental	Positive Animal Carcinogen Suspected Human Carcinogen		[13560-89-9]

(Continued)

TABLE C-9 (Continued)

<u>Flame Retardant</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>CHLORINATED COMPOUNDS</u> (Continued)				
Dispersions (Chlorinated Organics)				
Methyl pentachlorostearate				
Trichloroethylene	Toxic Eye, humans 5 ppm Toxic Effect: Irritation	Positive Animal Carcinogen Inhalation Skin and Eye Irritant Toxic Fumes Formed on Heating	100 ppm TWA 200 ppm Ceiling 300 ppm/5 Min./2 Hr. Peak	[79-01-6]
<u>BROMINATED COMPOUNDS</u>				
1,2-Bis(2,4,6-tribromophenoxy)-ethane				[67990-32-3]
Bis(2,4,6-tribromophenyl)-carbonate	Nontoxic Oral, rat LD <sub>50</sub> : >10 g/kg			[37853-59-1]
1,2-Bis(tetrabromophthalimido)-ethane				[32588-76-4]
Brominated organics				
Decabromobiphenyl				
Decabromodiphenyl oxide [Decabromodiphenyl ether]	Oral, rat TD <sub>Lo</sub> : 100 mg/kg Toxic Effect: Reproductive, Fertility	Tumorigen Teratogen		[1163-19-5]
1-(1,2-Dibromoethyl)-3,4-dibromocyclohexane				[3322-93-8]
Hexabromobenzene	Oral, rat LD <sub>50</sub> : >4 gm/kg	Liver and Kidney Injury		[87-82-1]
Hexabromocyclodecane				[25637-99-4]
Octabromodiphenyl oxide				

(Continued)

TABLE C-9 (Continued)

<u>Flame Retardant</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>BROMINATED COMPOUNDS</u> (Continued)				
Pentabromodiphenyl oxide				[32534-81-9]
Pentabromoethylbenzene				[85-22-3] [32534-81-9]
Pentabromotoluene				[87-83-2]
Tetrabromoxylene				[23488-36-2]
<u>MIXED HALOGEN COMPOUNDS</u>				
Brominated organics				
Pentabromochlorocyclohexane				[25495-99-2]
<u>MIXED HALOGEN/PHOSPHORUS COMPOUNDS</u>				
Chlorinated mixed phosphate				
Chlorinated organic phosphonate				
Bis(2-chloroethyl)2-chloroethyl phosphonate				
Ethylene bis(tris(2-cyanoethyl) phosphonium)bromide	Oral, rat LD <sub>50</sub> : 10 gm/kg			[10310-38-0]
Chlorinated polyphosphate				
Halogenated organic diphosphate (chloroneopentyl type)				
Halogenated phosphorus compound				
Halogenated organic polyphosphonate (Chloroethyl phosphonate (polymeric))				
Phosphonated chloroepoxy				
Phosphonium bromides (bisphosphonium compounds)				

(Continued)

TABLE C-9 (Continued)

<u>Flame Retardant</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>MIXED HALOGEN/PHOSPHORUS COMPOUNDS (Continued)</u>				
3,9-Tribromoneopentoxy-2,4,8,- 10-tetra-oxa-3,9-diphospha- spiro(5,5)-undecane-3,9-dioxide				
Tris(2-chloroethyl)phosphate	Intraperitoneal, rat LD <sub>50</sub> : 250 mg/kg	Suspected Carcinogen Tumorigen Primary Irritant Inhalation		[115-96-8]
Tris(1-chloro-2-propyl)- phosphate	Intravenous, mouse LD <sub>50</sub> : 56 mg/kg			[13674-84-5]
Tris(1,3-dichloro-2-propyl)- phosphate	Oral, rat TD <sub>Lo</sub> : 3600 mg/kg Toxic Effect: Reproduc- tive, Fertility, Embryo- toxicity	Mutagen Teratogen		[13674-87-8]
<u>PHOSPHORUS COMPOUNDS</u>				
Bis(5,5-dimethyl-2-thiono-1,3,- 2-dioxaphosphorinanyl)oxide				
t-Butyl phenyl diphenyl phosphate	Intravenous, mouse LD <sub>Lo</sub> : 100 mg/kg			[981-40-8] [56803-37-3]
Cresyl diphenyl phosphate	Oral, rat LD <sub>50</sub> : 6400 mg/kg			[26444-49-5]
Diamyl amyl phosphonate				
Dimethyl methylphosphonate				[756-79-6]
2-Ethylhexyl diphenyl phosphate [Octyl diphenyl phosphate]	Intravenous, rabbit LD <sub>Lo</sub> : 272 mg/kg	Ingestion		[1241-94-7]
Isopropyl tri(dioctyl phosphate) titanate				
Isopropyl tri(dioctyl pyrophosphate) titanate				
Isodecyl diphenyl phosphate				[29761-21-5]

(Continued)



TABLE C-9 (Continued)

<u>Flame Retardant</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>PHOSPHORUS COMPOUNDS</u> (Continued)				
Isopropylphenyl diphenyl phosphate				[26967-76-0]
Phenyl phosphonates				
Phenyl phosphonate from sulfonyl-bisphenol				
Phosphine oxides				
Octyl diphenyl phosphate		Skin Contact Inhalation		[115-88-8]
Phosphonate esters (Cyclic phosphonate)				
Red phosphorus treated with caprolactam				
Tributoxyethyl phosphate	May be Toxic Oral, guinea pig LD <sub>50</sub> : 3000 mg/kg	Heating Release Toxic Fumes		[78-51-3]
Tributyl phosphate	Toxic Oral, rat LD <sub>50</sub> : 3000 mg/kg	Ingestion Inhalation Skin Irritant Toxic Fumes When Heated	5 mg/m <sup>3</sup> TWA	[126-73-8]
Tricresyl phosphate	Moderately Toxic Oral, rat LD <sub>50</sub> : 4680 mg/kg	Ingestion Skin Absorption Primary Irritant Tumorigen	Ortho - 0.1 mg/m <sup>3</sup> TWA	[1330-78-5] Ortho [78-30-8]
Tricresyl phosphate dispersions	[See Tricresyl phosphate]			
Triethyl phosphate	Oral, rat LD <sub>50</sub> : 1600 mg/kg	Mutagen May Cause Nerve Damage Slight Irritant		[78-40-0]
Triisopropyl phenyl phosphate				

(Continued)

TABLE C-9 (Continued)

<u>Flame Retardant</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>PHOSPHORUS COMPOUNDS</u> (Continued)				
Triocetyl phosphate	Low Oral, rat LD <sub>50</sub> : 37 gm/kg			[1806-54-8] [78-42-2]
Triphenyl phosphate	Toxic Oral, rat LD <sub>50</sub> : 3000 mg/kg	Inhalation Ingestion Eye Contact	3 mg/m <sup>3</sup> TWA	[115-86-6]
Triphenyl phosphine oxide				
Trixylenyl phosphate [Tri(dimethylphenyl) phosphate]				[25155-23-1]
<u>REACTIVE ORGANICS</u>				
Alkoxide adducts of TBPA				
Allyl ether of pentabromophenol				
Allyl ether of TBBPA				
Bis(dibromopropyl ether) of TBBPA				
Bis(2-chloroethyl) vinyl phosphonate				
Bis(methyl ether) of TBBPA				
Bromine-phosphorus polyol				
3-Bromo-2,2-bis(bromomethyl) propanol				[1522-92-5]
Bis(chlorendo)cyclooctadiene				
Bis(chlorendo)furan				
Chlorendic acid [hexachloro- endomethylene-tetrahydro- phthalic acid], [HET Acid]	Oral, rat LD <sub>50</sub> : 1770 mg/kg	Tumorigen		[115-28-6]

(Continued)

TABLE C-9 (Continued)

<u>Flame Retardant</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>REACTIVE ORGANICS</u> (Continued)				
Chlorendic anhydride[hexa-chloroendomethylene-tetra-hydrophthalic anhydride] [HET Anhydride]		Eye Irritant		[115-27-5]
Chlorine-containing polyol				
Diacylate of ethylene oxide adduct of TBBPA				
trans-2,3-Dibromo-2-butene-1,4-diol				[3234-02-4]
Dibromoneopentyl glycol	Oral, rat LD <sub>50</sub> : 3458 mg/kg			[3296-90-0]
Dibromophenol	Oral, mouse LD <sub>50</sub> : 282 mg/kg			[615-58-7]
Dibromopropanol	Intraperitoneal, mouse LD <sub>50</sub> : 125 mg/kg	Tumorigen Mutagen		[96-13-9]
Dibromopropyl acrylate				[3066-70-4]
0,0-Diethyl-1,N,N-bis-(2-hydroxyethyl) aminomethyl phosphonate				
Di(polyoxyethylene) hydromethyl phosphonate				
Ethylene oxide adduct of TBBPA				
Epibromohydrin	Intraperitoneal, mouse LD <sub>50</sub> : 30 mg/kg	Mutagen		[3132-64-7]
Hexabromobutene				
Hexachlorocyclopentadiene	Oral, rat LD <sub>50</sub> : 115 mg/kg	Tumorigen Teratogen Primary Irritant Ingestion Inhalation Skin Absorption	10 ppb TWA (recommended)	[77-47-4]

(Continued)

TABLE C-9 (Continued)

<u>Flame Retardant</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>REACTIVE ORGANICS</u> (Continued)				
Oligomeric phosphate esters				
Oligomeric phosphite				
Pentabromophenol	Intraperitoneal, mouse LD <sub>50</sub> : 250 mg/kg			[608-71-9]
Phosphorus-containing polyols [diol from propylene oxide and dibutyl acid pyrophosphate], [high functionality polyol]				
Tetrabromobisphenol A [TBBPA]				[79-94-7]
Tetrabromophthalic anhydride [TBPA]				[632-79-1]
Tetrabromovinyl cyclohexene				
Tetrachlorophthalic anhydride [C <sub>6</sub> Cl <sub>4</sub> (CO) <sub>2</sub> O]	Slight Oral, rat TD <sub>50</sub> : 70 g/kg Toxic Effect: Reproduc- tive, Paternal	Skin Contact Ingestion Inhalation Mutagen	5 mg/m <sup>3</sup> TWA (recommended)	[117-08-8]
Tetrakis(hydroxymethyl)- phosphonium sulfate				
Tribromoneopentyl alcohol				
Tribromophenol [Bromol], [C <sub>6</sub> H <sub>2</sub> Br <sub>3</sub> OH]	May be Toxic Oral, rat LD <sub>50</sub> : 200 mg/kg			[118-79-6]
Tris(dipropylene glycol) phosphate				
Vinyl bromide [CH <sub>2</sub> CHBr]	Moderate Oral, rat LD <sub>50</sub> : 500 mg/kg	Inhalation Tumorigen Mutagen Indefinite Animal Carcinogen Eye Irritant	1 ppm TWA (recommended)	[593-60-2]

TABLE C-10. FREE RADICAL INITIATORS AND RELATED COMPOUNDS  
TOXICOLOGICAL AND WORKER EXPOSURE CONCERNS

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>ORGANIC INITIATORS</u>				
<u>ALKYL PEROXIDES</u>				
$\alpha, \alpha$ -Bis(t-butylperoxy) diisopropylbenzene				
Bis(p-methoxybenzoyl peroxide)				
t-Butyl cumyl peroxide				
Di-t-butyl peroxide	Eye, rabbit 500 mg/24h Toxic Effects: Mild Irritation	Tumorigen Primary Irritant Fire Risk		[110-05-4]
Dicumyl peroxide [Bis( $\alpha, \alpha$ - dimethylbenzyl)peroxide]	Oral, rat LD <sub>50</sub> : 4100 mg/kg	Inhalation Oxidizer Ignition Source Irritant		[80-43-3]
2,5-Dimethyl-2,5-bis(t-butyl- peroxy)hexane		Irritant Strong Oxidizer May Ignite Organics		
2,5-Dimethyl-2,5-bis(t-butyl- peroxy)hexene-3				
Hydroxyheptyl peroxide		Fire Risk Strong Oxidizer		
Octyl peroxide [caprylyl peroxide]				[7530-67-6] [19102-74-0]
<u>DIACETYL PEROXIDES</u>				
Acetyl Peroxide	Moderately Toxic Eye, rabbit 60 mg/1M Toxic Effect: Severe Irritation	Reactive Fire Risk Strong Oxidizer Irritant Tumorigen		[110-22-5]
Acetyl benzoyl peroxide	Moderately Toxic	Ingestion Irritant Explosive		[644-31-5]

TABLE C-10 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>DIACETYL PEROXIDES</u> (Continued)				
Benzoyl peroxide (various forms)	Eye, rabbit 500 mg/24H Toxic Effect: Severe Irritation	Allergen Irritant Explosive Tumorigen	5 mg/m <sup>3</sup> TWA	[94-36-0]
Bis(4-t-butyl benzoyl peroxide)				
Bis(-o-bromobenzoyl peroxide)				
Bis(-m-bromobenzoyl peroxide)				
Bis(p-bromobenzoyl peroxide)				
Bis(p-methoxy benzoyl peroxide)				
Di-p-chlorobenzoyl peroxide	Intraperitoneal, mouse LD <sub>50</sub> : 500 mg/kg	Fire Risk Strong Oxidizer Explosive		[94-17-7]
Decanoyl peroxide		Oxidizing Agent Fire Risk		[762-12-9]
Dichlorobenzoyl peroxide (o and p)	Intraperitoneal, mouse LD <sub>50</sub> : 500 mg/kg			[94-17-7]
Di-2,4-dichlorobenzoyl peroxide (in various mixtures)	Intraperitoneal, mouse LD <sub>50</sub> : 512 mg/kg			[80-43-3]
Dilisononanoyl peroxide				
Lauroyl peroxide [Didodecanoyl Peroxide]	Toxic Subcutaneous, mouse TD <sub>50</sub> : 185 mg/kg/46W Toxic Effect: Equivocal Tumorigenic Agent	Tumorigen Primary Irritant Ingestion Inhalation Explosive		[105-74-8]
Pelargonyl peroxide		Skin Irritant Fire Risk		
Propionyl peroxide	Inhalation, rat LC <sub>50</sub> : 100 ppm			[3248-28-0]
<u>DIBASIC ACID PEROXIDES</u>				
Succinic Acid Peroxide				

(Continued)

TABLE C-10 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>HYDROPEROXIDES</u>				
Acetyl acetone peroxide [2,4-pentanedione peroxide]				[37187-22-7]
t-Amyl hydroperoxide				
t-Butyl hydroperoxide	Moderately Toxic Skin, rabbit 500 mg/24H Toxic Effect: Severe Irritation	Mutagen Primary Irritant		[75-91-2]
t-Butyl hydroxyethyl peroxide				
Cumene hydroperoxide [ $\alpha,\alpha$ -dimethylbenzylhydroperoxide]	Toxic Inhalation, rat LC <sub>50</sub> : 220 ppm/4H Toxic Effect: Pulmonary System	Tumorigen Mutagen Primary Irritant Inhalation Skin Absorption		[80-15-9]
Cyclohexanone peroxide	Eye, rabbit 80 mg/1M Toxic Effect: Severe Irritation	Fire Risk Strong Oxidizer Primary Irritant		[78-18-2] [12262-58-7]
Diisopropylbenzene hydroperoxide	Unknown, mouse TD <sub>Lo</sub> : 391 mg/kg Toxic Effect: Equivocal Tumorigenic Agent	Skin Irritant Inhalation		[26762-93-6]
2,5-Dimethylhexane-2,5-dihydroperoxide				None
p-Menthane hydroperoxide	Unknown, mouse TD <sub>Lo</sub> : 620 mg/kg			[80-47-7]
Methyl ethyl ketone peroxide	Oral, mouse LD <sub>50</sub> : 470 mg/kg	Tumorigen Primary Irritant Fire Risk Strong Oxidizer	200 ppb	[1338-23-4]
1,1,3,3-Tetramethylbutyl-2-hydroperoxide				[5809-08-5]

(Continued)

TABLE C-10 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>PEROXYCARBONATES</u>				
Bis(4-t-butylcyclohexyl)peroxydicarbonate				[15520-11-3]
oo-t-Butyl-o-isopropyl mono-peroxycarbonate				
oo-t-Butyl-o-2(ethylhexyl)mono-peroxycarbonate				
Di(sec-butyl)peroxydicarbonate				[19910-65-7]
Di(2-ethylhexyl)peroxydicarbonate	Oral, rat LD <sub>50</sub> : 1020 mg/kg			[16111-62-9]
Diisopropyl peroxydicarbonate	Eye, rabbit 500 mg Toxic Effect: Severe Irritation Oral, rat LD <sub>50</sub> : 2140 mg/kg	Primary Irritant		[105-64-6]
Di(2-phenoxyethyl)peroxydicarbonate				
Di(n-propyl)peroxydicarbonate	Oral, rat LD <sub>50</sub> : 3400 mg/kg			[16066-38-9]
<u>PEROXYESTERS</u>				
t-Amyl perbenzoate				
t-Amyl perneodecanoate				
t-Amyl peroxy(2-ethylhexanoate)				
t-Amyl peroxy-pivalate				
n-Butyl-4,4-di(t-butylperoxy)valerate				

(Continued)



TABLE C-10 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>PEROXYESTERS (Continued)</u>				
t-Butyl peroxyacetate	Eye, rabbit 100 mg/1M Toxic Effect: Moderate Irritation Oral, mouse LD <sub>50</sub> : 632 mg/kg	Primary Irritant		[107-114]
t-Butyl peroxybenzoate	Oral, mouse LD <sub>50</sub> : 2500 mg/kg	Tumorigen Primary Irritant		[614-45-9]
t-Butyl peroxycrotonate				
t-Butyl peroxy cyclohexane				
t-Butyl peroxy(2-ethylhexanoate)				
t-Butyl peroxyisobutyrate				
t-Butyl peroxyisopropyl carbonate				
t-Butyl peroxy maleic acid				
t-Butyl peroxy-2-methyl benzoate				
t-Butyl peroxyneodecanoate				
t-Butyl peroxyperphthalic acid	Intraperitoneal, mouse LD <sub>50</sub> : 128 mg/kg			[15042-77-0]
t-Butyl peroxy pivalate	Oral, rat LD <sub>50</sub> : 4300 mg/kg			[927-07-1]
Butyl peroxy-o-toluate				
Cumyl peroxyneodecanoate				
Cumyl perpivalate				

(Continued)

TABLE C-10 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>PEROXYESTERS (Continued)</u>				
Di(t-amylperoxy)cyclohexane				
Di-t-butylperoxyazelaate				
1,1-Di-t-butylperoxycyclohexane				
1,1-Di(t-butylperoxy)-3,3,5-trimethylcyclohexane				
Di-t-butyl diperoxyphthalate				
2,5-Dimethyl-2,5-bis(benzoylperoxy)hexane				
2,5-Dimethyl-2,5-bis(2-ethylhexanoylperoxy)hexane				
2,5-Dimethyl-2,5-di(t-butylperoxy)hexane	Intraperitoneal, mouse LD <sub>50</sub> : 1700 mg/kg			[78-63-7]
2,5-Dimethylhexyl-2,5-diperoxy-2-ethylhexoate				
Mixed peresters				
2,4,4-Trimethylpentyl-2-peroxycyclohexane carboxylate				
<u>SULFONYL ACETYL PEROXIDES</u>				
Acetyl cyclohexyl sulfonyl peroxide				[3179-56-4]
<u>TERTIARY ALKYL PERKETALS</u>				
2,2-Bis(t-butylperoxy) butane				
1,1-Bis(t-butylperoxy) cyclohexane				

(Continued)

TABLE C-10 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>TERTIARY ALKYL PERKETALS</u> (Continued)				
1,1-Bis(t-butylperoxy)3,3,5-trimethylcyclohexane				
n-Butyl-4,4-bis(t-butylperoxy) valerate				
Cyclic peroxyketals				
1,1-Di(t-butylperoxy) cyclohexane				
Ethyl-3,3-bis(t-butylperoxy) butyrate				
<u>AZO COMPOUNDS</u>				
2,2'-Azobis(2,4-dimethyl-4-methoxyvaleronitrile)				
2,2'-Azobis(2,4-dimethyl-valeronitrile)				
2,2'-Azobis-2-methylbutyronitrile				
2,2'-azobis(methylisobutyrate)				
2,2'-Azobis(isobutyronitrile)	Toxic Intraperitoneal, mouse LD <sub>50</sub> :25 mg/kg	Ingestion		[78-67-1]
Azo-cyclohexane carbonitrile				
2-t-Butylazo-2-cyanobutane				
1-t-Butylazo-1-cyanocyclohexane				
2-t-Butylazo-1-cyanocyclohexane				
2-t-Butylazo-2-cyano-4-methoxy-4-methylpentane				

(Continued)

TABLE C-10 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>AZO COMPOUNDS (Continued)</u>				
2-t-Butylazo-2-cyano-4-methylpentane				
2-5-Butylazo-2-cyanopropane				
2-t-Butylazo-2-methoxy-4-methylpentane				
, -Diphenyl- -picrylhydrazine	Intravenous, mouse LD <sub>50</sub> :1800 ug/kg			[1898-66-4]
<u>INORGANIC INITIATORS</u>				
Ammonium Persulfate	Oral, rat LD <sub>50</sub> :820 mg/kg	Strong Oxidizer Fire Risk in Contact With Organics	2 mg/m <sup>3</sup> TWA (recommended)	[7727-54-0]
Ferrous Ammonium Sulfate Hexahydrate	Oral, rat LD <sub>50</sub> :3250 mg/kg			[7783-85-9]
Hydrogen Peroxide	Toxic Inhalation, mouse LC <sub>50</sub> :227 ppm	Irritant Fire and Explosion Risk Strong Oxidizer Mutagen Suspected Animal Carcinogen	1 ppm TWA	[7722-84-1]
Oxygen	Inhalation, humans TC <sub>LO</sub> :100 pph/14H Toxic Effect: Pulmonary System	Mutagen Highly Flammable		[7782-44-7]
Potassium Bisulfate	Low Oral, rat LD <sub>50</sub> :2340 mg/kg			[7646-93-7]
Potassium Persulfate	Moderately Toxic	Irritant Strong Oxidizer Fire Risk in Contact with Organics	2 mg/m <sup>3</sup> TWA (recommended)	[7727-21-1]

(Continued)

TABLE C-10 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>INORGANIC INITIATORS</u> (Continued)				
Sodium Metabisulfite	Moderate Intraperitoneal, rabbit LD <sub>50</sub> :192 mg/kg	Ingestion	5 mg/m <sup>3</sup> TWA (recommended)	[7681-57-4]
Sodium Persulfate	Intraperitoneal, mouse; LD <sub>50</sub> :226 mg/kg		2 mg/m <sup>3</sup> TWA (recommended)	[7775-27-1]
<u>PROMOTORS/ACTIVATORS</u>				
Alkaline Nitroprusside	Inhalation, humans LD <sub>50</sub> :11 mg/kg 5H			[14402-89-2]
Chromate-Arsenious Oxide Mixes				
Cobalt Naphthenate	Oral, rat LD <sub>50</sub> :3900 mg/kg		100 ug(Co)/m <sup>3</sup> TWA (recommended)	[61789-51-3]
Cobalt Octoate				
6% Cobalt Octoate + 14% Potas- sium Octoate + Triphenyl Phosphite				
Diethyl Aniline	May be Toxic Oral, rat LD <sub>50</sub> :782 mg/kg	Inhalation		[91-66-7]
N,N-Dimethylaniline	Toxic Oral, rat LD <sub>50</sub> :1410 mg/kg	Primary Irritant Skin Absorption Tumorigen	5 ppm TWA (skin)	[121-69-7]
N,N-Dimethyl-p-toluidine				
Ferrous Pyrophosphate				
Ferrous Sulfate	Low Oral, rat LD <sub>50</sub> :1389 mg/kg			[7782-63-0]
Ferrous Sulfide				

(Continued)

TABLE C-10 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>PROMOTORS/ACTIVATOR (Continued)</u>				
Hydrazine	Toxic Inhalation, rat LC <sub>50</sub> :570 ppm/4H	Tumorigen Mutagen Ingestion Inhalation Skin Absorption Skin and Eye Irritant Explosion Hazard Suspected Carcinogen	1 ppm TWA (skin)	[302-01-2]
Hydroquinone	Toxic Oral, humans LD <sub>Lo</sub> :29 mg/kg	Ingestion Inhalation Irritant Tumorigen Mutagen Teratogen	2 mg/m <sup>3</sup> TWA	[123-31-9]
Hydroxylamine	Intraperitoneal, mouse LD <sub>50</sub> :59 mg/kg	Strong Irritant Decomposes Rapidly at Room Temperature		[7803-49-8]
Lauryl Mercaptide	Inhalation, rat 5.02 ug/m <sup>3</sup> /16H Toxic Effect: Muta- gen	Eye Injury Inhalation Mutagen	0.5 ppm/15 M Ceiling (recommended)	[112-55-0]
2-Mercaptobenzothiazole +	Low Oral, rat LD <sub>50</sub> :3000 mg/kg			[149-30-4]
Cupric Chloride	Oral, rat LD <sub>50</sub> :140 mg/kg	Mutagen		[1344-67-8]
2,4-Pentanedione [Acetylac- etone]	Moderate Skin, rabbit 488 mg open Toxic Effect: Mild Irritation	Fire Risk Primary Irritant		[123-54-6]
Pyrogallol	Toxic Oral, rat LD <sub>50</sub> :789 mg/kg	Primary Irritant Ingestion Skin Absorption Tumorigen Mutagen		[87-66-1]

(Continued)

TABLE C-10 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>PROMOTORS/ACTIVATOR</u> (Continued)				
Sodium Formaldehyde Sulfoxylate	Probably Toxic Subcutaneous, mouse LD <sub>Lo</sub> :3000 mg/kg			[149-44-0]
Sodium Hydrosulfite (sodium dithionite)	Oral, humans TD <sub>Lo</sub> :300 mg/kg/7D Toxic Effect: Pulmonary System	Fire Risk Strong Reducing Agent		[7775-14-6]
Sodium Hyposulfite	Oral, humans TD <sub>Lo</sub> :300 mg/kg/7D			[10102-17-7]
Sodium Sulfide	Intraperitoneal, rat LD <sub>50</sub> :30 mg/kg	Mutagen Fire Risk Strong Skin Irritant Acid Sensitive (releases H <sub>2</sub> S)		[16721-80-5]
Sodium Thiosulfate	Low	Up to 0.1% in Food		[10102-17-7]
Sugar [dextrose],[glucose]	Nontoxic Oral, rat LD <sub>50</sub> :25,800 mg/kg			[50-99-7]
Thioglycolic Acid	Toxic Oral, rat LD <sub>50</sub> :250 mg/kg	Ingestion Inhalation Irritant to Skin	1 ppm TWA (skin) (recommended)	[68-11-1]
Vanadyl Acetyl Acetone				
Versene Iron				
<u>INHIBITORS</u>				
Benzaldehyde	Moderate Oral, mouse LD <sub>50</sub> :13 mg/kg	Ingestion Tumorigen Mutagen Primary Irritant		[100-52-7]

(Continued)

TABLE C-10 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>INHIBITORS (Continued)</u>				
p-Benzoquinone	Toxic Oral, rat LD <sub>50</sub> :250 mg/kg	Inhalation Strong Skin Irritant Tumorigen Mutagen Indefinite Animal Carcinogen	0.01 ppm TWA	[106-51-4]
p-t-Butyl Catechol	Skin, rabbit 500 mg/24H Toxic Effect: Severe Irritation	Skin Irritant		[98-29-3]
Catechol	Oral, rat LD <sub>50</sub> :3890 mg/kg	Toxic Fumes Inhalation Ingestion	5 ppm TWA	[120-80-9]
Chloroanil				
Copper	Toxic Oral, rat TD <sub>Lo</sub> : 1520 µg/kg Toxic Effect: Repro- ductive, Developmen- tal	Flammable in Powder Form Inhalation	Dust: 1 mg/m <sup>3</sup> TWA (recommended)	[7440-50-8]
2,5-Dichlorobenzoquinone				
2,6-Dichlorobenzoquinone				
Dinitrobenzene				
Diphenylamine	Oral, rat LD <sub>Lo</sub> :3000 mg/kg		10 mg/m <sup>3</sup> TWA 20 mg/m <sup>3</sup> STEL	[122-39-4]
2,5-Diphenyl-p-benzoquinone				
Ferric Salts				
Furfurylidene malononitrile	Intravenous, mouse LD <sub>50</sub> :5600 mg/kg			None
Hydroquinone [see Promoters/ Activators]				

(Continued)



TABLE C-10 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>INHIBITORS (Continued)</u>				
1,4-Naphthalenediol	Oral, rat LD <sub>Lo</sub> :100 mg/kg			[571-60-8]
Naphthoquinone	Toxic Oral, rat LD <sub>50</sub> :190 mg/kg	Irritant Equivocal Tumorigen		[130-15-4]
Nitrites				
p-Nitrotoluene	Oral, rat LD <sub>50</sub> :2144 mg/kg	Inhalation Ingestion Skin Absorption	5 ppm TWA	[99-99-0]
Oxygen (O <sub>2</sub> )				[7782-44-7]
Phenyl anthraquinone				
N-Phenyl-β-naphthylamine	Oral, mouse LD <sub>50</sub> :1450 mg/kg	Mutagen Animal Carcinogen Tumorigen		[135-88-6]
Picric Acid	Oral, rabbit LD <sub>Lo</sub> :120 mg/kg	Ingestion Skin Contact Explosive	0.1 mg/m <sup>3</sup> TWA (skin)	[88-89-1]
Primary and Secondary Amines				
Pyridine	Moderate Oral, rat LD <sub>50</sub> :891 mg/kg	Primary Irritant Ingestion Tumorigen Mutagen	5 ppm TWA	[110-86-1]
Pyrogallol [see Promoters/ Activators]				[87-66-1]
Quinone				
Sulfur	Eye, humans 8 ppm Toxic Effect: Irritation	Primary Irritant Fire Risk Explosion Risk		[7704-34-9]
Trinitrotoluene	Moderate Oral, rat LD <sub>Lo</sub> :700 mg/kg	Inhalation Ingestion	1.5 mg/m <sup>3</sup> TWA (skin)	[118-96-7]

TABLE C-11. HEAT STABILIZERS  
TOXICOLOGICAL AND WORKER EXPOSURE CONCERNS

<u>Heat Stabilizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No]</u>
<u>METAL COMPOUNDS</u>				
<u>BARIUM</u>				
Barium benzoate [Ba(C <sub>7</sub> H <sub>5</sub> O <sub>2</sub> ) <sub>2</sub> ·2H <sub>2</sub> O]			500 ug(Ba)/m <sup>3</sup> TWA (recommended)	
Barium bis(4-nonylphenoxide)			500 ug(Ba)/m <sup>3</sup> TWA (recommended)	[41157-58-8]
Barium caprate			500 ug(Ba)/m <sup>3</sup> TWA (recommended)	
Barium caprylate			500 ug(Ba)/m <sup>3</sup> TWA (recommended)	
Barium carbonate [BaCO <sub>3</sub> ]	Toxic Oral, rat LD <sub>50</sub> : 630 mg/kg	Ingestion	500 ug(Ba)/m <sup>3</sup> TWA (recommended)	[513-77-9]
Barium 2-ethylhexanoate			500 ug(Ba)/m <sup>3</sup> TWA (recommended)	
Barium laurate [Ba(C <sub>12</sub> H <sub>23</sub> O <sub>2</sub> ) <sub>2</sub> ]			500 ug(Ba)/m <sup>3</sup> TWA (recommended)	
Barium myristate [Ba(C <sub>14</sub> H <sub>27</sub> O <sub>2</sub> ) <sub>2</sub> ]			500 ug(Ba)/m <sup>3</sup> TWA (recommended)	
Barium naphthenate			500 ug(Ba)/m <sup>3</sup> TWA (recommended)	
Barium nonylphenate			500 ug(Ba)/m <sup>3</sup> TWA (recommended)	
Barium oleate			500 ug(Ba)/m <sup>3</sup> TWA (recommended)	
Barium phenate			500 ug(Ba)/m <sup>3</sup> TWA (recommended)	
Barium phenoxide			500 ug(Ba)/m <sup>3</sup> TWA (recommended)	

(Continued)

TABLE C-11 (Continued)

<u>Heat Stabilizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No]</u>
<u>BARIUM (Continued)</u>				
Barium ricinoleate			500 ug(Ba)/m <sup>3</sup> TWA (recommended)	
Barium silicate [BaSiO <sub>3</sub> ]	Toxic	Ingestion	500 ug(Ba)/m <sup>3</sup> TWA (recommended)	
Barium stearate [Ba(C <sub>18</sub> H <sub>35</sub> O <sub>2</sub> ) <sub>2</sub> ]	Toxic		500 ug(Ba)/m <sup>3</sup> TWA (recommended)	
<u>CADMIUM</u>				
Cadmium benzoate [Cd(C <sub>7</sub> H <sub>5</sub> O <sub>2</sub> ) <sub>2</sub> ·2H <sub>2</sub> O]			50 ug(Cd)/m <sup>3</sup> TWA 200 ug(Cd)/m <sup>3</sup> STEL (recommended)	
Cadmium caprate			50 ug(Cd)/m <sup>3</sup> TWA 200 ug(Cd)/m <sup>3</sup> STEL (recommended)	
Cadmium caprylate	Oral, rat LD <sub>50</sub> : 950 mg/kg		40 ug(Cd)/m <sup>3</sup> TWA 200 ug(Cd)/m <sup>3</sup> /15 min. ceiling (recommended)	[2191-10-8]
Cadmium 2-ethylhexanoate			50 ug(Cd)/m <sup>3</sup> TWA 200 ug(Cd)/m <sup>3</sup> STEL (recommended)	[2420-98-6]
Cadmium laurate			50 ug(Cd)/m <sup>3</sup> TWA 200 ug(Cd)/m <sup>3</sup> STEL (recommended)	
Cadmium lauryl mercaptide			50 ug(Cd)/m <sup>3</sup> TWA 200 ug(Cd)/m <sup>3</sup> STEL (recommended)	
Cadmium myristate			50 ug(Cd)/m <sup>3</sup> TWA 200 ug(Cd)/m <sup>3</sup> STEL (recommended)	
Cadmium naphthenate			50 ug(Cd)/m <sup>3</sup> TWA 200 ug(Cd)/m <sup>3</sup> STEL (recommended)	

(Continued)

TABLE C-11 (Continued)

<u>Heat Stabilizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>CADMIUM</u> (Continued)				
Cadmium oleate			50 ug(Cd)/m <sup>3</sup> TWA 200 ug(Cd)/m <sup>3</sup> STEL (recommended)	
Cadmium phenate			50 ug(Cd)/m <sup>3</sup> TWA 200 ug(Cd)/m <sup>3</sup> STEL (recommended)	
Cadmium phosphite			50 ug(Cd)/m <sup>3</sup> TWA 200 ug(Cd)/m <sup>3</sup> STEL (recommended)	
Cadmium ricinoleate [Cd(CH <sub>3</sub> (CH <sub>2</sub> ) <sub>5</sub> CHOHCH <sub>2</sub> CH:CH(CH <sub>2</sub> ) <sub>7</sub> CO <sub>2</sub> ) ]	Highly Toxic		50 ug(Cd)/m <sup>3</sup> TWA 200 ug(Cd)/m <sup>3</sup> STEL (recommended)	
Cadmium stearate	Highly Toxic Oral, rat LD <sub>50</sub> : 1125 mg/kg		40 ug/m <sup>3</sup> TWA 200 ug/m <sup>3</sup> /15 min. ceiling	[2223-93-0]
<u>CALCIUM</u>				
Calcium benzoate [Ca(C <sub>7</sub> H <sub>5</sub> O <sub>2</sub> ) <sub>2</sub> ·3H <sub>2</sub> O]				
Calcium caprate				
Calcium 2-ethylhexanoate				
Calcium laurate [Ca(C <sub>12</sub> H <sub>23</sub> O <sub>2</sub> ) <sub>2</sub> ·H <sub>2</sub> O]				
Calcium naphthenate				
Calcium oleate [Ca(C <sub>18</sub> H <sub>33</sub> O <sub>2</sub> ) <sub>2</sub> ]				
Calcium phenoxide [Ca(OC <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> ]				

(Continued)

TABLE C-11 (Continued)

<u>Heat Stabilizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No]</u>
<u>CALCIUM</u> (Continued)				
Calcium ricinoleate [Ca(CH <sub>3</sub> (CH <sub>2</sub> ) <sub>5</sub> CHOHCH <sub>2</sub> CHCH(CH <sub>2</sub> ) <sub>7</sub> CO <sub>2</sub> ) <sub>2</sub> ]	Low Toxicity			
Calcium stearate [Ca(C <sub>18</sub> H <sub>35</sub> O <sub>2</sub> ) <sub>2</sub> ]	Low Toxicity			[1592-23-0]
<u>MAGNESIUM</u>				
Magnesium 2-ethylhexanoate				
Magnesium laurate [Mg(C <sub>12</sub> H <sub>23</sub> O <sub>2</sub> ) <sub>2</sub> ·2H <sub>2</sub> O]				
Magnesium phenoxide				
Magnesium salicylate [Mg(C <sub>7</sub> H <sub>5</sub> O <sub>3</sub> ) <sub>2</sub> ·4H <sub>2</sub> O]				
Magnesium stearate [Mg(C <sub>18</sub> H <sub>35</sub> O <sub>2</sub> ) <sub>2</sub> ]	Nontoxic	Inhalation		[557-04-0]
<u>MANGANESE</u>				
Manganese carbonate [MnCO <sub>3</sub> ]		Inhalation Ingestion Primary Irritant	5 mg(Mn)/m <sup>3</sup> TLV (recommended)	[598-62-9]
Manganese oxide, hydroxide [Mn <sub>3</sub> O <sub>4</sub> ]	Nontoxic		3 mg(Mn)/m <sup>3</sup> TWA (vapor) (recommended)	[1317-35-7]
<u>POTASSIUM</u>				
Potassium benzoate [KC <sub>7</sub> H <sub>5</sub> O <sub>2</sub> ·3H <sub>2</sub> O]				
Potassium laurate [KOCC <sub>11</sub> H <sub>23</sub> ]		Primary Irritant		[10124-65-9]
Potassium naphthenate				

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TABLE C-11 (Continued)

<u>Heat Stabilizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No]</u>
<u>POTASSIUM (Continued)</u>				
Potassium oleate [C <sub>17</sub> H <sub>33</sub> COOK]	Eye, rabbit 12 mg/48H Toxic Effect: Irritation	Primary Irritant		[143-18-0]
Potassium salicylate [KC <sub>7</sub> H <sub>5</sub> O <sub>3</sub> ]				
Potassium stearate [KC <sub>18</sub> H <sub>35</sub> O <sub>2</sub> ]	Nontoxic			
<u>SODIUM</u>				
Sodium benzoate [C <sub>6</sub> H <sub>5</sub> COONa]	Low Oral, rat LD <sub>50</sub> : 4100 mg/kg	Mutagen Teratogen		[532-32-1]
Sodium borate [Na <sub>2</sub> B <sub>4</sub> O <sub>7</sub> ·10H <sub>2</sub> O]	Low			[1303-96-4]
Sodium carbonate [Na <sub>2</sub> CO <sub>3</sub> ]	Low			[497-19-8]
Sodium laurate	Skin, rat 28 mg/24H Toxic Effect: Severe Irritation	Mutagen Primary Irritant		[629-25-4]
Sodium phosphate [Na <sub>3</sub> PO <sub>4</sub> ·10H <sub>2</sub> O]				
Sodium phosphite [2NaH <sub>2</sub> PO <sub>3</sub> ·SH <sub>2</sub> O]				
Sodium salicylate [HOC <sub>6</sub> H <sub>4</sub> COONa]	Low Oral, rat TD <sub>10</sub> : 250 mg/kg Toxic Effect: Reproduc- tive, Developmental	Mutagen Teratogen		[54-21-7]
Sodium stearate [NaOCC <sub>17</sub> H <sub>35</sub> ]	Intravenous, dogs LD <sub>10</sub> : 10 mg/kg			[822-16-2]
<u>STRONTIUM</u>				
Strontium 2-ethylhexanoate				
Strontium laurate				

(Continued)

TABLE C-11 (Continued)

<u>Heat Stabilizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No]</u>
<u>STRONTIUM</u> (Continued)				
Strontium naphthenate				
Strontium stearate				
<u>ZINC</u>				
Zinc benzoate [ $\text{Zn}(\text{C}_7\text{H}_5\text{O}_2)_2$ ]				
Zinc caprate				
Zinc caprylate [ $\text{Zn}(\text{C}_8\text{H}_{15}\text{O}_2)_2$ ]	Oral, mouse $\text{LD}_{50}$ : 2370 mg/kg			[557-09-5]
Zinc 2-ethylhexanoate [Zinc octoate], [ $\text{Zn}(\text{OOCCH}(\text{C}_2\text{H}_5)\text{C}_4\text{H}_9)_2$ ]	Low			[136-53-8]
Zinc laurate [ $\text{Zn}(\text{C}_{12}\text{H}_{23}\text{O}_2)_2$ ]	Low			
Zinc naphthenate	Low Oral, rat $\text{LD}_{50}$ : 4920 mg/kg			[12001-85-3]
Zinc octoate [see Zinc caprylate]				
Zinc oleate [ $\text{Zn}(\text{C}_{18}\text{H}_{32}\text{O}_2)_2$ ]	Low Oral, mouse $\text{TD}_{\text{Lo}}$ : 1080 gm/kg/1Y Toxic Effect: Equivocal Tumorigen	Tumorigen		[557-07-3]
Zinc phenate				
Zinc stearate [ $\text{Zn}(\text{C}_{18}\text{H}_{35}\text{O}_2)_2$ ]	Nontoxic Intratracheal, rat $\text{LD}_{\text{Lo}}$ : 250 mg/kg		10 mg/m <sup>3</sup> TWA 20 mg/m <sup>3</sup> STEL (recommended)	[557-05-1]

(Continued)

TABLE C-11 (Continued)

<u>Heat Stabilizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>OTHER METAL STABILIZERS</u>				
Aluminum stearate $[Al(C_{18}H_{35}O_2)_3]$	Nontoxic		2 mg(Al)/m <sup>3</sup> TWA (recommended)	
Barium cadmium laurate	Oral, rat LD <sub>50</sub> : 1696 mg/kg		50 ug(Cd)/m <sup>3</sup> TWA 200 ug(Cd)/m <sup>3</sup> STEL (recommended)	
Barium cadmium stearate			50 ug(Cd)/m <sup>3</sup> TWA 200 ug(Cd)/m <sup>3</sup> STEL (recommended)	[1191-79-3]
Lithium stearate $[LiC_{18}H_{35}O_2]$				
<u>TIN</u>				
Dibutyltin bis(n-butyl maleate) $[(C_4H_9)_2Sn(OOCCH:CHCOOC_4H_9)_2]$			0.1 mg(Sn)/m <sup>3</sup> TWA 0.2 mg(Sn)/m <sup>3</sup> STEL (recommended)	
Dibutyltin S,S-bis(isooctyl thioglyco- late) $[(C_4H_9)_2Sn(SCH_2COOC_8H_{17})_2]$ , [Dibutyltin bis(isooctyl mercapto- acetate)]	Oral, rat LD <sub>50</sub> : 500 mg/kg		0.1 mg(Sn)/m <sup>3</sup> TWA 0.2 mg(Sn)/m <sup>3</sup> STEL (recommended)	[25168-24-5]
Dibutyltin bis(lauryl mercaptide) $[(C_4H_9)_2Sn(SC_{12}H_{25})_2]$			0.1 mg(Sn)/m <sup>3</sup> TWA 0.2 mg(Sn)/m <sup>3</sup> STEL (recommended)	[1185-81-5]
Dibutyltin bis(n-octyl maleate) $[(C_4H_9)_2Sn(OOCCH:CHCOOC_8H_{17})_2]$			0.1 mg(Sn)/m <sup>3</sup> TWA 0.2 mg(Sn)/m <sup>3</sup> STEL (recommended)	
Dibutyltin diacetate $[(C_4H_9)_2Sn(C_2H_3O_2)_2]$	Oral, rat LD <sub>50</sub> : 110 mg/kg	Ingestion	0.1 mg(Sn)/m <sup>3</sup> TWA 0.2 mg(Sn)/m <sup>3</sup> STEL (recommended)	[1067-33-0]
Dibutyltin dicaprylate [Dibutyltin dioctoate]	Oral, rat LD <sub>50</sub> : 130 mg/kg	Primary Irritant	0.1 mg(Sn)/m <sup>3</sup> TWA 0.2 mg(Sn)/m <sup>3</sup> STEL (recommended)	[4731-77-5]

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TABLE C-11 (Continued)

<u>Heat Stabilizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No]</u>
<u>TIN (Continued)</u>				
Dibutyltin dilaurate [(C <sub>4</sub> H <sub>9</sub> ) <sub>2</sub> Sn(OOCC <sub>11</sub> H <sub>23</sub> ) <sub>2</sub> ], [Dibutyl tin laurate]	Toxic Oral, rat LD <sub>50</sub> : 175 mg/kg	Inhalation Skin Irritant	0.1 mg(Sn)/m <sup>3</sup> TWA 0.2 mg(Sn)/m <sup>3</sup> STEL (recommended)	[77-58-7]
Dibutyltin laurate-maleate			0.1 mg(Sn)/m <sup>3</sup> TWA 0.2 mg(Sn)/m <sup>3</sup> STEL (recommended)	
Dibutyltin maleate [{(C <sub>4</sub> H <sub>9</sub> ) <sub>2</sub> SnOOCCH:CHCOO} <sub>n</sub> ] n = 1 to 3	Toxic Intravenous, mouse LD <sub>50</sub> : 56 mg/kg	Inhalation	0.1 mg(Sn)/m <sup>3</sup> TWA 0.2 mg(Sn)/m <sup>3</sup> STEL (recommended)	[15535-69-0] [32076-99-6]
Dibutyltin β-mercaptopropionate	Intravenous, mouse LD <sub>50</sub> : 100 mg/kg		0.1 mg(Sn)/m <sup>3</sup> TWA 0.2 mg(Sn)/m <sup>3</sup> STEL (recommended)	[78-06-8] [27380-35-4]
Dibutyltin octoate [see Dibutyltin caprylate]				
Dibutyltin succinate			0.1 mg(Sn)/m <sup>3</sup> TWA 0.2 mg(Sn)/m <sup>3</sup> STEL (recommended)	
Dibutyltin sulfide [(C <sub>4</sub> H <sub>9</sub> ) <sub>2</sub> Sn:S]	Toxic Oral, rat LD <sub>50</sub> : 145 mg/kg	Inhalation	0.1 mg(Sn)/m <sup>3</sup> TWA 0.2 mg(Sn)/m <sup>3</sup> STEL (recommended)	[4253-22-9]
Dimethyltin bis(isooctyl mercaptoacetate)			0.1 mg(Sn)/m <sup>3</sup> TWA 0.2 mg(Sn)/m <sup>3</sup> STEL (recommended)	[26636-01-1]
Dimethyltin bis(β-alkanonyl oxyethyl mercaptide)			0.1 mg(Sn)/m <sup>3</sup> TWA 0.2 mg(Sn)/m <sup>3</sup> STEL (recommended)	[26401-97-8]
Dimethyltin bis(dibutyl dithiocarbamate)	Intravenous, mouse LD <sub>50</sub> : 180 mg/kg		0.1 mg(Sn)/m <sup>3</sup> TWA 0.2 mg(Sn)/m <sup>3</sup> STEL (recommended)	[64653-05-0]
Di-n-octyltin S,S-bis(isooctyl thioglycolate) [Di-n-octyltin S,S-bis- (isooctyl mercaptoacetate)]	Oral, rat LD <sub>50</sub> : 1277 mg/kg	Teratogen	0.1 mg(Sn)/m <sup>3</sup> TWA (skin)	[26401-97-8]

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TABLE C-11 (Continued)

<u>Heat Stabilizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No]</u>
<u>TIN (Continued)</u>				
Di-n-octyltin bis(2-ethylhexyl maleate)	Oral, rat LD <sub>50</sub> : 2760 mg/kg		0.1 mg(Sn)/m <sup>3</sup> TWA 0.2 mg(Sn)/m <sup>3</sup> STEL (recommended)	[10039-33-5]
Di-n-octyltin dilaurate			0.1 mg(Sn)/m <sup>3</sup> TWA 0.2 mg(Sn)/m <sup>3</sup> STEL (recommended)	
Di-n-octyltin β-mercaptopropionate [Di-n-octyltin thiodipropionate]			0.1 mg(Sn)/m <sup>3</sup> TWA 0.2 mg(Sn)/m <sup>3</sup> STEL (recommended)	
Di-n-octyltin maleate			0.1 mg(Sn)/m <sup>3</sup> TWA 0.2 mg(Sn)/m <sup>3</sup> STEL (recommended)	
Di-n-octyltin maleate polymer			0.1 mg(Sn)/m <sup>3</sup> TWA 0.2 mg(Sn)/m <sup>3</sup> STEL (recommended)	
(Maleoxyldioxy)bis(dibutyl(lauroyloxy) tin)			0.1 mg(Sn)/m <sup>3</sup> TWA 0.2 mg(Sn)/m <sup>3</sup> STEL (recommended)	[13239-20-8]
Thiabis(monobutyltin sulfide) [S(Sn(S)C <sub>4</sub> H <sub>9</sub> ) <sub>2</sub> ]			0.1 mg(Sn)/m <sup>3</sup> TWA 0.2 mg(Sn)/m <sup>3</sup> STEL (recommended)	[39839-19-5]
Thiabismonomethyltin bis(β-alkanoyloxy- ethylmercaptide)			0.1 mg(Sn)/m <sup>3</sup> TWA 0.2 mg(Sn)/m <sup>3</sup> STEL (recommended)	
<u>LEAD</u>				
Basic lead carbonate [2PbCO <sub>3</sub> ·Pb(OH) <sub>2</sub> ], [White Lead]	Toxic	Inhalation	0.15 mg(Pb)/m <sup>3</sup> TWA 0.45 mg(Pb)/m <sup>3</sup> STEL (recommended)	[1319-46-6]
Basic lead chlorosilicate [47% SiO <sub>2</sub> + 3% Cl]			0.15 mg(Pb)/m <sup>3</sup> TWA 0.45 mg(Pb)/m <sup>3</sup> STEL (recommended)	

(Continued)

TABLE C-11 (Continued)

<u>Heat Stabilizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No]</u>
<u>LEAD (Continued)</u>				
Basic lead silicate [3PbO·2SiO <sub>2</sub> ·2H <sub>2</sub> O]	Toxic	Inhalation	0.15 mg(Pb)/m <sup>3</sup> TWA 0.45 mg(Pb)/m <sup>3</sup> STEL (recommended)	
Basic lead silicatesulfate [undisclosed complex, 24% SiO <sub>2</sub> + 60% SO <sub>3</sub> ]			0.15 mg(Pb)/m <sup>3</sup> TWA 0.45 mg(Pb)/m <sup>3</sup> STEL (recommended)	
Basic lead sulfate	Toxic	Inhalation	0.15 mg(Pb)/m <sup>3</sup> TWA 0.45 mg(Pb)/m <sup>3</sup> STEL (recommended)	
Basic lead sulfate phthalate			0.15 mg(Pb)/m <sup>3</sup> TWA 0.45 mg(Pb)/m <sup>3</sup> STEL (recommended)	
Dibasic lead phosphate [PbHPO <sub>4</sub> ]	Toxic	Inhalation	0.15 mg(Pb)/m <sup>3</sup> TWA 0.45 mg(Pb)/m <sup>3</sup> STEL (recommended)	
Dibasic lead phosphite [2PbO·PbHPO <sub>3</sub> ·1/2H <sub>2</sub> O]	Toxic	Inhalation	0.15 mg(Pb)/m <sup>3</sup> TWA 0.45 mg(Pb)/m <sup>3</sup> STEL (recommended)	[1344-40-7]
Dibasic lead phthalate [2PbO·Pb(OOC) <sub>2</sub> C <sub>6</sub> H <sub>4</sub> ·1/2H <sub>2</sub> O]	Toxic	Skin Absorption	0.15 mg(Pb)/m <sup>3</sup> TWA 0.45 mg(Pb)/m <sup>3</sup> STEL (recommended)	[69011-06-9]
Dibasic lead stearate [2PbO·Pb(C <sub>17</sub> H <sub>35</sub> COO) <sub>2</sub> ]			0.15 mg(Pb)/m <sup>3</sup> TWA 0.45 mg(Pb)/m <sup>3</sup> STEL (recommended)	[56189-09-4]
Lead 2-butenedioic acid [Lectro 78]			0.15 mg(Pb)/m <sup>3</sup> TWA 0.45 mg(Pb)/m <sup>3</sup> STEL (recommended)	[13698-55-0]
Lead carbonate [PbCO <sub>3</sub> ]	Toxic Oral, guinea pig LD <sub>50</sub> :1000 mg/kg	Inhalation Ingestion Tumorigen	0.2 mg(Pb)/m <sup>3</sup> TWA (recommended)	[598-63-0]

(Continued)

TABLE C-11 (Continued)

<u>Heat Stabilizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No]</u>
<u>LEAD (Continued)</u>				
Lead chlorosilicate [Lectro 60]			0.15 mg(Pb)/m <sup>3</sup> TWA 0.45 mg(Pb)/m <sup>3</sup> STEL (recommended)	
Lead chlorosilicate sulfate complex [Lectro 80]			0.15 mg(Pb)/m <sup>3</sup> TWA 0.45 mg(Pb)/m <sup>3</sup> STEL (recommended)	
Lead-2-ethylhexanoate [Pb(C <sub>7</sub> H <sub>15</sub> COO) <sub>2</sub> ]			0.15 mg(Pb)/m <sup>3</sup> TWA 0.45 mg(Pb)/m <sup>3</sup> STEL (recommended)	
Lead naphthenate	Oral, rat LD <sub>50</sub> : 5100 mg/kg		0.15 mg(Pb)/m <sup>3</sup> TWA 0.45 mg(Pb)/m <sup>3</sup> STEL (recommended)	[61790-14-5]
Lead salicylate [(Pb(OOC(OH)C <sub>6</sub> H <sub>4</sub> ) <sub>2</sub> )]	Probably Toxic		0.15 mg(Pb)/m <sup>3</sup> TWA 0.45 mg(Pb)/m <sup>3</sup> STEL (recommended)	
Lead silicate sulfate			0.15 mg(Pb)/m <sup>3</sup> TWA 0.45 mg(Pb)/m <sup>3</sup> STEL (recommended)	
Lead stearate [see Normal Lead Stearate]				
Lead sulfate [PbSO <sub>4</sub> ]	Toxic Oral, guinea pig LD <sub>Lo</sub> : 30 gm/kg	Strong Tissue Irritant Inhalation	200 ug(Pb)/m <sup>3</sup> TWA	[7446-14-2]
Litharge [PbO]	Toxic Intraperitoneal, rat LD <sub>Lo</sub> : 430 mg/kg	Primary Irritant Ingestion Inhalation Tumorigen Mutagen	200 ug(Pb)/m <sup>3</sup> TWA	[1317-36-8]
Monobasic lead sulfate [PbO·PbSO <sub>4</sub> ]	Toxic	Inhalation	0.15 mg(Pb)/m <sup>3</sup> TWA 0.45 mg(Pb)/m <sup>3</sup> STEL (recommended)	
Normal lead orthosilicate [SiO <sub>2</sub> 35-45%], [PbSiO <sub>3</sub> ]	Toxic	Inhalation	200 ug(Pb)/m <sup>3</sup> TWA	[10099-76-0]

(Continued)

TABLE C-11 (Continued)

<u>Heat Stabilizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No]</u>
<u>LEAD (Continued)</u>				
Normal lead stearate [Pb(C <sub>17</sub> H <sub>35</sub> COO) <sub>2</sub> ]	Toxic Oral, guinea pig LD <sub>50</sub> : 6000 mg/kg	Skin Absorption	0.1 mg(Pb)/m <sup>3</sup> TWA (recommended)	[7428-48-0]
Tetrabasic lead fumarate [4PbO·Pb(OOC) <sub>2</sub> C <sub>2</sub> H <sub>2</sub> ·2H <sub>2</sub> O]			0.15 mg(Pb)/m <sup>3</sup> TWA 0.45 mg(Pb)/m <sup>3</sup> STEL (recommended)	
Tetrabasic lead sulfate [4PbO·PbSO <sub>4</sub> ·H <sub>2</sub> O]			0.15 mg(Pb)/m <sup>3</sup> TWA 0.45 mg(Pb)/m <sup>3</sup> STEL (recommended)	
Tribasic lead maleate [3PbO·Pb(OOC) <sub>2</sub> C <sub>2</sub> H <sub>2</sub> ·1/2H <sub>2</sub> O]	Toxic	Skin Absorption	0.15 mg(Pb)/m <sup>3</sup> TWA 0.45 mg(Pb)/m <sup>3</sup> STEL (recommended)	
Tribasic lead sulfate [3PbO·PbSO <sub>4</sub> ·H <sub>2</sub> O]	Toxic	Inhalation	0.15 mg(Pb)/m <sup>3</sup> TWA 0.45 mg(Pb)/m <sup>3</sup> STEL (recommended)	[12202-17-4] [12397-06-7]
<u>ANTIMONY MERCAPTIDES</u>				
Antimony thioglycolate			0.5 mg(Sb)/m <sup>3</sup> TWA	
Antimony S,S',S"-tris(isooctyl mercapto- acetate) [Sb(SCH <sub>2</sub> COOC <sub>8</sub> H <sub>17</sub> ) <sub>3</sub> ]			0.5 mg(Sb)/m <sup>3</sup> TWA	[27288-44-4]
Antimony tris(lauryl mercaptide) [Sb(SC <sub>12</sub> H <sub>25</sub> ) <sub>3</sub> ]	Intravenous, mouse LD <sub>50</sub> : 180 mg/kg		0.5 mg(Sb)/m <sup>3</sup> TWA	[6939-83-9]
<u>MISCELLANEOUS</u>				
2-Aminocrotonic acid				[20748-08-7]
Benzoguanamine [C <sub>6</sub> H <sub>5</sub> C <sub>3</sub> N <sub>3</sub> (NH <sub>2</sub> ) <sub>2</sub> ]	Intraperitoneal, mouse LD <sub>50</sub> : 100 mg/kg			[91-76-9]
Dicyandiamide [NH <sub>2</sub> C(NH)(NHCN)]				[461-58-5]

(Continued)

TABLE C-11 (Continued)

<u>Heat Stabilizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No]</u>
<u>MISCELLANEOUS (Continued)</u>				
Dipentaerythritol [(CH <sub>2</sub> OH) <sub>3</sub> CCCH <sub>2</sub> OCH <sub>2</sub> C(CH <sub>2</sub> OH) <sub>3</sub> ]	Low			[126-58-9]
Diphenylthiourea [Thiocarbanilide], [CS(NHC <sub>6</sub> H <sub>5</sub> ) <sub>2</sub> ]	Low Intraperitoneal, mouse LD <sub>50</sub> : 500 mg/kg			[3898-06-0] [102-08-9]
Glycerol	Low			[56-81-5]
Pentaerythritol [C(CH <sub>2</sub> OH) <sub>4</sub> ]	Oral, mouse LD <sub>50</sub> : 25.5 gm/kg	Nuisance Particulate	5 mg/m <sup>3</sup> TWA (dust) (recommended)	[115-77-5]
α-Penylindole				[948-65-2]
Sorbitol [C <sub>6</sub> H <sub>8</sub> (OH) <sub>6</sub> ]				[50-70-4]
Thiolauric anhydride				[73625-50-4]
Trimethylethane [CH <sub>3</sub> C(CH <sub>2</sub> OH) <sub>3</sub> ]				[77-85-0]
Trimethylolpropane [C <sub>2</sub> H <sub>5</sub> C(CH <sub>2</sub> OH) <sub>3</sub> ]				

TABLE C-12. LUBRICANTS AND OTHER PROCESSING AIDS  
TOXICOLOGICAL AND WORKER EXPOSURE CONCERNS

<u>Lubricant/Processing Aid</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>FATTY ACIDS AND ALCOHOLS</u>				
Behenic acid				
Oleic acid	Nontoxic Skin, rabbits 500 mg open Toxic Effect: Mild Irritation	Primary Irritant Mutagen		[112-80-1]
Palmityl alcohol	Skin, humans 75 mg/3D-I Toxic Effect: Mild Irritation	Primary Irritant		[36653-82-4]
Stearic acid	Nontoxic Skin, humans 75 mg/3D-8 Toxic Effect: Mild Irritation	Primary Irritant Tumorigen		[57-11-4]
Stearyl alcohol	Nontoxic Oral, rat LD <sub>50</sub> :20 gm/kg	Tumorigen		[112-92-5]
<u>AMIDES</u>				
Behenamide				[3061-75-4]
Erucamide				[112-84-5]
Ethylene bisstearamide				[110-30-5] [8031-03-9] [12764-90-8]
Ethylene hydroxystearamide				
12-Hydroxy-N-(2-hydroxyethyl) stearamide				[123-16-2] [106-15-0]
Methylene bisstearamide				

TABLE C-12 (Continued)

<u>Lubricant/Processing Aid</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>AMIDES (Continued)</u>				
Oleamide	Low			[301-02-0]
Saturated fatty amide				
Stearamide	Implant, mice TD <sub>Lo</sub> : 1000 mg/kg Toxic Effect: Carcinogenic			[124-26-5]
Stearoguanamine				
<u>ESTERS</u>				
Acetylated partial esters				
12-Acetyloxy-9-octadecenoic acid, butyl ester				[140-04-5]
Alkoxylated fatty acid esters				
Butyl stearate	Oral, rat TD <sub>Lo</sub> : 418 gm/kg Toxic Effect: Reproductive, Newborn Effects	Teratogen		[123-95-5]
Castor oil	Eye, rabbit 50 mg Toxic Effect: Irritation	Tumorigen Primary Irritant		[8001-79-4]
Cetyl palmitate	Nontoxic			
Diethylene glycol monostearate	Nontoxic Intraperitoneal, mouse LD <sub>50</sub> : 200 mg/kg			[106-11-6]
Diethylene glycol oleate	Nontoxic			
Diethylene glycol ricinoleate	Nontoxic			

(Continued)



TABLE C-12 (Continued)

<u>Lubricant/Processing Aid</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>ESTERS</u> (Continued)				
Ethylene glycol distearate				
Ethylene glycol monostearate				
Ethyl stearate	Skin, rabbits 500 mg/24h Toxic Effect: Mild Irritation	Primary Irritant		[111-61-5]
Glycerol monooleate	Nontoxic			
Glycerol monoricinoleate				
Glycerol-mono-12-hydroxy- stearate				[1323-38-2]
Glycerol monostearate	Nontoxic Intraperitoneal, mouse LD <sub>50</sub> : 200 mg/kg			[31566-31-1]
Glycerol trioleate				
Glycerol tris(12-hydroxy- stearate)				
Guanidine stearate				
Hardened vegetable oils				
Hydrogenated castor oil [see Glycerol tris(12-hydroxy- stearate)]				
Hydrogenated vegetable oil				
Methyl 12-hydroxystearate	Low			[141-24-2]

(Continued)

TABLE C-12 (Continued)

<u>Lubricant/Processing Aid</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>ESTERS (Continued)</u>				
Methyl stearate				
Montan esters				
Octyl stearate				
Pentaerythritol tetrastearate				
Polyoxyethylene glycol mono-stearate				
Sorbitan trioleate				
Stearyl stearate				[2778-96-3]
Sulfonated castor oil [Turkey Red Oil]				[8002-33-3]
Triglyceryl 12-hydroxystearate				
Triglyceryl palmitate				
Triglyceryl stearate				
<u>METALLIC SOAPS</u>				
Aluminum stearate	Nontoxic		2 $\mu\text{g}/\text{m}^3$ TWA (recommended)	[637-12-7]
Barium stearate	Toxic		0.5 $\mu\text{g}/\text{m}^3$ TWA (recommended)	[6865-35-6]
Cadmium stearate	Highly Toxic Inhalation, humans $\text{TC}_{\text{Lo}}$ : 1800 $\mu\text{g}/\text{m}^3/2\text{Y}$ Toxic Effect: Cardiovascular; Metabolism, Nutrition		40 $\mu\text{g}/\text{m}^3$ TWA 300 $\mu\text{g}/\text{m}^3/15 \text{ min.}$ Ceiling (recommended)	[2223-93-0]

(Continued)

TABLE C-12 (Continued)

<u>Lubricant/Processing Aid</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>METALLIC SOAPS (Continued)</u>				
Calcium oleate				
Calcium ricinoleate	Low			
Calcium stearate	Low			[1592-23-0]
Lead oleate	Toxic	Skin absorption		
Lead stearate [Dibasic lead stearate]	Toxic Oral, guinea pigs LD <sub>50</sub> : 6000 mg/kg	Skin absorption	0.1 mg(Pb)/m <sup>3</sup> (recommended)	[7428-48-0]
Lithium stearate				[4485-12-5]
Magnesium oleate	Low			
Magnesium stearate	Nontoxic			[557-04-0]
Potassium stearate	Nontoxic			
Sodium dioctyl sulfosuccinate [Dioctyl sodium sulfosuccinate]	Low			
Sodium stearate	Intravenous, dog LD <sub>50</sub> : 10 mg/kg			[822-16-2]
Stannous octoate	Toxic		100 ug(Sn)/m <sup>3</sup> TWA (recommended)	
Stannous ricinoleate			100 ug(Sn)/m <sup>3</sup> TWA (recommended)	
Stannous stearate			100 ug(Sn)/m <sup>3</sup> TWA (recommended)	

(Continued)

TABLE C-12 (Continued)

<u>Lubricant/Processing Aid</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>METALLIC SOAPS (Continued)</u>				
Zinc oleate	Low			
Zinc stearate	Nontoxic Intratracheal, rat LD <sub>50</sub> : 250 mg/kg		10 mg/m <sup>3</sup> TWA 20 mg/m <sup>3</sup> STEL (recommended)	[557-05-1]
<u>NATURAL WAXES</u>				
Carnauba wax	Nontoxic			[8015-86-9]
Castorwax				
Dammar wax				[9000-16-2]
Spermaceti wax	Low			[8002-23-1]
<u>PETROLEUM-BASED WAXES</u>				
Candelilla wax	Nontoxic			
Ceresin wax	Nontoxic			[8001-75-0]
Microcrystalline wax				
Paraffin wax	Nontoxic		2 mg/m <sup>3</sup> TWA (fume)	[8002-74-2]
<u>POLYMERIC LUBRICANTS</u>				
Carboxymethyl cellulose	Nontoxic			
Cellulose acetate lacquers	Nontoxic			
Nylon	Implant, rat TD <sub>50</sub> : 123 mg/kg Toxic Effect: Equivocal Tumorigen	Tumorigen		[63428-83-1]

(Continued)

TABLE C-12 (Continued)

<u>Lubricant/Processing Aid</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>POLYMERIC LUBRICANTS</u> (Continued)				
Polyethylene wax	Impregnation, rat TD <sub>Lo</sub> : 33 mg/kg Toxic Effect: Tumorigen	Positive Animal Carcinogen		[9002-88-4]
Polypropylene wax		Positive Animal Carcinogen		[9003-07-0]
Polytetrafluoroethylene wax	Impregnation, rat TD <sub>Lo</sub> : 80 mg/kg Toxic Effect: Tumorigen	Positive Animal Carcinogen		[9002-84-0]
Polyvinyl acetate				[9003-20-7]
Polyvinyl alcohol	Subcutaneous, rat TD <sub>Lo</sub> : 2500 mg/kg Toxic Effect: Carcinogen	Carcinogen		[9002-89-5]
Silicone grease [see Silicone Oil]	Nontoxic			
Silicone oil	Nontoxic			
<u>POLYMER FILMS AND SHEETS</u>				
Cellophane	Impregnation, rat TD <sub>Lo</sub> : 18 mg/kg Toxic Effect: Tumorigen			[9005-81-6]
Cellulose acetate	Nontoxic			[9004-35-7]
Cellulose acetate butyrate				[9004-36-8]
Methyl cellulose				[9004-67-5]

(Continued)

TABLE C-12 (Continued)

<u>Lubricant/Processing Aid</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>POLYMER FILMS AND SHEETS</u> (Continued)				
Nylon	Implant, rat TD <sub>Lo</sub> :33 mg/kg Toxic Effect: Tumorigen	Positive Animal Carcinogen		[63428-83-1]
Polyethylene	Impregnation, rat TD <sub>Lo</sub> :33 mg/kg Toxic Effect: Tumorigen	Positive Animal Carcinogen		[9002-88-4]
Polyethylene terephthalate				
Polyester [Mylar]	Impregnation, rat TD <sub>Lo</sub> :116 mg/kg Toxic Effect: Tumorigen	Tumorigen		[25038-59-4]
Polytetrafluoroethylene	Impregnation, rat TD <sub>Lo</sub> :80 mg/kg Toxic Effect: Tumorigen	Positive Animal Carcinogen		[9002-84-0]
Polyvinyl acetate				[9003-20-7]
Polyvinyl alcohol	Subcutaneous, rat TD <sub>Lo</sub> :2500 mg/kg Toxic Effect: Carcinogen	Carcinogen		[9002-89-5]
Polymethacrylate		Tumorigen		[9003-01-4]
Polydimethylsiloxane	Nontoxic			
Polytetrafluoroethylene				
Polyvinyl chloride	Nontoxic	Suspected Human Carcinogen		[9002-86-2]
Polyvinylidene chloride				
Silicone resins	Nontoxic			

(Continued)

TABLE C-12 (Continued)

<u>Lubricant/Processing Aid</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>MISCELLANEOUS</u>				
Dibutyl phthalate	Toxic Oral, humans LD <sub>50</sub> :140 mg/kg	Irritant Causes Nausea	5 mg/m <sup>3</sup> TWA (air)	[84-74-2]
Lecithin	Nontoxic			
<u>INORGANICS</u>				
Aluminum silicate [see Clay]				
Calcium carbonate	Nontoxic		10 mg/m <sup>3</sup> TWA (recommended)	[1344-95-2]
Calcium silicate	Nontoxic	Irritant Dust	10 mg/m <sup>3</sup> TWA (recommended)	[1332-58-7]
Clay	Nontoxic Intraperitoneal, rat TD <sub>50</sub> :450 mg/kg/3w Toxic Effect: Carcinogen	Tumorigen	10 mg/m <sup>3</sup> TLV (recommended)	[7782-42-5]
Graphite	Low	Fire Risk	15 mppcf	[7782-42-5]
Magnesium silicate	Toxic Skin, humans 300 ug/3D Toxic Effect: Mild Irritation	Inhalation Primary Irritant		[12001-26-2]
Mica		Inhalation Irritant	20 mppcf	[1327-44-2] [1200-26-2]
Molybdenum disulfide	Low	Inhalation	10 mg/m <sup>3</sup> TWA (recommended)	[1317-33-5]
Potassium silicate				

(Continued)

TABLE C-12 (Continued)

<u>Lubricant/Processing Aid</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>INORGANICS (Continued)</u>				
Silica (fumed)	Intraperitoneal, rat LD <sub>50</sub> : 50 mg/kg		80 mg/m <sup>3</sup> /TSP <sub>102</sub>	[7631-86-9]
Talc	Moderate	Inhalation Primary Irritant	2 mppcf TWA (nonfibrous) (recommended)	[14807-96-6]



TABLE C-13. PLASTICIZERS  
TOXICOLOGICAL AND WORKER EXPOSURE CONCERNS

<u>Plasticizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>PHTHALATES</u>				
Alkyl benzyl phthalate				[68515-40-2]
Bis(tetrahydrofufural) phthalate				
Butyl benzyl phthalate	Moderate Impregnation, mouse LD <sub>50</sub> : 3,160 mg/kg	Ingestion Inhalation Skin Irritant Indefinite Animal Carcinogen		[85-68-7]
Butyl benzyl tetrachloro phthalate				
Butyl cyclohexyl phthalate	Probably Low			[84-64-0]
Butyl decyl phthalate	Probably Low Oral, rat LD <sub>50</sub> : 21 gm/kg			[89-19-0]
Butyl ethylhexyl phthalate	Low			[85-69-8]
Butyl hexyl phthalate				
Butyl isodecyl phthalate				[42343-36-2]
Butyl octyl phthalate [see Butyl ethylhexyl phthalate]				[84-78-6]
Cyclohexyl benzyl phthalate				
Cresyl benzyl phthalate				
n-Decyl n-octyl phthalate	Oral, rat LD <sub>50</sub> : 1.7 gm/kg			[119-07-3]
Decyl tridecyl phthalate				
Diallyl phthalate	Slightly Toxic Oral, rat LD <sub>50</sub> : 770 mg/kg	Skin Irritant		[131-17-9]

(Continued)

TABLE C-13 (Continued)

<u>Plasticizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<b>PHthalATES (Continued)</b>				
Di-n-amyl phthalate	Oral, rat TD <sub>Lo</sub> : 8.8 gm/kg Toxic Effect: Reproduc- tive; Paternal	Inhalation Skin Contact		[131-18-0]
Dibenzyl phthalate				[523-31-9]
Dibutoxyethyl phthalate [Dibutyl Cellosolve phthalate]	Low Oral, guinea pig LD <sub>Lo</sub> : 6000 mg/kg	Teratogen		[117-83-9]
Dibutyl phthalate	Toxic Oral, human TD <sub>Lo</sub> : 140 mg/kg Toxic Effect: Behavioral Symptoms; Gastrointestinal Tract; Urogenital System	Irritant Inhalation	5 mg/m <sup>3</sup> TWA	[84-74-2]
Dibutyl tetrachloro phthalate				
Dicapryl phthalate [Di-2-octyl phthalate], [Bis(-1-methyl- heptyl) phthalate]	Low Impregnation, mouse LD <sub>50</sub> : 14 gm/kg			[131-15-7]
Dicyclohexyl phthalate	Oral, rat LD <sub>50</sub> : 30 gm/kg	Inhalation		[84-61-7]
Didecyl phthalate	Low Percutaneous, rabbit LD <sub>50</sub> : 17 gm/kg	Primary Irritant		[84-77-5]
Di(2,3-epoxypropyl) phthalate	Oral, rat LD <sub>50</sub> : 1245 mg/kg			[7195-45-1]
Diethoxyethoxy ethyl phthalate [Dicarbitol phthalate]				
Di(2-ethylbutyl) phthalate				
Di(2-ethylhexyl) phthalate [Dioctyl phthalate]	Oral, rat LD <sub>50</sub> : 31 gm/kg	Positive Animal Carcinogen Mucous Membrane Irritant CNS Depressant	5 mg/m <sup>3</sup> TWA	[117-81-7]

(Continued)

TABLE C-13 (Continued)

<u>Plasticizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>PHthalATES</u> (Continued)				
Diethyl phthalate	Moderate Inhalation, humans TC <sub>Lo</sub> : 1000 mg/m <sup>3</sup> Toxic Effect: Irritant to Eye and Pulmonary System	Primary Irritant Ingestion Inhalation Eye and Mucous Membrane Irritant CNS Depressant	5 mg/m <sup>3</sup> TWA 10 mg/m <sup>3</sup> STEL (recommended)	[84-66-2]
Di-n-heptyl phthalate		Skin Contact		[3648-21-3]
Dihexyl phthalate	Low Skin, rabbit LD <sub>50</sub> : 20 gm/kg	Primary Irritant Skin Contact Inhalation		[84-75-3]
Dihydroabietyl phthalate				
Diisobutyl phthalate	Low Intraperitoneal, rat LD <sub>50</sub> : 3749 mg/kg			[84-69-3]
Diisodecyl phthalate	Moderate	Irritant		[26761-40-0]
Diisoheptyl phthalate				[41451-28-9]
Diisohexyl phthalate				[3068-96-0]
Diisononyl phthalate		Skin Contact Inhalation		[28553-12-0]
Diisooctyl phthalate	Low Oral, rat LD <sub>50</sub> : 17.3 ml/kg			[27564-26-3]
Dilauryl phthalate				
Dimethoxyethyl phthalate	Low Intraperitoneal, rat LD <sub>50</sub> : 3735 mg/kg	Irritant Mutagen		[117-82-8]
Dimethyl phthalate	Toxic Oral, rat LD <sub>50</sub> : 6900 mg/kg	Primary Irritant Ingestion Inhalation Irritant	5 mg/m <sup>3</sup> TWA	[131-11-3]

(Continued)

TABLE C-13 (Continued)

<u>Plasticizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>PHTHALATES (Continued)</u>				
Dimethyl isobutyl carbinyl phthalate				
Dinonyl phthalate	Low Oral, rat LD <sub>50</sub> : 2000 mg/kg			[84-76-4]
Di-n-octyl phthalate	Skin, rabbit 500 mg/24 Hr. Toxic Effect: Mild Irritant	Primary Irritant		[117-81-7] [117-84-0]
Di-n-octyl, n-decyl phthalate	Low			
Diphenyl phthalate	Moderate			[84-62-8]
Dipropyl phthalate	Low			[131-17-9]
Ditridecyl phthalate	Low Skin, rabbit 10 mg/24 Hr. Open Toxic Effect: Mild Irritant	Skin Irritant Inhalation		[119-06-2]
Di(3,5,5-trimethylhexyl) phthalate				
Diundecyl phthalate	Eye, rabbit 100 mg Toxic Effect: Mild Irritant	Primary Irritant		[3648-20-2]
Ethylhexyl decyl phthalate				[119-07-3]
2-Ethylhexyl isodecyl phthalate				[1330-96-7]
Heptyl nonyl phthalate				[19295-81-9] [70955-56-5]
n-Heptyl, n-nonyl, n-undecyl phthalate				[68515-44-6] [68515-41-3] [68515-42-4] [68514-45-7] [68515-43-5] [3648-20-2]

(Continued)

TABLE C-13 (Continued)

<u>Plasticizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>PHthalATES</u> (Continued)				
n-Hexyl, n-decyl phthalate	Oral, rat LD <sub>50</sub> : 49 gm/kg			[25724-58-7]
Hexyl octyl decyl phthalate (20%/36%/44%)				[68515-51-5]
(5%/56%/38%)				[68648-93-1]
Isodecyl benzyl phthalate				
Isooctyl isodecyl phthalate	Low			
Methoxyethoxyethyl phthalate				
Methoxyethoxyethyl benzyl phthalate				
Octyl benzyl phthalate				
n-Octyl, n-decyl phthalate	Oral, rat LD <sub>50</sub> : 45 gm/kg			[119-07-3]
7-(2,6,6,8-Tetramethyl-4-oxa- 3-oxo-nonyl)benzyl phthalate				[16883-83-3]
<u>BISPHthalATES</u>				
Ethylene glycol bis-(n-butyl) phthalate				
<u>HEXAHYDROPHthalATES</u>				
D1-2-Ethylhexylhexahydro- phthalate				
2-Ethylhexylhexahydro isophthalate				

(Continued)

TABLE C-13 (Continued)

<u>Plasticizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>ISOPHTHALATES</u>				
Diethyl isophthalate				[636-53-3]
Di-(2-ethylhexyl) isophthalate [Dioctyl isophthalate]	Low Oral, rat LD <sub>50</sub> : 4390 mg/kg	Primary Irritant		[137-89-3]
Diisooctyl isophthalate				
Dimethyl isophthalate	Oral, rat LD <sub>50</sub> : 4390 mg/kg			[1459-93-4]
Dinonylphenyl isophthalate				
<u>TEREPHTHALATES</u>				
Di-(2-ethylhexyl) terephthalate [Dioctyl terephthalate]	Low			[6422-86-2]
Chlorinated dioctyl terephthalate				
<u>TETRAHYDROPHTHALATES</u> <u>[Chlorendates]</u>				
2-Ethylhexyl epoxy tetrahydrophthalate				
<u>PHTHALATE MIXTURES</u> <u>AND UNSPECIFIED</u>				
Blend (50/50) of dioctyl and dioctyldecyl phthalates				
Blend (50/50) of dioctyl and didecyl phthalates				
Mixed Alcohol phthalates				
Mixed Alcohol phthalates				
Mixed Normal Alcohol phthalates				

(Continued)

TABLE C-13 (Continued)

<u>Plasticizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>PHthalate MIXTURES</u> <u>AND UNSPECIFIED (Continued)</u>				
Straight Chain Alcohol phthalates				
Straight Chain Alcohol phthalates				
Mixed alkyl phthalates				
Mixed-n-alkyl phthalates				[68515-60-6]
Alkyl aryl phthalate				
Alkyl aryl modified phthalate				
Alkyl aryl modified phthalate				
High molecular weight phthalate				
High molecular weight linear phthalate				
High solvating phthalate				
Modified phthalate				
Octyl fatty phthalate				
High molecular weight phthalate "polyester"				
<u>TRIMELLITATES</u>				
Diisooctyl monoisodecyl trimellitate				
Heptyl nonyl trimellitate				[68515-60-5]
Heptyl nonyl undecyl trimelli- tate				[68515-58-2]
Isooctyl isodecyl trimellitate				

(Continued)

TABLE C-13 (Continued)

<u>Plasticizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>TRIMELLITATES (Continued)</u>				
n-Octyl, n-decyl trimellitate				
Tricapryl trimellitate				
Tri-(2-ethylhexyl) trimellitate	Low			[3319-31-1]
Tri-n-hexyl trimellitate				
Triisodecyl trimellitate				[36631-30-8]
Triisononyl trimellitate				[53894-23-8]
Triisooctyl trimellitate	Low			[27251-75-8]
Tri-n-octyl trimellitate				[89-04-3] [3319-31-1]
Tri-n-octyl n-decyl trimellitate				[67989-23-5]
<u>PYROMELLITATES</u>				
Tetra-n-butyl pyromellitate				
Tetraethyl pyromellitate				
Tetramethyl pyromellitate				
<u>EPOXY TYPE PLASTICIZERS</u>				
Bisphenol A diglycidyl ethers (8.0-9.4% oxirane)	Nontoxic Skin, rabbit 500 mg, Open Toxic Effect: Mild Irritant	Primary Irritant Mutagen		[1675-54-3]
Di-2-ethylhexyl-4,5-epoxy tetrahydro phthalate (3.6-3.9% oxirane)				
Di-isodecyl tetrahydro-4,5- epoxy tallate				

(Continued)



TABLE C-13 (Continued)

<u>Plasticizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>EPOXY TYPE PLASTICIZERS</u> (Continued)				
Diisodecyl-4,5-epoxy tetra hydrophthalate (3.0% oxirane)				
Epoxidized linseed oil (9.0- 10.0% oxirane)				[8016-11-3]
Epoxidized soybean oil (6.7- 7.0% oxirane)				[8013-07-8]
2-Ethylhexyl epoxy tallate (4.4-4.9% oxirane)	Oral, rat LD <sub>50</sub> : 20.8 gm/kg			[61789-01-3]
Epoxy tallate				
Epoxy fatty nitrile				
Octyl epoxy stearate (3.5-3.9% oxirane)				
Octyl epoxy tallate	Oral, rat LD <sub>50</sub> : 32 gm/kg			[61788-72-5]
<u>POLYESTERS AND OTHER POLYMERIC PLASTICIZERS</u>				
Acrylic-type Polyester				[39363-92-3] [68583-85-7]
Adipic Acid Polyesters				
Adipic Acid Polyesters Low Viscosity				
Medium Viscosity				
Medium Molecular Weight				
Medium High Molecular Weight				
Alkyds				

(Continued)

TABLE C-13 (Continued)

<u>Plasticizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>POLYESTERS AND OTHER POLYMERIC PLASTICIZERS (Continued)</u>				
Azelaic acid polyesters				[39316-47-1]
Butadieneacrylonitrile polymer				
Easy processing polymeric				
2-Ethyl-1,3-hexanediol polyadipate				
Neopentyl glycol polyadipate				
Polybutylene glycol				
Polyester, acetylated				
Polyester, not acetylated or not "terminated"				
Polyester				
Polypropylene glycol polyadipate				
Polystyrene resin, polyalpha methyl				
Polyurethane-based polymeric powder				
Resinous plasticizer, EVA terpolymer				
Sebacic acid polyester				[39316-47-7]
Sebacic acid polyester oil modified				
Sulfonamide-Formaldehyde				
Reactive-type plasticizer				

(Continued)

TABLE C-13 (Continued)

<u>Plasticizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>PHOSPHATES</u>				
Alkyl aryl phosphate				
p-t-Butylphenyl diphenyl phosphate	Intravenous, mouse LD <sub>50</sub> : 100 mg/kg			[981-40-8] [56803-37-3]
Chlorophenyl diphenyl phosphate				
Chlorinated diphosphate				[38051-10-4]
Cresyl diphenyl phosphate	Oral, rat LD <sub>50</sub> : 6.4-12.8 gm/kg			[26444-49-5]
Di-(2-ethylhexyl) phenyl phosphate	Intravenous, rabbit LD <sub>50</sub> : 272 mg/kg			[78-31-9]
Diphenyl octyl phosphate		Inhalation Skin Contact		[115-88-8]
2-Ethylhexyl diphenyl phosphate	Intravenous, rabbit LD <sub>50</sub> : 272 mg/kg	Ingestion		[1241-94-7]
Halogenated organic phosphate				
Isodecyl diphenyl phosphate				[29761-21-5]
Isooctyl diphenyl phosphate				
Isopropylated phenyl phosphate				
Isopropyl phenyl diphenyl phosphate				[26967-76-0]
Phenyl isopropyl phenyl phosphate				
o-Phenylphenyl diphenyl phosphate				
Triaryl phosphate (synthetic)				
Tributoxyethyl phosphate	May be Toxic Oral, guinea pig LD <sub>50</sub> : 3000 mg/kg			[78-51-3]

(Continued)

TABLE C-13 (Continued)

<u>Plasticizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<b>PHOSPHATES (Continued)</b>				
Tributyl phosphate	Toxic Oral, rat LD <sub>50</sub> : 3000 mg/kg	Inhalation Skin Irritant	5 mg/m <sup>3</sup> TWA	[126-73-8]
Tricresyl phosphate	Toxic Oral, rat LD <sub>50</sub> : 4680 mg/kg	Primary Irritant Inhalation Skin Absorption	Ortho - 0.1 mg/m <sup>3</sup> TWA	Ortho [78-30-8] Other [1330-78-5]
Tricresyl diphenyl phosphate				
Triethyl phosphate	Oral, rat LD <sub>50</sub> : 1600 mg/kg	Nerve Damage Slight Irritant Mutagen		[78-40-0]
Tri-(2-ethylhexyl) phosphate	Low Oral, rat LD <sub>50</sub> : 37 gm/kg			[78-42-2]
Tri-n-hexyl phosphate				
Triisopropyl phenol phosphate				
Tri-2-methoxyethyl phosphate				
Triphenyl phosphate	Toxic Subcutaneous, cat LD <sub>50</sub> : 100 mg/kg	Inhalation	3 mg/m <sup>3</sup> TWA	[115-86-6]
Tris(2-chloroethyl) phosphate	Oral, rat LD <sub>50</sub> : 1230 mg/kg	Inhalation Suspected Carcinogen		[306-52-5] [115-96-8]
Tris(chlorophenyl) phosphate				
Tris-chloropropyl phosphate				None
Tris(2,3-dichloropropyl) phosphate	Oral, rat LD <sub>50</sub> : 2830 mg/kg	Mutagen		[78-43-3]
Tris(tetrahydrofurfuryl) phosphate				

(Continued)

TABLE C-13 (Continued)

<u>Plasticizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>PHOSPHATES (Continued)</u>				
Trixylenyl phosphate [tri(di-methylphenyl) phosphite]				[25155-23-1]
Unspecified phosphate				
<u>PHOSPHONATES</u>				
Chlorinated organic phosphonate				
Chlorinated polyphosphonate (27% Cl, 15% P)				[4351-70-6]
Di-(2-ethylhexyl n-octyl) phosphonate				
Halogenated organic polyphosphonate				
<u>PHOSPHITES</u>				
Triphenyl phosphite	Oral, rat LD <sub>50</sub> : 1.6-3.2 gm/kg	Strong Irritant		[101-02-0]
Tris(2-chloroethyl) phosphite	Intraperitoneal, mouse LD <sub>50</sub> : 250 mg/kg	Reactive		[140-08-9]
<u>LINEAR PLASTICIZERS</u>				
<u>GLUTARATES</u>				
Dialkyl diether glutarate				
Dibutoxyethyl glutarate				
Dibutoxyethoxyethyl glutarate				
Dicumylphenyl glutarate				
Didecyl glutarate				
Diisodecyl glutarate				
Mixed dialkyl glutarate				

(Continued)

TABLE C-13 (Continued)

<u>Plasticizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>ADIPATES</u>				
Benzyl octyl adipate				
Butyl carbitol adipate				
Dialkoxymethyl adipate				
Dibenzyl adipate				
Dibutoxyethyl adipate	Low Intraperitoneal, rat LD <sub>50</sub> : 600 mg/kg			[141-18-4]
Dibutoxyethoxyethyl adipate	Oral, rat LD <sub>50</sub> : 6000 mg/kg			[141-17-3]
Dibutyl adipate	Oral, rat LD <sub>50</sub> : 12900 mg/kg	Primary Irritant		[105-99-7]
Dicapryl adipate	Low			
Didecyl adipate	Low Oral, rat LD <sub>50</sub> : 21 gm/kg			[105-97-5]
Di-(1,3-di-methylbutyl) adipate				
Diethyl adipate	Low Oral, rat LD <sub>50</sub> : >1.6 gm/kg	Mutagen		[141-28-6]
Di-(2-ethylhexyl) adipate	Low Oral, rat LD <sub>50</sub> : 9110 mg/kg	Moderate Eye Irritant Positive Animal Carcinogen Mutagen		[103-23-1]
Di-n-hexyl adipate	Low Oral, rat LD <sub>50</sub> : 5.6 gm/kg			[110-33-8]
Diisobutyl adipate	Intraperitoneal, rat LD <sub>50</sub> : 5950 mg/kg			[141-04-8]

(Continued)

TABLE C-13 (Continued)

<u>Plasticizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>ADIPATES</u> (Continued)				
Diisodecyl adipate	Low			[27178-16-1]
Diisononyl adipate				[33703-08-1]
Diisooctyl adipate	Low			[1330-86-5]
Diisopropyl adipate	Intravenous, rat LD <sub>50</sub> : 640 mg/kg			[6938-94-9]
Dimethyl adipate				[627-93-0]
Dinonyl adipate	Low			[151-32-6]
Dipropyl adipate	Intraperitoneal, rat LD <sub>50</sub> : 3786 mg/kg			[106-19-4]
Ditridecyl adipate				[16958-92-2]
Di-(2,2,4-Trimethyl-1,3-penta- nediol monoisobutyrate) adipate				
Heptyl nonyl adipate				[68515-75-3]
n-Hexyl n-decyl adipate				[22707-35-3]
Isooctyl isodecyl adipate				[68130-92-7] [31474-57-4]
n-Octyl n-decyl adipate				[110-29-2]
Tridecyl adipate				
<u>MIXED ADIPATES</u>				
C <sub>7</sub> -C <sub>9</sub> linear adipates				
Straight chain alcohol adipates				
Straight chain alcohol adipates				

(Continued)

TABLE C-13 (Continued)

<u>Plasticizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>POLYMERIC ADIPATES</u>				
Di-(2-ethylhexyl) adipate (polymeric)				
High molecular weight adipate				
Modified polypropylene adipate				
Polypropylene adipate				
<u>CITRATES</u>				
Acetyl tri-n-butyl citrate	Low			[77-90-7]
Acetyl triethyl citrate	Nontoxic Impregnation, mouse LD <sub>50</sub> : 1150 mg/kg			[77-89-4]
Acetyl tri-(2-ethylhexyl) citrate	Low			
Acetyl tri-n-hexyl citrate				
Acetyl tri-(n-octyl, n-decyl) citrate				
Tribenzyl citrate				
Tributyl citrate	Low			[77-94-1]
Triethyl citrate	Low Oral, rat LD <sub>50</sub> : 7 gm/kg	Inhalation Ingestion		[77-93-0]
Tris(-2-ethylhexyl) citrate				
<u>AZELATES</u>				
Dibenzyl azelate				[1932-84-9]
Dibutoxyethyl azelate				
Diethyl azelate				[624-17-9]

(Continued)



TABLE C-13 (Continued)

<u>Plasticizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>AZELATES</u> (Continued)				
Di-(2-ethylbutyl) azelate				
Di-(2-ethylhexyl) azelate	Very Low Intravenous, rat LD <sub>50</sub> :1060 mg/kg	Primary Irritant		[103-24-2]
Di-n-hexyl azelate	Oral, rat LD <sub>50</sub> :16 gm/kg			[109-31-9]
Diisobutyl azelate				
Diisooctyl azelate	Low			[26544-17-2]
Dimethyl azelate				
Low temperature azelate plasticizer				
<u>SEBACATES</u>				
Butyl acetoxy sebacate				
Butyl benzyl sebacate				
Dibenzyl sebacate				[140-24-9]
Dibutoxyethyl sebacate				
Dibutoxyethoxyethyl sebacate				
Dibutyl sebacate	Low Oral, rat LD <sub>50</sub> :16-32 gm/kg	Teratogen		[109-43-3]
Di(-1,3-dimethylbutyl) sebacate				
Dihexyl sebacate				
Diisooctyl sebacate	Low			[27214-90-0]
Diisopropyl sebacate				[7491-02-3]

(Continued)

TABLE C-13 (Continued)

<u>Plasticizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>SEBACATES (Continued)</u>				
Dimethyl sebacate				
Dinonyl sebacate				[4121-16-8]
Diethyl sebacate [di-(2-ethylhexyl) sebacate]	Low Oral, rat LD <sub>50</sub> : 1280 mg/kg			[122-62-3] [2432-87-3]
Heptyl nonyl sebacate				
<u>ISOSEBACATES</u>				
Di-n-butyl isosebacate				
Di-(2-ethylhexyl) isosebacate	Intraperitoneal, mouse LD <sub>50</sub> : 200 mg/kg			[29590-28-1]
<u>SUCCINATES</u>				
Diethyl succinate	Low Oral, rat LD <sub>50</sub> : 8530 mg/kg	Primary Irritant		[123-25-1]
Tetrabutyl thiosuccinate				
<u>FORMAL</u>				
Butyl carbitol formal				
Dibutoxyethoxyethyl formal				
<u>PELARGONATES</u>				
Isodecyl pelargonate				
<u>TARTRATES</u>				
Dibutyl tartrate				[87-92-3]
Diisobutyl tartrate				

(Continued)

TABLE C-13 (Continued)

<u>Plasticizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>FUMARATES</u>				
Dibutyl fumarate	Nontoxic Oral, rat LD <sub>50</sub> : 8530 mg/kg	Primary Irritant		[105-75-9]
Diisooctyl fumarate				[1330-76-3] [1330-75-2]
Dioctyl fumarate	Low Oral, rat LD <sub>50</sub> : 29.2 gm/kg	Primary Irritant		[2997-85-5] [141-02-6]
<u>ISOBUTYRATES</u>				
2,2,4-Trimethyl-1,3-pentandiol diisobutyrate				
Sucrose acetate isobutyrate	Nontoxic			[126-13-6]
<u>MALEATES</u>				
Di-n-butyl maleate	Low Oral, rat LD <sub>50</sub> : 3730 mg/kg	Primary Irritant		[105-76-0]
Di-2-ethylhexyl maleate	Oral, rat LD <sub>50</sub> : 14 gm/kg	Primary Irritant		[2915-53-9]
Di-n-octyl maleate	Low Oral, rat LD <sub>50</sub> : 14.2 gm/kg			[2915-53-9]
Monobutyl maleate				
<u>PENTAERYTHRITOL</u>				
Pentaerythritol fatty acid ester				
Pentaerythritol tetracaprylate- caprate				

(Continued)

TABLE C-13 (Continued)

<u>Plasticizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>OTHER LINEAR ESTERS</u>				
Mixed dibasic ester				
Sucrose octoacetate	Low			
<u>EXTENDERS</u>				
<u>PETROLEUM DERIVATIVES</u>				
Alkyl aryl hydrocarbons				
Aromatic hydrocarbons (70% aromatic hydrocarbons, 23% polar compounds)				
Biphenyl	Inhalation, humans TC <sub>Lo</sub> : 4.4 mg/m <sup>3</sup> Toxic Effect: Peripheral Nervous System, Gastrointestinal Tract	Mutagen Tumorigen	0.2 ppm TWA	[98-52-4]
Butyl naphthalene				
Diisopropyl biphenyl				
Naphthalene	Oral, rat LD <sub>50</sub> : 1780 mg/kg	Primary Irritant Ingestion Inhalation Skin Absorption Tumorigen	10 ppm TWA	[91-20-3]
Naphthenic Oil				
Polyalkyl naphthalene				
Terphenyls, partially hydrogenated				
o,m,p-Terphenyl mixture	Oral, rat LD <sub>50</sub> : 2.4 gm/kg		1 ppm Ceiling	[84-15-1] [92-06-8]
Poly-alpha-methyl styrene				

(Continued)

TABLE C-13 (Continued)

<u>Plasticizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>CHLORINATED AROMATICS</u>				
Chlorobenzene	Oral, rat LD <sub>50</sub> : 2910 mg/kg		75 ppm TWA	[25321-22-6] [108-90-7]
o-Dichlorobenzene	Inhalation, rat LC <sub>10</sub> : 821 ppm/7 Hr. Toxic Effect: Behavioral Symptoms, Liver, Eye	Inhalation Indefinite Human Carcinogen	50 ppm Ceiling	[95-50-1]
Chlorinated biphenyl				
21% Cl				
32% Cl				
42% Cl				
48% Cl				
54% Cl				
60% Cl				
68% Cl				
Chlorinated Naphthalene				
22% Cl				
50% Cl				
56% Cl				
70% Cl				
Chlorinated Terphenyl				
60% Cl				
Chlorinated Paraffin	Low			[63449-39-8]
40% Cl				
42% Cl				
52% Cl				
70% Cl				

(Continued)

TABLE C-13 (Continued)

<u>Plasticizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>PARAFFIN OILS</u>				
White paraffin oil, highly refined	Nontoxic Intraperitoneal, mouse 52 gm/kg/17 Wk. Toxic Effect: Neoplastic Effect		5 mg/m <sup>3</sup> TWA 10 mg/m <sup>3</sup> STEL (recommended)	[8012-95-1]
Petrolatum	Intraperitoneal, mouse TD <sub>Lo</sub> : 14 gm/kg Toxic Effect: Equivocal Tumorigenic Agent; Blood; Pulmonary System	Tumorigen		[8009-03-8]
<u>OTHER CYCLIC PLASTICIZER</u>				
<u>ABIETIC DERIVATIVES</u>				
Hydroabietyl alcohol				
Hydrogenated methyl abietate				
Methyl abietate (methyl ester of rosin)	Low			[8050-13-3]
<u>BENZOIC ACID DERIVATIVES</u>				
Benzyl benzoate	Oral, rat LD <sub>50</sub> : 1700 mg/kg	Ingestion Skin and Eye Irritant		[120-51-4]
Cumyl phenyl dibenzoate				
Diethylene glycol dibenzoate	Nontoxic Oral, rat LD <sub>50</sub> : 2830 mg/kg			[120-55-8] [94-49-5]
Dipropylene glycol dibenzoate				[27138-31-4]
Diethylene and Dipropylene glycol dibenzoate blend				
Ethylene glycol dibenzoate				[94-49-5]
Glyceryl tribenzoate	Oral, rat LD <sub>50</sub> : 11.7 gm/kg			[614-33-5]

(Continued)

TABLE C-13 (Continued)

<u>Plasticizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>BENZOIC ACID DERIVATIVES</u> (Continued)				
Neopentyl glycol dibenzoate				
Pentaerythritol tetrabenzoate				
Octylene Glycol Dibenzoate				
Polyethylene glycol (200) dibenzoate				[9004-86-8]
Polyethylene glycol (300) dibenzoate				[9004-86-8]
Polyethylene glycol (400) dibenzoate				[9004-86-8]
Polyethylene glycol (600) dibenzoate	Oral, rat LD <sub>50</sub> : 5340 mg/kg			[9004-86-3]
Sucrose benzoate				
Triethylene glycol dibenzoate	Low Oral, rat LD <sub>50</sub> : 2830 mg/kg			[120-56-9]
Trimethylolethane Tribenzoate				None
2,2,4-Trimethyl-1,3-pentanediol isobutyrate benzoate				[35164-39-7]
Proprietary low stain benzoic acid derivative				
<u>POLYPHENYL</u>				
Hydrogenated terphenyl				[61788-32-1]
<u>LACTAM</u>				
2-Pyrrolidone	Oral, rat LD <sub>50</sub> : 6500 mg/kg			[616-45-5]

(Continued)

TABLE C-13 (Continued)

<u>Plasticizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>ACETATES</u>				
Cumyl phenyl acetate				
<u>PHENOXYs</u>				
Acetyl paracumyl phenol				
<u>KETONES</u>				
Benzophenone	Oral, rat LD <sub>50</sub> : 2895 mg/kg			[119-61-9]
<u>GLYCOLATES</u>				
Butyl phthalyl butyl glycolate	Oral, rat LD <sub>50</sub> : 15 gm/kg	Mutagen		[85-70-1]
Dibutyl methylene bis(hydroxyglyco- late				
Dicapryl diglycolate				
Dioctyl thiodiglycolate				
Ethyl phthalyl ethyl glycolate	Oral, rat LD <sub>50</sub> : 10% in diet			[84-72-0]
Methyl phthalyl ether glycolate	Oral, rat LD <sub>50</sub> : 9.04 gm/kg	Primary Irritant		[85-71-2]
<u>GLYCEROL DERIVATIVES</u>				
Glycerol	Nontoxic Oral, mouse LD <sub>50</sub> : 26 gm/kg	Primary Irritant	10 mg/m <sup>3</sup> TWA (recommended)	[56-81-5]
Glycerol carbonate				[64057-77-8]
Glycerol diacetate	Nontoxic Oral, mouse LD <sub>50</sub> : 8.5 gm/kg			[106-61-6]

(Continued)



TABLE C-13 (Continued)

<u>Plasticizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>GLYCEROL DERIVATIVES</u> (Continued)				
Glycerol monacetate	Subcutaneous, rat LD <sub>50</sub> : 5.5 gm/kg	Mutagen		[25395-31-7] [26446-35-5]
Glycerol triacetate	Subcutaneous, rat LD <sub>50</sub> : 2.8 gm/kg	Primary Irritant		[102-76-1]
Glycerol tributyrate	Oral, rat LD <sub>50</sub> : 13 gm/kg	Tumorigen		[60-01-5]
Glycerol triricinoleate				
<u>GLYCOL DERIVATIVES</u>				
<u>GLYCOLS AND GLYCOL ESTERS</u>				
1,3-Butanediol	Low Oral, rat LD <sub>50</sub> : 23 gm/kg	Primary Irritant		[107-88-0]
2,3-Butanediol 1,4-Butanediol dicaprylate				
1,4-Butanediol dipelargonate				
Butyl carbitol acetate				
Diethylene glycol dipelargonate				[106-01-4]
Diethylene glycol monobutyl ether acetate [Butyl Carbitol Acetate]				
2,2-Diethyl-1,3-propanediol				
Ethylene glycol diacetate	Moderate Intraperitoneal, mouse LD <sub>50</sub> : 1070 mg/kg	Ingestion Mild Eye Irritant		[111-55-7]
Ethylene glycol dipelargonate				

(Continued)

TABLE C-13 (Continued)

<u>Plasticizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>GLYCOLS AND GLYCOL ESTERS</u> (Continued)				
2-Ethyl-1,3-hexanediol	Oral, rat LD <sub>50</sub> : 400 mg/kg	Eye and Mucous Membrane Irritant		[94-96-2]
1,5-Hexanediol				
Polyethylene glycol 200	Oral, rat LD <sub>50</sub> : 28900 mg/kg			[25322-68-3]
Polyethylene glycol 300	Oral, rat LD <sub>50</sub> : 27500 mg/kg			[25322-68-3]
Polyethylene glycol 400	Oral, rat LD <sub>50</sub> : 33750 mg/kg	Primary Irritant		[25322-68-3]
Polyethylene glycol 600	Oral, mouse LD <sub>50</sub> : 47 gm/kg			[25322-68-3]
Polyethylene glycol 900				
Polyethylene glycol 1000	Oral, rat LD <sub>50</sub> : 42 gm/kg			[25322-68-3]
Polyethylene glycol 1500				
Polyethylene glycol 1450				
Polyethylene glycol 1500 and 500s	Oral, rat LD <sub>50</sub> : 44200 mg/kg	Primary Irritant		[25322-68-3]
Polyethylene glycol 1530				
Polyethylene glycol 3350				
Polyethylene glycol 4000	Oral, rat LD <sub>50</sub> : 59 gm/kg	Primary Irritant		[25322-68-3]
Polyethylene glycol 4500				
Polyethylene glycol 6000	Oral, rat LD <sub>50</sub> : 33750 mg/kg			[25322-68-3]

(Continued)

TABLE C-13 (Continued)

<u>Plasticizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>GLYCOLS AND GLYCOL ESTERS</u> (Continued)				
Polyethylene glycol 8000				
Polyethylene glycol 20M				
Polyethylene glycol (200) di-(2-ethylhexoate) [Polyethylene glycol dioctoate]				[18268-70-7]
Polyethylene glycol (600) monolaurate				
Tetraethylene glycol di-(2- ethylenehexanoate)	Oral, rat LD <sub>50</sub> : 18 gm/kg			[18268-70-7]
Tetraethylene glycol diheptanoate				
Triethylene glycol diacetate				
Triethylene glycol dicaprylate				
Triethylene glycol dicaprylate- caprate				
Triethylene glycol di-(2-ethyl- butyrate)	Oral, rat LD <sub>50</sub> : 6000 mg/kg			[95-08-9]
Triethylene glycol di-(2- ethylhexoate)				
Triethylene glycol diheptanoate				
Triethylene glycol diperlargonate				
Triethylene glycol ester of fatty acid				
Triglycol ester of vegetable oil fatty acid				

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TABLE C-13 (Continued)

<u>Plasticizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>GLYCOLS AND GLYCOL ESTERS</u> (Continued)				
Trimethylol ethane tricarprylate-caprate				
Trimethylol propane triheptanoate				
<u>DERIVATIVES OF FATTY ACIDS</u>				
<u>LAURATES</u>				
Butoxyethyl laurate				
Diethylene glycol monolaurate	Nontoxic			
Glycerol monolaurate	Nontoxic			
Polyethylene glycol (400) dilaurate				
1,2 Propylene glycol monolaurate				
<u>MYRISTATES</u>				
n-Butyl myristate	Nontoxic			
Isopropyl myristate	Nontoxic Skin, humans 85 mg/3 days Toxic Effect: Mild Irritant	Primary Irritant		[110-27-0]
Isopropyl myristate-palmitate	Nontoxic			

(Continued)

TABLE C-13 (Continued)

<u>Plasticizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>OLEATES</u>				
Butoxyethyl oleate				
Butyl oleate	Low Skin, rabbits 500 mg/24 Hrs. Toxic Effect: Moderate Irritant			[142-77-8]
Diethylene glycol monooleate	Nontoxic			
Ethylene glycol monobutyl ether oleate	Probably Low			
Glycerol monooleate	Nontoxic			[25496-72-4]
Glycerol trioleate [Olein]				
Isopropyl oleate				
Lead oleate	Toxic Oral, guinea pig LD <sub>50</sub> : 4 gm/kg	Skin Absorption	50 ug(Pb)/m <sup>3</sup> TWA	[1120-46-3]
Methoxyethyl oleate	Oral, rat LD <sub>50</sub> : 16 gm/kg			[111-10-4]
Methyl oleate	Low Skin, mouse TD <sub>50</sub> : 54 gm/kg/45 Wk. Toxic Effect: Blood, Skin, Tumor	Tumorigen		[112-62-9]
n-Propyl oleate				
Tetrahydrofurfuryl oleate				
<u>PALMITATES</u>				
Isooctyl palmitate	Low			[1341-38-4]

(Continued)

TABLE C-13 (Continued)

<u>Plasticizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>PALMITATES (Continued)</u>				
Isopropyl palmitate	Nontoxic Skin, humans 84 mg/3 day Toxic Effect: Mild Irritant	Primary Irritant		[142-91-6]
Myricyl palmitate [Beeswax]				
<u>RICINOLEATES</u>				
n-Butyl acetyl ricinoleate				
Butyl ricinoleate	Low			[140-04-5]
Diethylene glycol monoricino- leate	Nontoxic			
Glycerol ricinoleate [Caster Oil]				
Glycerol triacetyl ricinoleate	Low			
Methyl acetyl ricinoleate	Low Eye, rabbit 500 mg Toxic Effect: Irritant	Primary Irritant		[140-03-4]
Methoxyethyl acetyl ricinoleate	Oral, rat LD <sub>50</sub> : 20 gm/kg	Primary Irritant		[140-05-6]
Methyl ricinoleate	Low			[7705-99-9]
Propylene glycol monoricino- leate	Low			
<u>STEARATES</u>				
Butyl acetoxystearate				
Butoxyethyl stearate				
Butyl epoxystearate				

(Continued)

TABLE C-13 (Continued)

<u>Plasticizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>STEARATES</u> (Continued)				
Butyl stearate	Low Oral, rat LD <sub>50</sub> : >32 gm/kg			[123-95-5]
Diethylene glycol distearate	Nontoxic			
Ethyl stearate	Low Skin, rabbit 500 mg/24 Hr. Toxic Effect: Moderate Irritant	Primary Irritant		[111-61-5]
Glycerol monostearate	Nontoxic			
Glycerol triacetoxystearate	Low			
Glycerol tri(epoxy acetoxy stearate)				
Hexadecyl stearate [Cetyl Stearate]				
Isobutyl stearate				[646-13-9]
Isooctyl epoxy stearate				
Methoxyethylacetoxy stearate				
Methoxyethyl stearate				
Methyl hydroxystearate wax				
Methyl pentachlorostearate (stabilized)				
Methyl stearate	Low Subcutaneous, mouse TD <sub>Lo</sub> : 5200 mg/kg/65 Wk. Toxic Effect: Neoplastic Effects	Tumorigen		[112-61-8]

(Continued)

TABLE C-13 (Continued)

<u>Plasticizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>STEARATES (Continued)</u>				
Octyl stearate				
1,2-Propylene glycol monostearate	Nontoxic Impregnation, mouse LD <sub>50</sub> : 200 mg/kg			[1323-39-3]
Vinyl stearate	Low			
<u>TALL OILS</u>				
Isooctyl esters of tall oil				
Methyl esters of tall oil				
<u>FATTY NITRILES</u>				
Fatty acid nitrile				
Oleyl nitrile				
Tallow nitrile				
<u>OTHER MISCELLANEOUS PLASTICIZERS</u>				
<u>CARBONATES</u>				
Bis-dimethyl benzyl carbonate				
Dinonyl phenyl carbonate				
<u>ETHERS</u>				
Bis(dimethylbenzyl) ether				
Cumyl phenyl benzyl ether				
Nonylphenol ethylene oxide	Oral, rat LD <sub>50</sub> : 1310 mg/kg	Primary Irritant		[9016-45-9]

(Continued)



TABLE C-13 (Continued)

<u>Plasticizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>ETHERS</u> (Continued)				
Tridecanol ethylene oxide adduct	Skin, rabbit 2 gm/4 Wk. Toxic Effect: Mild Irritant	Primary Irritant		[24938-91-8]
<u>SULFONAMIDES</u>				
n-Cyclohexyl-p-toluene sulfonamide				[1077-56-1] [80-39-7]
n-Ethyl-o,p-toluene sulfonamide				[2503-71-6]
n-Ethyl-p-toluene sulfonamide				[88-19-7] [70-55-3]
Sulfonamide-formaldehyde resin				
o,p-Toluene sulfonamide	Oral, rat LD <sub>50</sub> :4870 mg/kg	Eye Irritant Suspected Animal Carcinogen (Ortho)		
<u>AMIDES</u>				
Benzamide				
Dibutyl lauramide				
2,2'-(2-Ethylhexamidodiethyl) di-2-ethylhexoate				
Urea	Intravenous, rabbit LD <sub>50</sub> :4800 mg/kg	Tissue Irritant		[57-13-6]
<u>NITRO COMPOUNDS</u>				
Nitrobenzene	Percutaneous, rat LD <sub>50</sub> :2100 mg/kg	Ingestion Inhalation Skin Contact Primary Irritant	1 ppm TWA (skin)	[98-95-3]
o-Nitrobiphenyl	Oral, rat LD <sub>50</sub> :1580 mg/kg	Mutagen		[86-00-0]

(Continued)

TABLE C-13 (Continued)

<u>Plasticizer</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>NITRO COMPOUNDS (Continued)</u>				
2-Nitrodiphenyl ether				
o-Nitrotoluene	Oral, rat LD <sub>50</sub> : 891 mg/kg	Ingestion Inhalation Skin Absorption	5 ppm TLV (skin) (recommended)	[88-72-2]
<u>SULFONATES</u>				
Phenol, cresol esters of pentadecylsulfonic acid				
Cresyl-p-toluene sulfonate				
<u>OTHERS</u>				
Camphor	Subcutaneous, mouse LD <sub>50</sub> : 2200 mg/kg	Irritant Mutagen	2 mg/m <sup>3</sup> TWA	[16-22-2]
alpha-Methyl-D glucoside				
Sorbitol	Low Oral, rat LD <sub>50</sub> : 15.9 gm/kg			[50-70-4]

TABLE C-14. PRESERVATIVES  
TOXICOLOGICAL AND WORKER EXPOSURE CONCERNS

<u>Preservative</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
Barium metaborate [Busan 11-M-1]				[13701-59-2]
Butyl p-hydroxybenzoate [Butyl paraben]	Low to Moderate Intraperitoneal, mouse LD <sub>50</sub> :230 mg/kg	Primary Irritant		[94-26-8]
Copper-8-quinolinate	May be Toxic Low human toxicity Intraperitoneal, mouse LD <sub>50</sub> :67 mg/kg	Indefinite Animal Carcinogen		[10380-28-6]
1,2-Dibromo-2,4-dicyanobutane [Tektamer 38]				
3,5-Dimethyltetrahydro-1,3,5-thiadiazine-2-thione [Mylone], [Dazomet]	Oral, rat LD <sub>50</sub> :500 mg/kg	Skin Contact Inhalation		[533-74-4]
Diphenyl antimony 2-ethylhexanoate			0.5 mg(Sb)/m <sup>3</sup> TWA (recommended)	
2-Hydroxy-5-chlorobenzoic-3,4'-dichloro-anilide				
8-Hydroxyquinoline	Moderately Toxic Oral, rat LD <sub>50</sub> :1200 mg/kg	Indefinite Animal Carcinogen Mutagen		[148-24-3]
Intercede N-638 [trialkyl organotin]			100 ug(Sn)/m <sup>3</sup> TWA (recommended)	
2-Methyl-1-naphthyl maleimide				
Methyl p-hydroxybenzoate [Methyl paraben]	Low Oral, mouse LD <sub>Lo</sub> :3000 mg/kg	Skin and Eye Irritant Mutagen		[99-76-3]
2-N-Octyl-4-isothiazolin-3-one [Micro-Chek 11], [Micro-Chek 11D]	Low			
10,10-Oxybisphenoarsine [Vinyzene BP-5], [Vinyzene BP-5-2], [Vinyzene SB-1]	Toxic Oral, bird LD <sub>50</sub> :24 mg/kg	Skin and Eye Irritant	200 ug(As)/m <sup>3</sup> TWA (recommended)	[58-36-6]

(Continued)

TABLE C-14 (Continued)

<u>Preservative</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
Phenyl mercuric salicylate [C <sub>6</sub> H <sub>4</sub> (OH)(COOHgC <sub>6</sub> H <sub>5</sub> )]	Highly Toxic	Ingestion Inhalation Skin Absorption	50 ug (Hg)/m <sup>3</sup> TWA (recommended)	
Propyl p-hydroxybenzoate [Propyl para-ben], [C <sub>10</sub> H <sub>12</sub> O <sub>3</sub> ]	Low Oral, mouse LD <sub>50</sub> : 6000 mg/kg	Eye and Skin Irritant		[94-13-3]
PPC [DM-50], [organometallic]				
Quaternary ammonium naphthenate				
3,5,3',4'-Tetrachlorosalicylanilide	Oral, rat LD <sub>50</sub> : 243 mg/kg	Primary Irritant		[1154-59-2]
2,2'-Thiobis(4,6-dichlorophenol)				
Tributyltin fluoride	Moderately Toxic Oral, rabbit LD <sub>50</sub> : 50 mg/kg	Ingestion Skin and Eye Irritant	100 ug(Sn)/m <sup>3</sup> TWA	[1983-10-4]
Tributyltin oxide [(C <sub>4</sub> H <sub>9</sub> ) <sub>3</sub> SnOSn(C <sub>4</sub> H <sub>9</sub> ) <sub>3</sub> ]	Toxic Oral, rat LD <sub>50</sub> : 87 mg/kg	Inhalation Ingestion Skin and Eye Irritant	100 ug(Sn)/m <sup>3</sup> TWA	[56-35-9]
Tributyltin salicylate [Cotin P]	Oral, rat LD <sub>50</sub> : 137 mg/kg		100 ug(Sn)/m <sup>3</sup> TWA	[4342-30-7]
Trichloromethylmercapto-4-cyclohexene-1,2-dicarboximide [Captan], [Vancide 89], [C <sub>9</sub> H <sub>8</sub> Cl <sub>3</sub> NO <sub>2</sub> S], [N-trichloromethylmercaptotetrahydrophthalimide]	Toxic Oral, humans LD <sub>50</sub> : 1071 mg/kg	Positive Carcinogen Ingestion Skin Irritant Inhalation Skin Contact Possible Teratogen Equivocal Tumorigen Mutagen	5 mg/m <sup>3</sup> TWA 15 mg/m <sup>3</sup> STEL (recommended)	[133-06-2]
n-(Trichloromethylthio)phthalimide [Folpet], [Phaltan], [C <sub>6</sub> H <sub>4</sub> (CO) <sub>2</sub> NSCCl <sub>3</sub> ]	May be Toxic Oral, rat TD <sub>10</sub> : 500 mg/kg/5D Toxic Effect: Mutagen	Possible Teratogen Mutagen		[133-07-3]
N-(Trichloromethylthio)tetraphthalimide				
Zinc borate [3ZnO·2B <sub>2</sub> O <sub>3</sub> ]	Low	Ingestion		[1332-07-6]

TABLE C-15. SOLUTION MODIFIERS  
TOXICOLOGICAL AND WORKER EXPOSURE CONCERNS

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>ACIDS, BASES, AND BUFFERS</u>				
<u>ACIDS</u>				
Formic Acid [HCOOH]	Toxic Oral, rat LD <sub>50</sub> :1100 mg/kg	Primary Irritant Corrosive to Tissues Mutagen	5 ppm TWA	[64-18-6]
Hydrochloric acid [HCl]	Inhalation, humans LC <sub>50</sub> :1000 ppm/1H		5 ppm Ceiling	[7647-01-0]
Lactic acid [CH <sub>3</sub> CHOHCOOH]	Oral, rat LD <sub>50</sub> :3730 mg/kg			[598-82-3]
Maleic acid [HOOCCH:CHCOOH]	Moderate Oral, rat LD <sub>50</sub> :708 mg/kg	Primary Irritant		[110-16-7]
Nitric acid [HNO <sub>3</sub> ]	Highly Toxic Oral, human LD <sub>50</sub> :430 mg/kg	Inhalation Corrosive Strong Oxidizer	2 ppm TWA	[7697-37-2]
2-Naphthalenesulfonic acid [C <sub>10</sub> H <sub>7</sub> SO <sub>3</sub> H]	May be Toxic Oral, rat LD <sub>50</sub> :400 mg/kg			[120-18-3]
Phosphoric acid [H <sub>3</sub> PO <sub>4</sub> ]	Toxic Inhalation, humans TC <sub>50</sub> :100 mg/m <sup>3</sup> Toxic Effect: Irritant	Ingestion Inhalation Primary Irritant	1 mg/m <sup>3</sup> TWA	[7664-38-2]
Sulfuric acid [H <sub>2</sub> SO <sub>4</sub> ]	Highly Toxic Inhalation, humans LD <sub>50</sub> :3 mg/m <sup>3</sup> /24H Toxic Effect: Mouth	Primary Irritant	1 mg/m <sup>3</sup> TWA	[7664-93-9]
<u>BASES</u>				
Ammonia	Toxic Oral, rat LD <sub>50</sub> :350 mg/kg	Inhalation Irritant Moderate Fire Risk Mutagen	50 ppm	[7664-41-7]

(Continued)

TABLE C-15 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>BASES (Continued)</u>				
Ammonium hydroxide [NH <sub>4</sub> OH] [See Ammonia]				
Methanolic sodium methoxide [Sodium methoxide in methyl alcohol] [CH <sub>3</sub> ONa·CH <sub>3</sub> OH]	Toxic	Fire Risk Corrosive		[124-41-4]
Potassium hydroxide [KOH]	Toxic Skin, humans 50 mg/24H Toxic Effect: Severe Irritation	Ingestion Inhalation Primary Irritant Mutagen	2 mg/m <sup>3</sup> TWA (recommended)	[1310-58-3]
Sodium hydroxide [NaOH]	Toxic Eye, rabbit 1 mg/24H Toxic Effect: Severe Irritation	Corrosive Primary Irritant	2 mg/m <sup>3</sup> TWA	[1310-73-2]
<u>BUFFERS</u>				
Ammonium acetate [(NH <sub>4</sub> )C <sub>2</sub> H <sub>3</sub> O <sub>2</sub> ]	Intravenous, mouse LD <sub>50</sub> : 90 mg/kg			[631-61-8]
Borax [Na <sub>2</sub> B <sub>4</sub> O <sub>7</sub> ]	Low Oral, humans LD <sub>50</sub> : 709 mg/kg		5 mg/m <sup>3</sup> TWA (recommended)	[1303-96-4]
Calcium carbonate [CaCO <sub>3</sub> ]	Nontoxic		10 mg/m <sup>3</sup> TWA (recommended)	[471-34-1] precipitated; [1317-65-3] limestone; [13397-26-7] whiting
Potassium bicarbonate [KHCO <sub>3</sub> ]				
Sodium acetate [NaC <sub>2</sub> H <sub>3</sub> O <sub>2</sub> ]	Low Oral, rat LD <sub>50</sub> : 3530 mg/kg	Primary Irritant		[127-09-3]

(Continued)

TABLE C-15 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>BUFFERS (Continued)</u>				
Sodium bicarbonate [ $\text{NaHCO}_3$ ]	Low Oral, rat $\text{LD}_{50}$ : 4220 mg/kg	Primary Irritant		[144-55-8]
Sodium carbonate [ $\text{Na}_2\text{CO}_3 \cdot \text{H}_2\text{O}$ ]	Low Oral, rat $\text{LD}_{50}$ : 4000 mg/kg	Primary Irritant		[497-19-8]
Sodium formate [ $\text{HCOONa}$ ]	Oral, mouse $\text{LD}_{50}$ : 11,200 mg/kg			[141-53-7]
Sodium hydrogen phosphate [sodium phosphate, dibasic] [ $\text{NaH}_2\text{PO}_4$ ]	Low Intramuscular, rat $\text{LD}_{50}$ : 250 mg/kg			[7558-80-7]
<u>CHAIN TRANSFER AGENTS</u>				
Acetaldehyde [ $\text{CH}_3\text{CHO}$ ]	Highly Toxic Inhalation, humans $\text{TC}_{\text{LO}}$ : 134 ppm/3M Toxic Effect: Irritation, Pulmonary System	Primary Irritant Inhalation Dangerous Fire Risk Mutagen Teratogen	200 ppm TWA	[75-07-0]
Acetic acid [ $\text{CH}_3\text{COOH}$ ]	Toxic Inhalation, humans $\text{TC}_{\text{LO}}$ : 816 ppm/3M Toxic Effect: Irritant	Ingestion Inhalation Primary Irritant Mutagen	10 ppm TWA	[64-19-7]
Acetic anhydride [ $\text{CH}_3(\text{CO})_2\text{O}$ ]	Oral, rat $\text{LD}_{50}$ : 1780 mg/kg	Primary Irritant	5 ppm TWA	[108-24-7]
Acetone [ $\text{CH}_3\text{COCH}_3$ ]	Inhalation, humans $\text{TC}_{\text{LO}}$ : 500 ppm Toxic Effect: Eye Irritation	Primary Irritant Inhalation Dangerous Fire Risk Mutagen	1000 ppm TWA	[67-64-1]
Acetylene [ $\text{HCCH}$ ]	Inhalation, mammals $\text{LC}_{\text{LO}}$ : 500,000 ppm/5M	Dangerous Fire Risk	2500 ppm Ceiling	[74-86-2]

(Continued)

TABLE C-15 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>CHAIN TRANSFER AGENTS (Continued)</u>				
Benzene [C <sub>6</sub> H <sub>6</sub> ]	Toxic Inhalation, humans TC <sub>Lo</sub> :100 ppm/10Y-1 Toxic Effect: Carcinogen	Dangerous Fire Risk Ingestion Inhalation Skin Absorption Mutagen Teratogen Carcinogen Primary Irritant	10 ppm TWA	[71-43-2]
Bromoform [CHBr <sub>3</sub> ]	Toxic Intraperitoneal, mouse TD <sub>Lo</sub> :1100 mg/kg/8W-1 Toxic Effect: Neoplastic	Ingestion Inhalation Skin Absorption Mutagen	0.5 ppm (skin)	[75-25-2]
n-Butane [C <sub>4</sub> H <sub>10</sub> ]	Inhalation, rat LC <sub>50</sub> :658 gm/m <sup>3</sup> /4H	Dangerous Fire Risk	800 ppm TLV (recommended)	[106-97-8]
1-Butanethiol [C <sub>4</sub> H <sub>9</sub> SH]	Toxic Inhalation, rat LC <sub>50</sub> :4020 ppm/4H	Inhalation Dangerous Fire Risk Primary Irritant	10 ppm TWA	[109-79-5]
Butyl chloride [(CH <sub>3</sub> ) <sub>3</sub> CCl]	Implant, mouse TD <sub>Lo</sub> :3000 mg/kg/8W-1 Toxic Effect: Neoplastic	Flammable Mutagen		[507-20-0]
t-Butyl mercaptan [2-methyl-2-propanethiol]	Highly Toxic Oral, rat LD <sub>50</sub> :4729 mg/kg	Dangerous Fire Risk Primary Irritant		[75-66-1]
Carbon tetrabromide [CBr <sub>4</sub> ]	Moderately Toxic Intravenous, rat LD <sub>50</sub> :56 mg/kg	Narcotic	0.1 ppm TWA 0.3 ppm STEL (recommended)	[558-13-4]
Carbon tetrachloride [CCl <sub>4</sub> ]	Highly Toxic Oral, humans LD <sub>Lo</sub> :43 mg/kg	Ingestion Inhalation Skin Absorption Narcotic Positive Carcinogen Mutagen Teratogen Primary Irritant Tumorigen	10 ppm TWA 22 ppm Ceiling	[56-23-5]

(Continued)



TABLE C-15 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>CHAIN TRANSFER AGENTS (Continued)</u>				
Chlorobenzene [C <sub>6</sub> H <sub>5</sub> Cl]	Toxic Inhalation, mouse LC <sub>50</sub> : 15 gm/m <sup>3</sup>	Inhalation Skin Contact Moderate Fire Risk	75 ppm TWA	[108-90-7]
Chloroform [CHCl <sub>3</sub> ]	Toxic Inhalation, human TC <sub>10</sub> : 1000 mg/m <sup>3</sup> /1Y Toxic Effect: Systemic, Behavioral Symptoms, Gastro- intestinal Tract	Inhalation Ingestion Narcotic Suspected Carcinogen Tumorigen Mutagen Teratogen Primary Irritant	50 ppm TWA	[67-66-3]
Crotonaldehyde [2-butenal] [CH <sub>3</sub> CH:CHCHO]	Toxic Inhalation, humans TC <sub>10</sub> : 12 mg/m <sup>3</sup> /10 Min. Toxic Effect: Eye, Pulmonary System	Irritant to Skin and Eyes Dangerous Fire Risk	2 ppm TWA	[123-73-9]
Cyclohexane [C <sub>6</sub> H <sub>12</sub> ]	Moderately Toxic Oral, rat LD <sub>50</sub> : 29,820 mg/kg	Primary Irritant Dangerous Fire Risk Inhalation Skin Contact Mutagen	300 ppm TWA	[110-82-7]
n-Decyl mercaptan [C <sub>10</sub> H <sub>21</sub> SH]	Toxic	Ingestion Inhalation		
trans-Dichloroethylene [ClHC:CHCl]	Toxic Inhalation, humans TC <sub>10</sub> : 4800 mg/m <sup>3</sup> /10 Min. Toxic Effect: Behavioral Symptoms	Ingestion Inhalation Skin Absorption Irritant Narcotic Dangerous Fire Risk		[156-60-5]
Diethyl zinc [Zn(C <sub>2</sub> H <sub>5</sub> ) <sub>2</sub> ]		Ignites Spontaneously in Air		[557-20-0]

(Continued)

TABLE C-15 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>CHAIN TRANSFER AGENTS</u> (Continued)				
Dipentene [C <sub>10</sub> H <sub>16</sub> ]	Moderately Toxic Oral, rat LD <sub>50</sub> : 5000 mg/kg	Moderate Fire Risk Primary Irritant		[138-86-3]
Dodecylmercaptan [C <sub>12</sub> H <sub>25</sub> SH]	Oral, rat LD <sub>50</sub> : 309 mg/kg		0.5 ppm 15 minute Ceiling (recommended)	[112-55-0]
Ethane [C <sub>2</sub> H <sub>6</sub> ]		Severe Fire Risk		[74-84-0]
Ethanethiol [C <sub>2</sub> H <sub>5</sub> SH]	Highly Toxic Inhalation, rat LC <sub>50</sub> : 4420 ppm/4 Hr.	Primary Irritant Ingestion Inhalation Dangerous Fire Risk	10 ppm Ceiling	[75-08-1]
Ethyl acetate [CH <sub>3</sub> COOC <sub>2</sub> H <sub>5</sub> ]	Toxic Inhalation, humans TC <sub>Lo</sub> : 400 ppm Toxic Effect: Irritation of Eyes, Pulmonary System and Nasal Passages	Primary Irritant Inhalation Skin Absorption Skin and Eye Irritant Dangerous Fire Risk Tumorigen	400 ppm TWA	[141-78-6]
Ethylbenzene [C <sub>6</sub> H <sub>5</sub> C <sub>2</sub> H <sub>5</sub> ]	Moderately Toxic Inhalation, humans TC <sub>Lo</sub> : 100 ppm/8 Hr. Toxic Effect: Irritation, Behavioral Symptoms	Ingestion Inhalation Skin Absorption Skin and Eye Irritant Dangerous Fire Risk Teratogen	100 ppm TWA (skin)	[100-41-4]
Ethylmercaptoacetate	Intraperitoneal, mouse LD <sub>50</sub> : 100 mg/kg			[623-51-8]
Formic Acid [See Acids]				
Hydrogen [H <sub>2</sub> ]		Highly Flammable and Explosive		[1333-74-0]
Isobutanol [(CH <sub>3</sub> ) <sub>2</sub> CHCH <sub>2</sub> OH]	Moderately Toxic Inhalation, rat LC <sub>Lo</sub> : 8000 ppm/4H	Primary Irritant Flammable Tumorigen Mutagen	100 ppm TWA	[78-83-1]

(Continued)

TABLE C-15 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>CHAIN TRANSFER AGENTS</u> (Continued)				
Isobutane [(CH <sub>3</sub> ) <sub>2</sub> CHCH <sub>3</sub> ]		Dangerous Fire Risk		[75-28-5]
Isopropanol [(CH <sub>3</sub> ) <sub>2</sub> CHOH]	Moderately Toxic Oral, rat LD <sub>50</sub> : 5840 mg/kg	Primary Irritant Ingestion Inhalation Dangerous Fire Risk Tumorigen Mutagen Suspected Human Carcinogen	400 ppm TWA	[67-63-0]
Isopropyl benzene [Cumene], [C <sub>6</sub> H <sub>5</sub> CH(CH <sub>3</sub> ) <sub>2</sub> ]	Toxic Inhalation, humans TC <sub>Lo</sub> : 200 ppm Toxic Effect: Irritant	Primary Irritant Ingestion Inhalation Skin Absorption Moderate Fire Risk	50 ppm TWA (skin)	[98-82-8]
Lauryl mercaptan [C <sub>12</sub> H <sub>25</sub> SH] [See Dodecyl mercaptan]				
Mercaptoacetic acid [Thioglycolic acid], [HSCH <sub>2</sub> COOH]	Toxic Oral, rat LD <sub>50</sub> : 250 mg/kg	Corrosive Ingestion Inhalation Skin Irritant		[68-11-1]
2-Mercaptoethanol [HSCH <sub>2</sub> CH <sub>2</sub> OH]	Moderately Toxic Oral, rat LD <sub>50</sub> : 300 mg/kg	Primary Irritant Inhalation Ingestion Mutagen		[60-24-2]
Methane [CH <sub>4</sub> ]		Severe Fire Risk		[74-82-8]
Methanol [CH <sub>3</sub> OH]	Toxic Inhalation, humans TC <sub>Lo</sub> : 86000 mg/m <sup>3</sup> Toxic Effect: Irritant	Ingestion Dangerous Fire Risk Mutagen Teratogen Primary Irritant	200 ppm TWA	[67-56-1]

(Continued)

TABLE C-15 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>CHAIN TRANSFER AGENTS (Continued)</u>				
Methyl acetate	Moderately Toxic Inhalation, humans TC <sub>10</sub> : 15,000 mg/m <sup>3</sup> Toxic Effect: Eye, Pulmonary System	Inhalation Primary Irritant Dangerous Fire Risk	200 ppm TWA	[79-20-9]
2-Methyl-2-propanethiol [See t-Butyl mercaptan]				[75-66-1]
α-Methyl styrene dimer				
2-Naphthalenethiol [RPA], [C <sub>10</sub> H <sub>7</sub> SH]	Intraperitoneal, mouse LD <sub>50</sub> : 200 mg/kg			[91-60-1]
3-Pentanol [CH <sub>3</sub> CH <sub>2</sub> CHOHCH <sub>2</sub> CH <sub>3</sub> ]	Oral, rat LD <sub>50</sub> : 1870 mg/kg	Moderate Fire Risk		[584-02-1]
Perchloroethylene [Cl <sub>2</sub> C:CCl <sub>2</sub> ]	Moderately Toxic Inhalation, humans TC <sub>10</sub> : 96 ppm/7H Toxic Effect: Peripheral Nervous System, Eye, Behavioral Symptoms	Inhalation Irritant to Eyes and Skin Positive Animal Carcinogen Mutagen	100 ppm TWA 200 ppm Ceiling 300 ppm/5H/3H Peak	[127-18-4]
Phenol [C <sub>6</sub> H <sub>5</sub> OH]	Toxic Oral, humans LD <sub>10</sub> : 140 mg/kg	Ingestion Inhalation Skin Absorption Strong Tissue Irritant Mutagen	5 ppm TWA (skin)	[108-95-2]
Polybromobutenes		Dangerous Fire Risk		
Propane [C <sub>3</sub> H <sub>8</sub> ]		Dangerous Fire Risk	1000 ppm TWA	[74-98-6]
2-Propanethiol [C <sub>3</sub> H <sub>7</sub> SH]	Oral, rat LD <sub>50</sub> : 1790 mg/kg		0.5 ppm Ceiling (recommended)	[107-03-9]
Propylene [CH <sub>3</sub> CH:CH <sub>2</sub> ]		Dangerous Fire Risk Tumorigen		[115-07-1]

(Continued)

TABLE C-15 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>CHAIN TRANSFER AGENTS</u> (Continued)				
Sodium acetate [NaC <sub>2</sub> H <sub>3</sub> O <sub>2</sub> ] [See Buffers]				
Terpinolene [C <sub>10</sub> H <sub>16</sub> ]	Oral, rat LD <sub>50</sub> :4390 mg/kg	Moderate Fire Risk		[586-62-9]
Thiophenol [C <sub>6</sub> H <sub>5</sub> SH]	Moderately Toxic Oral, rat LD <sub>50</sub> :46 mg/kg	Primary Irritant	0.5 ppm TWA (recommended)	[108-98-5]
Toluene [C <sub>6</sub> H <sub>5</sub> CH <sub>3</sub> ]	Toxic Inhalation, rat LC <sub>Lo</sub> :4000 ppm/4H	Primary Irritant Ingestion Inhalation Skin Absorption Dahgerous Fire Risk Tumorigen Mutagen Teratogen	200 ppm TWA 300 ppm Ceiling	[108-88-3]
Trichloroethylene [CHCl:CCl <sub>2</sub> ]	Toxic Inhalation, humans TD <sub>Lo</sub> :6900 mg/m <sup>3</sup> /10 Min. Toxic Effect: Central Nervous System, Behavioral	Inhalation Positive Animal Carcinogen Mutagen Teratogen Primary Irritant	100 ppm TWA 200 ppm Ceiling	[79-01-6]
Triethylamine [(C <sub>2</sub> H <sub>5</sub> ) <sub>3</sub> N]	Toxic Oral, rat LD <sub>50</sub> :460 mg/kg	Ingestion Inhalation Primary Irritant Mutagen Fire Risk	25 ppm TWA	[121-44-8]
Water				
<u>COAGULANTS</u>				
Calcium chloride [CaCl <sub>2</sub> ]	Low Oral, rat LD <sub>50</sub> :1000 mg/kg	Equivocal Tumorigenic Agent Mutagen		[10043-52-4]
Hydrochloric acid [See Acids]				

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TABLE C-15 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>COAGULANTS</u> (Continued)				
Sodium chloride [NaCl]	Oral, rat LD <sub>50</sub> : 3000 mg/kg			[7647-14-5]
Sulfuric acid [See Acids]				
<u>CROSSLINKING AGENTS</u>				
Dialdehyde starch				
Diepoxides				
Dimethylolurea [CO(NHCH <sub>2</sub> OH) <sub>2</sub> ]	Oral, rat LD <sub>50</sub> : 3400 mg/kg	Skin Irritant		[140-95-4]
Dihydroxydiphenylsulfone [(C <sub>6</sub> H <sub>4</sub> OH) <sub>2</sub> SO <sub>2</sub> ]				
Diisocyanates				
Divinyl benzene [C <sub>6</sub> H <sub>4</sub> (CH:CH <sub>2</sub> ) <sub>2</sub> ]	Toxic Oral, rat LD <sub>50</sub> : 4040 mg/kg	Inhalation Primary Irritant	10 ppm TWA (recommended)	[108-57-6]
Divinyl sulfone [CH <sub>2</sub> :CHSO <sub>2</sub> CH:CH <sub>2</sub> ]	Oral, rat LD <sub>50</sub> : 32 mg/kg	Primary Irritant		[77-77-0]
Glutaraldehyde	Moderate Skin, humans 6 mg/3D-1 Toxic Effect: Severe Irritation	Primary Irritant Mutagen Teratogen	0.2 ppm Ceiling (recommended)	[111-30-8]
Glycol dimethacrylates				
Glyoxal [OHCCOH]	Moderate Intraperitoneal, rat LD <sub>50</sub> : 100 mg/kg	Ingestion Inhalation Primary Irritant Mutagen		[107-22-2]
Oxalic acid [HOCCOOH]	Toxic Oral, rat LD <sub>50</sub> : 375 mg/kg	Inhalation Ingestion Strong Irritant	1 mg/m <sup>3</sup> TWA	[144-62-7]

(Continued)

TABLE C-15 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>CROSSLINKING AGENTS (Continued)</u>				
Polyacrolein				
Trimethylolmelamine				[1017-56-7]
Trivinyl benzene				
<u>DEFOAMANTS</u>				
Aluminum oxide, hydrated [See Protective Colloids]				
Decanol $[\text{CH}_3(\text{CH}_2)_8\text{CH}_2\text{OH}]$	Low Oral, rat LD <sub>50</sub> : 4720 mg/kg Toxic Effect: Behavioral Symptoms; Pulmonary System	Tumorigen Primary Irritant		[112-30-1]
Dimethyl silicone (polymeric) $[(\text{CH}_3)_2\text{SiO}]_x$	Low			[9006-65-9]
Glycerol 12-Hydroxyoleate [glyceryl monoricinoleate] $[\text{C}_6\text{H}_{13}\text{CHOHC}_{10}\text{H}_{18}\text{COOCH}_2\text{CHOHCH}_2\text{OH}]$				
Heptanol $[\text{CH}_3(\text{CH}_2)_5\text{CH}_2\text{OH}]$	Low Oral, rat LD <sub>50</sub> : 3250 mg/kg			[111-70-6]
Hexanol $[\text{CH}_3(\text{CH}_2)_4\text{CH}_2\text{OH}]$	Low Oral, rat LD <sub>50</sub> : 720 mg/kg	Primary Irritant		[111-27-3]
Octanol $[\text{CH}_3(\text{CH}_2)_6\text{CH}_2\text{OH}]$	Low Oral, mouse LD <sub>50</sub> : 1790 mg/kg	Mutagen Primary Irritant		[111-87-5]
<u>EMULSIFIERS</u>				
Alkyl naphthalene sulfonic acid				
Ammonium oleate $[\text{C}_{17}\text{H}_{33}\text{COONH}_4]$				

(Continued)

TABLE C-15 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>CAS No.</u>
<u>EMULSIFIERS</u> (Continued)				
Ammonium stearate [C <sub>17</sub> H <sub>35</sub> COONH <sub>4</sub> ]	Low			[102-89-7]
Cetyl trimethyl ammonium bromide [C <sub>16</sub> H <sub>33</sub> (CH <sub>3</sub> ) <sub>3</sub> NBr]	Oral, mouse LD <sub>50</sub> : 60 mg/kg	Primary Irritant		[13316-70-6]
Cetyl pyridinium chloride [C <sub>16</sub> H <sub>33</sub> C <sub>5</sub> H <sub>5</sub> NCl·H <sub>2</sub> O]	Oral, rat LD <sub>50</sub> : 200 mg/kg	Primary Irritant		[123-03-5]
Dihexyl sodium sulfosuccinate				[3006-15-3]
Dodecyl benzene sulfonate	Oral, rat LD <sub>50</sub> : 650 mg/kg			[1886-81-3]
Dodecyl benzene sodium sulfonate [C <sub>12</sub> H <sub>25</sub> C <sub>6</sub> H <sub>4</sub> SO <sub>3</sub> Na]	Oral, rat LD <sub>50</sub> : 1260 mg/kg	Primary Irritant		[25155-30-0]
Dodecyl pyridinium chloride				
Dresinate [Rosin soap]				
Ethyl crotonate [CH <sub>3</sub> CH:CHCOOC <sub>2</sub> H <sub>5</sub> ]	Oral, rat LD <sub>50</sub> : 3000 mg/kg	Strong Irritant Dangerous Fire Risk		[623-70-1]
Isopropylamine dodecyl benzene sulfonate				[26264-05-1]
Lauric acid [CH <sub>3</sub> (CH <sub>2</sub> ) <sub>10</sub> COOH]	Low Oral, rat LD <sub>50</sub> : 12 gm/kg	Tumorigen		[143-07-7]
Lauryl trimethyl quaternary ammonium bromide				
Lauroxypolyethylene glycol				
Myristic acid [CH <sub>3</sub> (CH <sub>2</sub> ) <sub>12</sub> COOH]	Nontoxic Skin, humans 75 mg/3D-1 Toxic Effect: Moderate Irritation	Primary Irritant		[544-63-8]

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TABLE C-15 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>EMULSIFIERS</u> (Continued)				
Palmitic acid $[\text{CH}_3(\text{CH}_2)_{14}\text{COOH}]$	Nontoxic Intravenous, mouse $\text{LD}_{50}$ : 57 mg/kg Toxic Effect: Convulsions	Tumorigen Primary Irritant		[57-10-3]
Polyoxyethylene oleate	Intravenous, mouse $\text{LD}_{50}$ : 500 mg/kg			[9004-96-0]
Potassium caprylate	Skin, humans 7320 mg Toxic Effect: Irritation	Primary Irritant		[764-71-6]
Potassium dehydroabietate				
Potassium laurate $[\text{KOCC}_{11}\text{H}_{23}]$	Skin, humans 9560 mg Toxic Effect: Irritation			[10124-65-9]
Potassium myristate				
Potassium oleate $[\text{C}_{17}\text{H}_{33}\text{COOK}]$	Eye, rabbit 12 mg/48h Toxic Effect: Irritation	Primary Irritant		[143-18-0]
Potassium palmitate	Skin, humans 11,800 mg Toxic Effect: Irritation	Primary Irritant		[2624-31-9]
Potassium sodium tartrate $[\text{KNaC}_4\text{H}_4\text{O}_6 \cdot 4\text{H}_2\text{O}]$	Nontoxic			
Potassium stearate $[\text{C}_{17}\text{H}_{35}\text{COOK}]$	Nontoxic			
Sodium capryl sulfonate				
Sodium cetyl sulfate				
Sodium decyl sulfate	Intravenous, mouse $\text{LD}_{50}$ : 56 mg/kg			[142-87-0]

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TABLE C-15 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>EMULSIFIERS (Continued)</u>				
Sodium decyl sulfonate				
Sodium dioctyl sulfosuccinate [C <sub>8</sub> H <sub>17</sub> OOCCH <sub>2</sub> CH(SO <sub>3</sub> Na)COOC <sub>8</sub> H <sub>17</sub> ]	Low Skin, rabbit 10 mg/24H Toxic Effect: Moderate Irritation	Primary Irritant		[577-11-7]
Sodium dodecyl diphenyl ether disulfonate				
Sodium dodecyl sulfate [Sodium lauryl sulfate]	Low Skin, humans 250 mg/24H Toxic Effect: Mild Irritation	Tumorigen Mutagen Primary Irritant		[151-21-3]
Sodium dodecyl sulfonate				
Sodium hexadecyl sulfate				[1120-01-0]
Sodium lauryl benzene sulfonate				
Sodium lauryl sulfate [NaC <sub>12</sub> H <sub>25</sub> SO <sub>4</sub> ], [See Sodium dodecyl sulfate]				
Sodium naphthalene sulfonate [C <sub>12</sub> H <sub>7</sub> SO <sub>3</sub> Na]	May be Toxic	Ingestion Inhalation		
Sodium oleate [C <sub>17</sub> H <sub>33</sub> COONa]	Low Intravenous, mouse LD <sub>50</sub> : 152 mg/kg			[143-19-1]
Sodium resinate [Sodium abietate], [C <sub>19</sub> H <sub>29</sub> COONa]				[68919-80-2]
Sodium stearate [NaOOC <sub>17</sub> H <sub>35</sub> ]	Intravenous, dog LD <sub>50</sub> : 10 mg/kg			[822-16-2]

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TABLE C-15 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>EMULSIFIERS</u> (Continued)				
Sodium tetradecyl sulfonate				
Stearic acid $[\text{CH}_3(\text{CH}_2)_{16}\text{COOH}]$	Nontoxic Skin, humans 75 mg/3D-I Toxic Effect: Mild Irritation	Tumorigen Primary Irritant		[57-11-4]
Stearyl trimethyl ammonium chloride	Unknown, mouse $\text{LD}_{50}$ : 50 mg/kg			[112-03-8]
Sulfonated castor oil [Turkey Red Oil]	Low			[8002-33-3]
Triton X-100	Oral, rat $\text{LD}_{50}$ : 1800 mg/kg			[9036-19-5]
Triton X-200	Oral, rat $\text{LD}_{50}$ : 17,500 mg/kg			[9010-41-7]
<u>FEED STREAM DESSICANTS</u>				
Alumina [See Protective Colloids]				
Aluminum alkyls				
Calcium hydride $[\text{CaH}_2]$		Skin Irritant Flammable		[7789-78-8]
Calcium sulfate (anhydrous) $[\text{CaSO}_4]$	Nontoxic Intraperitoneal, rat $\text{TD}_{50}$ : 450 mg/kg/3w Toxic Effect: Carcinogen	Tumorigen	10 mg/m <sup>3</sup> TWA (recommended)	[10101-41-4] [7778-18-9] gypsum [14798-04-0] anhydrite [23296-15-3] precipitated
Caustic Soda (solid) [See Bases (Sodium hydroxide)]				

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TABLE C-15 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>FEED STREAM DESSICANTS (Continued)</u>				
Copper, (metallic) [Cu]	Toxic (powders) Oral, rat TD <sub>Lo</sub> :152 mg/kg Toxic Effect: Reproductive, Embryotoxicity, Developmental	Ingestion Inhalation Powder is Flammable	1 mg/m <sup>3</sup> TWA (dust) 2mg/m <sup>3</sup> STEL (recommended)	[7440-50-8]
Molecular seive	Oral, rat LD <sub>50</sub> : 2,000-28,000 mg/kg			
Silica gel	Toxic Oral, rat LD <sub>50</sub> : 3160 mg/kg	Inhalation (Silicosis)	80 mg/m <sup>3</sup> TWA	[7631-86-9]
Sodium, (metal) [Na]		Strong Tissue Irritant Severe Fire Risk in Contact with Water Ignites Spontaneously in Air		[7440-23-5]
Sodium hydroxide on asbestos [See Bases]				
<u>INERT GASES</u>				
Carbon dioxide [CO <sub>2</sub> ]	Inhalation, humans LC <sub>Lo</sub> : 100,000 ppm/1M		5000 ppm TWA	[124-38-9]
Nitrogen [N <sub>2</sub> ]				[7727-37-9]
<u>PROTECTIVE COLLOIDS</u>				
Acrylic acid-2-ethylhexyl-acrylate copolymer				
Alumina [Al <sub>2</sub> O <sub>3</sub> ]	Nontoxic Intraleural, rat TD <sub>Lo</sub> : 90 mg/kg Toxic Effect: Equivocal Tumorigenic Agent	Inhalation Tumorigen	10 mg/m <sup>3</sup> TWA (recommended)	[1344-28-1]

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TABLE C-15 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>PROTECTIVE COLLOIDS</u> (Continued)				
Barium persulfate [BaS <sub>2</sub> O <sub>8</sub> ·4H <sub>2</sub> O]				
Barium phosphate [BaHPO <sub>4</sub> ]				
Barium sulfate [BaSO <sub>4</sub> ]	Nontoxic Intrapleural, rat TD <sub>Lo</sub> : 200 mg/kg Toxic Effect: Equivocal Tumorigenic Agent	Tumorigen		[13462-86-7] [7727-43-7]
Calcium persulfate				
Calcium phosphate [Ca <sub>3</sub> (PO <sub>4</sub> ) <sub>2</sub> ]				[7758-87-4]
Carboxymethyl cellulose	Nontoxic Oral, rat LD <sub>50</sub> : 27,000 mg/kg			[9004-32-4] [9000-11-7]
Clay [Kaolin], [Al <sub>2</sub> O <sub>3</sub> SiO <sub>2</sub> ]		Irritant Inhalation	10 mg/m <sup>3</sup> TWA (recommended)	[1327-36-2]
Ethyl cellulose	Nontoxic, Skin, rabbit 500 mg/24 Hr. Toxic Effect: Mild Irritation	Primary Irritant		[9004-57-3]
Gelatin	Nontoxic			
Gum acacia	Oral, rabbit LD <sub>50</sub> : 800 mg/kg	Primary Irritant		[9000-01-5]
Hydroxyapatite [Ca <sub>10</sub> (PO <sub>4</sub> ) <sub>6</sub> (OH) <sub>2</sub> ]				
Hydroxyethyl cellulose [Cellosize]	Nontoxic			
Hydroxypropyl cellulose	Nontoxic Oral, rat LD <sub>50</sub> : 10,200 mg/kg			[9004-64-2]

(Continued)

TABLE C-15 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>PROTECTIVE COLLOIDS (Continued)</u>				
Hydroxypropyl methyl cellulose				
Magnesium carbonate [MgCO <sub>3</sub> ]				[546-93-0]
Magnesium oxide [MgO]	Toxic Inhalation, humans TC <sub>Lo</sub> :400 mg/m <sup>3</sup> Toxic Effect: Unspecified	Inhalation Tumorigen	15 mg/m <sup>3</sup> TWA	[1309-48-4]
Magnesium persulfate				
Magnesium phosphate [(Mg) <sub>3</sub> (PO <sub>4</sub> ) <sub>2</sub> ·4H <sub>2</sub> O]				
Magnesium silicate [MgSiO <sub>3</sub> ]	Toxic Skin, humans 300 ug/3D Toxic Effect: Mild Irritation	Inhalation Primary Irritant		[1343-90-4]
Methyl cellulose [Methocel]	Intraperitoneal, mouse LD <sub>50</sub> :275 gm/kg			[9004-67-5]
Methyl(hydroxypropyl)cellulose				
Pectin	Nontoxic			[9000-69-5]
Polyacrylamide resin [(-CH <sub>2</sub> CHONH <sub>2</sub> -) <sub>x</sub> ]	Nontoxic			
Polyvinyl alcohol [(-CH <sub>2</sub> CHOH-) <sub>x</sub> ]	Nontoxic Subcutaneous, rat TD <sub>Lo</sub> :2500 mg/kg Toxic Effect: Carcinogen	Positive Animal Carcinogen Tumorigen		[9002-89-5]
Polyvinyl pyrrolidone [(-C <sub>6</sub> H <sub>9</sub> NO-) <sub>x</sub> ]	Nontoxic Intraperitoneal, rat TD <sub>Lo</sub> :2500 mg/kg Toxic Effect: Carcinogen	Tumorigen Suspected Animal Carcinogen		[9003-39-8]
Potassium persulfate [K <sub>2</sub> S <sub>2</sub> O <sub>8</sub> ]			2 mg(S <sub>2</sub> O <sub>8</sub> )/m <sup>3</sup> TWA (recommended)	[7727-21-1]

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TABLE C-15 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>PROTECTIVE COLLOIDS</u> (Continued)				
Sodium polyacrylate	Eye, rabbit 2 mg Toxic Effect: Moderate Irritation	Primary Irritant		[9003-04-7]
Starch [ $(-C_6H_5H_{10}-)_x$ ]	Skin, humans 300 ug/3D Toxic Effect: Mild Irritation	Primary Irritant		[9005-25-8]
Sulfonated polystyrene				
Talc $[Mg_3Si_4O_{10}(OH)_2]$ or $[3MgO \cdot 4SiO_2 \cdot H_2O]$	Moderate Skin, humans 300 ug/3D-I Toxic Effect: Mild Irritation	Inhalation Primary Irritant Tumorigen	2 mppcf TWA (non-fibrous) (recommended)	[14807-96-6]
Zinc oxide $[ZnO]$	Nontoxic Oral, rat $TD_{Lo}$ : 6846 mg/kg	Inhalation Mutagen Teratogen Primary Irritant	5 mg/m <sup>3</sup> TWA	[1314-13-2]
<u>SOLVENTS</u>				
Acetic acid [See Chain Transfer Agents]				
Acetone [See Chain Transfer Agents]				
Amyl acetate $[CH_3COOC_5H_{11}]$	Moderate Inhalation, humans $TC_{Lo}$ : 5000 mg/m <sup>3</sup> /30M Toxic Effect: Behavioral Symptoms, Pulmonary System	Inhalation Ingestion Primary Irritant Dangerous Fire Risk	100 ppm TWA	[628-63-7]
n-Amyl alcohol $[C_5H_{11}OH]$	Moderate Oral, rat $LD_{50}$ : 3030 mg/kg	Ingestion Inhalation Moderate Fire Risk Primary Irritant		[71-41-0]
Benzene [See Chain Transfer Agents]				

(Continued)

TABLE C-15 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<b>SOLVENTS (Continued)</b>				
Benzyl alcohol [C <sub>6</sub> H <sub>5</sub> CH <sub>2</sub> OH]	Low Oral, rat LD <sub>50</sub> :1230 mg/kg	Primary Irritant Tumorigen		[100-51-6]
Bromobenzene [C <sub>6</sub> H <sub>5</sub> Br]	Inhalation, rat LC <sub>50</sub> :20,411 mg/m <sup>3</sup>	Inhalation Skin Irritant Moderate Fire Risk Mutagen		[108-86-1]
n-Butane [C <sub>4</sub> H <sub>10</sub> ], [See Chain Transfer Agents]				
1-Butanol [CH <sub>3</sub> (CH <sub>2</sub> ) <sub>2</sub> CH <sub>2</sub> OH]	Toxic Inhalation, humans TC <sub>LO</sub> :25 ppm Toxic Effect: Irritant, Nasal, Eye, Pulmonary System	Primary Irritant Eye and Skin Irritant Moderate Fire Risk Mutagen	100 ppm TWA	[71-36-3]
2-Butanol [sec-Butyl Alcohol], [CH <sub>3</sub> CH <sub>2</sub> CHOHCH <sub>3</sub> ]	Toxic Inhalation, rat LC <sub>LO</sub> :16,000 ppm/4H	Primary Irritant Inhalation Eye and Skin Irritant Dangerous Fire Risk Mutagen	150 ppm TWA	[78-92-2]
2-Butanone [Methyl ethyl ketone], [CH <sub>3</sub> CH <sub>2</sub> COCH <sub>3</sub> ]	Inhalation, humans TC <sub>LO</sub> :100 ppm/5H Toxic Effect: Irritant, Nasal, Eye, Pulmonary System	Teratogen Primary Irritant	200 ppm TWA	[78-93-3]
t-Butyl alcohol [(CH <sub>3</sub> ) <sub>3</sub> COH]	Toxic Oral, rat LD <sub>50</sub> :3500 mg/kg	Inhalation Eye and Skin Irritant Dangerous Fire Risk Tumorigen Mutagen	100 ppm TWA	[75-65-0]
t-Butyl benzene [C <sub>10</sub> H <sub>14</sub> ]	Toxic Oral, rat LD <sub>LO</sub> :5000 mg/kg	Ingestion		[98-06-6]
Carbon tetrachloride [See Chain Transfer Agents]				

(Continued)



TABLE C-15 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>SOLVENTS (Continued)</u>				
Chlorobenzene [See Chain Transfer Agents]				
Chloroform [See Chain Transfer Agents]				
Cumene [Isopropyl benzene], [See Chain Transfer Agents]				
Cyclohexane [See Chain Transfer Agents]				
Cyclohexanone [C <sub>6</sub> H <sub>10</sub> O]	Toxic Inhalation, humans TC <sub>Lo</sub> :75 ppm Toxic Effect: Nasal, Eye, Pulmonary System	Inhalation Skin Contact Moderate Fire Risk Primary Irritant Mutagen	50 ppm TWA	[108-94-1]
n-Decane [CH <sub>3</sub> (CH <sub>2</sub> ) <sub>8</sub> CH <sub>3</sub> ]	Skin, mouse TD <sub>Lo</sub> :25 gm/kg/52W Toxic Effect: Equivocal Tumorigenic Agent	Moderate Fire Risk Narcotic		[124-18-5]
o-Dichlorobenzene [C <sub>6</sub> H <sub>4</sub> Cl <sub>2</sub> ]	Moderately Toxic Inhalation, rat LC <sub>Lo</sub> :821 ppm/7H Toxic Effect: Behavioral Symptoms, Liver, Eye	Primary Irritant Inhalation Ingestion Tumorigen Mutagen Indefinite Human Carcinogen	50 ppm Ceiling	[95-50-1]
1,2-Dichloroethane [ClCH <sub>2</sub> CH <sub>2</sub> Cl]	Toxic Oral, humans TD <sub>Lo</sub> :428 mg/kg Toxic Effect: Gastrointestinal Tract	Mutagen Tumorigen Ingestion Inhalation Primary Irritant Skin Absorption Strong Eye and Skin Irritant	50 ppm TWA 100 ppm Ceiling	[107-06-2]
Diesel fuel, hydrogenated				[68334-30-5]

(Continued)

TABLE C-15 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>SOLVENTS (Continued)</u>				
Dimethyl acetamide [CH <sub>3</sub> CON(CH <sub>3</sub> ) <sub>2</sub> ]	Intraperitoneal, mouse LD <sub>50</sub> : 3200 mg/kg	Inhalation Skin Absorption Strong Irritant	10 ppm TWA (skin)	[127-19-5]
Dimethyl formamide [HCON(CH <sub>3</sub> ) <sub>2</sub> ]	Inhalation, mouse LC <sub>50</sub> : 9400 mg/m <sup>3</sup> /2H	Tumorigen Teratogen Strong Tissue Irritant	10 ppm TWA (skin)	[68-12-2]
Dimethyl sulfoxide [(CH <sub>3</sub> ) <sub>2</sub> SO]	Oral, rat LD <sub>50</sub> : 17,500 mg/kg	Ingestion Mutagen		[67-68-5]
p-Dioxane [OCH <sub>2</sub> CH <sub>2</sub> OCH <sub>2</sub> CH <sub>2</sub> ]	Highly Toxic Inhalation, humans TC <sub>10</sub> : 470 ppm/3D Toxic Effect: Cardiovascular, Gastrointestinal, Convulsions	Inhalation Skin Absorption Primary Irritant Positive Animal Carcinogen	100 ppm TWA (skin)	[123-91-1]
Dodecane [CH <sub>3</sub> (CH <sub>2</sub> ) <sub>10</sub> CH <sub>3</sub> ]	Skin, mouse TD <sub>10</sub> : 11 gm/kg/22W-I Toxic Effect: Equivocal Tumorigenic Agent			[112-40-3]
Ethanol [C <sub>2</sub> H <sub>5</sub> OH]	Oral, rat LD <sub>50</sub> : 7060 mg/kg Toxic Effect: Pulmonary System	Depressant Drug Dangerous Fire Risk	1000 ppm TWA	[64-17-5]
Ethylene dichloride [See 1,2-Dichloroethane]				
2-Ethoxyethyl acetate [CH <sub>3</sub> CO <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> OCH <sub>2</sub> CH <sub>3</sub> ]	Oral, rat LD <sub>50</sub> : 2900 mg/kg		100 ppm TWA (skin)	[111-15-9]
Ethyl acetate [CH <sub>3</sub> COOC <sub>2</sub> H <sub>5</sub> ]	Moderately Toxic Inhalation, humans TC <sub>10</sub> : 400 ppm Toxic Effect: Nasal, Eye, Pulmonary System	Tumorigen Primary Irritant Inhalation Skin Absorption Eye and Skin Irritant Dangerous Fire and Explosion Risk	400 ppm TWA	[141-78-6]

(Continued)

TABLE C-15 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>SOLVENTS</u> (Continued)				
Ethylbenzene [C <sub>6</sub> H <sub>5</sub> C <sub>2</sub> H <sub>5</sub> ]	Moderately Toxic Inhalation, humans TC <sub>10</sub> :100 ppm/8H Toxic Effect: Irritant, Eye, Behavioral Symptoms, Pulmonary System	Ingestion Inhalation Skin Absorption Irritant to Skin and Eyes Dangerous Fire Risk Teratogen	100 ppm TWA (skin)	[100-41-4]
Furfuryl alcohol [C <sub>4</sub> H <sub>3</sub> OCH <sub>2</sub> OH] or [OCH:CHCH:CCH <sub>2</sub> OH]	Toxic Inhalation, rat LC <sub>50</sub> :233 ppm/4H	Primary Irritant Inhalation Tumorigen Mutagen	50 ppm TWA	[98-00-0]
Heptane [CH <sub>3</sub> (CH <sub>2</sub> ) <sub>5</sub> CH <sub>3</sub> ]	Moderately Toxic Intravenous, mouse LD <sub>50</sub> :222 mg/kg	Inhalation Dangerous Fire Risk	500 ppm TWA	[142-82-5]
Hexane [CH <sub>3</sub> (CH <sub>2</sub> ) <sub>4</sub> CH <sub>3</sub> ]	Moderately Toxic Inhalation, humans TC <sub>10</sub> :5000 ppm/10 Min. Toxic Effect: Central Nervous System, Behavioral Symptoms	Primary Irritant Ingestion Inhalation Dangerous Fire Risk Teratogen	500 ppm TWA	[110-54-3]
Isobutane [See Chain Transfer Agents]				
Isobutyl alcohol [See Chain Transfer Agents]				
Isobutyric acid [(CH <sub>3</sub> ) <sub>2</sub> CHCOOH]	Oral, rat LD <sub>50</sub> :280 mg/kg	Corrosive Strong Skin Irritant		[79-31-2]
Isooctane [(CH <sub>3</sub> ) <sub>3</sub> CCH <sub>2</sub> CH(CH <sub>3</sub> ) <sub>2</sub> ]	Moderately Toxic	Dangerous Fire Risk Ingestion Inhalation	350 mg/m <sup>3</sup> TWA (recommended)	[540-84-1]
Isopentane [(CH <sub>3</sub> ) <sub>2</sub> CHCH <sub>2</sub> CH <sub>3</sub> ]	Low	Dangerous Fire Risk	350 mg/m <sup>3</sup> TWA 1800 mg/m <sup>3</sup> /15 Min. Ceiling (recommended)	[78-78-4]

(Continued)

TABLE C-15 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<b>SOLVENTS (Continued)</b>				
Isopropyl alcohol [See Chain Transfer Agents]				
Isopropyl benzene [See Chain Transfer Agents (Cumene)]				
Kerosene	Moderately Toxic Unknown, man LD <sub>50</sub> :1176 mg/kg	Ingestion Inhalation Moderate Fire Risk		None
Methanol [See Chain Transfer Agents]				
Methyl acetate [See Chain Transfer Agents]				
Methylene chloride [CH <sub>2</sub> Cl <sub>2</sub> ]	Moderately Toxic Oral, rat LD <sub>50</sub> :167 mg/kg	Inhalation Ingestion Skin Absorption Primary Irritant Tumorigen Mutagen Teratogen	500 ppm TWA 1000 ppm Ceiling	[75-09-2]
Methyl ethyl ketone [See 2-Butanone]				
Methyl isobutyl ketone [(CH <sub>3</sub> ) <sub>2</sub> CHCH <sub>2</sub> COCH <sub>3</sub> ]	Inhalation, humans TC <sub>Lo</sub> :200 ppm Toxic Effect: Irritant	Ingestion Inhalation Dangerous Fire Risk Primary Irritant	100 ppm TWA	[108-10-1]
Methyl isobutyrate	Oral, rat LD <sub>50</sub> :16,000 mg/kg			[547-63-7]
Mineral oil	Intraperitoneal, mouse TD <sub>Lo</sub> :14 gm/kg Toxic Effect: Equivocal Tumorigenic Agent			[8012-95-1]
Naphtha	Inhalation, rat LC <sub>Lo</sub> :1600 ppm/6H	Dangerous Fire Risk	100 ppm TWA	[8030-306-6]

(Continued)

TABLE C-15 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>SOLVENTS (Continued)</u>				
Nitrobenzene [C <sub>6</sub> H <sub>5</sub> NO <sub>2</sub> ]	Highly Toxic Oral, rat LD <sub>50</sub> : 640 mg/kg	Ingestion Inhalation Skin Absorption Primary Irritant	1 ppm TWA (skin)	[98-95-3]
Pentane [CH <sub>3</sub> (CH <sub>2</sub> ) <sub>3</sub> CH <sub>3</sub> ]	Inhalation, humans TC <sub>LO</sub> : 90,000 ppm/5 Min. Toxic Effect: Central Nervous System	Narcotic Dangerous Fire and Explosion Risk	1000 ppm TWA	[109-66-0]
3-Pentanone [Diethyl ketone], [C <sub>2</sub> H <sub>5</sub> COC <sub>2</sub> H <sub>5</sub> ]	Low Inhalation, rat LC <sub>LO</sub> : 8000 ppm/4H	Dangerous Fire Hazard Primary Irritant	200 ppm TWA (recommended)	[96-22-0]
2-Propanol [Isopropyl alcohol], [See Chain Transfer Agent]	Oral, man LD <sub>LO</sub> : 8600 mg/kg Inhalation, humans TC <sub>LO</sub> : 400 ppm Toxic Effect: Irritation		400 ppm TWA	[67-63-0]
n-Propyl acetate [C <sub>3</sub> H <sub>7</sub> OOCCH <sub>3</sub> ]	Moderately Toxic Inhalation, humans TC <sub>LO</sub> : 1000 mg/m <sup>3</sup> Toxic Effect: Eye, Pulmonary System	Primary Irritant Dangerous Fire Risk	200 ppm TWA	[109-60-4]
Pyridine [N(CH) <sub>3</sub> CN]	Toxic Inhalation, rat LC <sub>50</sub> : 4000 ppm/4H	Primary Irritant Ingestion Inhalation Dangerous Fire Risk Mutagen	5 ppm TWA	[110-86-1]
1,1,2,2-Tetrafluorodichloroethane [CClF <sub>2</sub> CClF <sub>2</sub> ], [Freon 114]	Moderately Toxic	Inhalation		
Tetrahydrofuran [CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> CH <sub>2</sub> O]	Low Toxicity Inhalation, rat LC <sub>LO</sub> : 28,000 mg/m <sup>3</sup> /2H	Dangerous Fire Risk Mutagen	200 ppm TWA	[109-99-9]

(Continued)

TABLE C-15 (Continued)

<u>Chemical</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>SOLVENTS (Continued)</u>				
Toluene [See Chain Transfer Agents]				
Triethylamine [See Chain Transfer Agents]				
2,2,4-Trimethylpentane [See Isooctane]				
Water				
Xylene [ $C_6H_4(CH_3)_2$ ]	Toxic Inhalation, humans $TC_{Lo}$ : 200 ppm Toxic Effect: Irritant	Primary Irritant Inhalation Ingestion Moderate Fire Risk Mutagen Teratogen	100 ppm TWA	[1330-20-7]
<u>THICKENERS</u>				
Glycerol [ $C_3H_5(OH)_3$ ]	Low Toxicity			[56-81-5]
Glycols				
Polyglycols				

TABLE C-16. ULTRAVIOLET STABILIZERS  
TOXICOLOGICAL AND WORKER EXPOSURE CONCERNS

<u>Ultraviolet Stabilizers</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>BENZOPHENONES</u>				
4-Alkoxy-2-hydroxybenzophenone [Uvinul 410]				
4-Butoxy-2,2'-dihydroxybenzophenone [Cyasorb UV287]				
5-Chloro-2-hydroxybenzophenone [C <sub>6</sub> H <sub>5</sub> COC <sub>6</sub> H <sub>4</sub> OHCl]				[85-19-8]
Cyasorb UV 2126 [Polymer of 4-(2-Acryloyloxyethoxy)-2-hydroxybenzophenone]	Oral, rat LD <sub>50</sub> : >10 gm/kg			
4-Decyloxy-2-hydroxybenzophenone				
2,4-Dibenzoyl resorcinol [DBR]				
2,4-Dihydroxybenzophenone [C <sub>6</sub> H <sub>5</sub> COC <sub>6</sub> H <sub>4</sub> (OH) <sub>2</sub> ]	Low Oral Toxicity Intraperitoneal, mouse LD <sub>50</sub> : 100 mg/kg	Primary Irritant		[131-56-6]
2,2'-Dihydroxy-4,4'-dimethoxybenzophenone [Uvinul D-49]	Low Oral Toxicity			[131-54-4]
2,2'-Dihydroxy-4-methoxybenzophenone [Cyasorb UV 24]	Low Oral Toxicity Oral, rat LD <sub>50</sub> : >10 gm/kg			[131-53-3]
2,2'-Dihydroxy-4(octoxy)benzophenone [Cyasorb UV 314]				
Disodium 2,2'-dihydroxy-4,4'-dimethoxy-5,5'-disulfobenzophenone [Uvinul DS-49]	Low Oral Toxicity			[3121-60-6]
4-Dodecyloxy-2-hydroxybenzophenone [Rylex D]	Low Oral Toxicity			
4(Heptyloxy)-2-hydroxybenzophenone [Unistat 247]				

(Continued)

TABLE C-16 (Continued)

<u>Ultraviolet Stabilizers</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>BENZOPHENONES</u> (Continued)				
2-Hydroxy-4-acryloxyethoxybenzophenone	Low Oral Toxicity			
2-Hydroxy-4-(2-ethylhexoyl)benzophenone	Skin, rabbit 500 mg/24h Toxic Effect: Moderate Irritation	Primary Irritant		[2549-90-8]
2-Hydroxy-4-isooctoxybenzophenone	Low Oral Toxicity			[33059-05-1]
2-Hydroxy-4-methoxybenzophenone [Uvinul M 40], [Cyasorb UV9]	Low Oral Toxicity Oral, rat LD <sub>50</sub> : >10 gm/kg			[131-57-7]
2-Hydroxy-4-methoxy-5-methylbenzophenone [Unistat 2211]				
2-Hydroxy-5-methoxybenzophenone	Intraperitoneal, mouse LD <sub>50</sub> : 1000 mg/kg			[14770-96-8]
2-Hydroxy-1-methoxy-5-sulfobenzophenone [Uvinul MS-40]				
2-Hydroxy-4-methoxy-5-sulfobenzophenone [Cyasorb UV-284]				[4065-45-6]
2-Hydroxy-4-n-octyloxybenzophenone [Cyasorb UV 531]	Low Oral Toxicity Oral, rat LD <sub>50</sub> : >10 gm/kg	Primary Irritant		[1843-05-6]
Mark 1535	Low Oral Toxicity			
Permyl B100 [Substituted phenone]	Low Oral Toxicity			
Resyn 78-6121 [low molecular weight alkyl methacrylate-substituted benzophenone]				

(Continued)



TABLE C-16 (Continued)

<u>Ultraviolet Stabilizers</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>BENZOPHENONES</u> (Continued)				
2,2',4,4'-Tetrahydroxybenzophenone [Uvinul D-50]	Low Oral Toxicity			[131-55-5]
Uvinul 490 [mixture of 2,2'-Dihydroxy-4,4'-dimethoxybenzophenone]	Low Oral Toxicity			[1341-54-4]
<u>BENZOTRIAZOLES</u>				
2(3'-t-Butyl-2'-hydroxy-5'-methylphenyl)-5-chlorobenzotriazole [Tinuvin 326]	Low Oral Toxicity			[3896-11-5]
2(3',5'-Di-t-butyl-2'-hydroxyphenyl)-5-chlorobenzotriazole [Tinuvin 327]	Low Oral Toxicity			[3864-99-1]
2(2'-Hydroxy-3',5-di-t-amylphenyl)benzotriazole [Tinuvin 328]	Low Oral Toxicity			[25973-55-1]
2(2'-Hydroxy-3',5'-di-t-butylphenyl)benzotriazole [Tinuvin 320]	Low Oral Toxicity			[3846-71-7]
2(2'-Hydroxy-5'-methylphenyl)-benzotriazole [Tinuvin P]	Low Oral Toxicity Oral, mouse LD <sub>50</sub> :6500 mg/kg	Primary Irritant		[2440-22-4]
2(2'-Hydroxy-5-t-octylphenyl)-benzotriazole	Low Oral Toxicity Oral, rat LD <sub>50</sub> :>10 gm/kg			
Mark 446	Low Oral Toxicity			[35344-07-1]
<u>NICKEL ORGANICS</u>				
Bis(2,2'-thiobis(4-t-octylphenylato))nickel [See Nickel bis(octylphenyl sulfide)]				
Mark 1306A				
Negopex A				

(Continued)

TABLE C-16 (Continued)

<u>Ultraviolet Stabilizers</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>NICKEL ORGANICS (Continued)</u>				
Nickel bis(0-ethyl(3,5-di-t-butyl-4-hydroxybenzyl))phosphonate [Irgastab 2002]			15 ug(Ni)/m <sup>3</sup> TWA (recommended)	[30947-30-9]
Nickel bis(octylphenyl sulfide) [Ferro AM-101 and AM-105]			15 ug(Ni)/m <sup>3</sup> TWA (recommended)	
Nickel dibutyldithiocarbamate [Ni(SC(S)N(C <sub>4</sub> H <sub>9</sub> ) <sub>2</sub> ) <sub>2</sub> ]	Oral, mouse TD <sub>10</sub> : 22 mg/kg/78W Toxic Effect: Equivocal Tumorigen	Tumorigen Fungicide	15 ug(Ni)/m <sup>3</sup> TWA (recommended)	[13927-77-0]
Nickel diisobutyldithiocarbamate [ISO Butyl Niclate]			15 ug(Ni)/m <sup>3</sup> TWA (recommended)	
Nickel dimethyldithiocarbamate [Methyl Niclate]	Oral, rat LD <sub>50</sub> : 17 gm/kg		15 ug(Ni)/m <sup>3</sup> TWA (recommended)	[15521-65-0]
10% Nickel Hex-Cem			15 ug(Ni)/m <sup>3</sup> TWA (recommended)	
10071 PB MB				
Sanduvor NPU [Phenylmethyl-decanoyl pyrazolate-Nickel]	Low Oral Toxicity		15 ug(Ni)/m <sup>3</sup> TWA (recommended)	
(2,2'-Thiobis(4-t-octylpheno-lato))-n-butylamine nickel [Cyasorb UV 1084]	Low Oral Toxicity Oral, rat LD <sub>50</sub> : >10 gm/kg		15 ug(Ni)/m <sup>3</sup> TWA (recommended)	[14516-71-3]
UV Chek AM-205	Low Oral Toxicity			
<u>MISCELLANEOUS, ACRYLATES</u>				
Butyl 2-cyano-3-methyl-3-(p-methoxyphenyl)acrylate [UV Absorber 317]				
N-(β-Cyano-β-carbomethoxyvinyl)-2-methylindoline [UV Absorber 340]	Low Oral Toxicity			

(Continued)

TABLE C-16 (Continued)

<u>Ultraviolet Stabilizers</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>MISCELLANEOUS, ACRYLATES</u> (Continued)				
Ethyl 2-cyano-3,3-diphenylacrylate [Uvinul N-35]	Intraperitoneal, mouse LD <sub>50</sub> : 100 mg/kg			[5232-99-5]
2-Ethylhexyl 2-cyano-3,3-diphenyl- acrylate [Uvinul N-539]				[6197-30-4]
Methyl-2-carbomethoxy-3-(p-meth- oxyphenyl)acrylate [Cyasorb UV-1988]				[7443-25-6]
Methyl 2-cyano-3-methyl-3-(p-meth- oxyphenyl)acrylate [UV Absorber 318]				
<u>MISCELLANEOUS, SALICYLATES</u>				
p-t-Butyl phenyl salicylate 10316 COP MP [Proprietary]	Low Oral Toxicity			
Dipropylene glycol salicylate [C <sub>3</sub> H <sub>6</sub> (OOCCH <sub>2</sub> OH)OC <sub>3</sub> H <sub>6</sub> OH]				
2-Ethylhexyl salicylate				[6969-49-9]
p-Octylphenyl salicylate [C <sub>6</sub> H <sub>4</sub> OHCOOC <sub>6</sub> H <sub>4</sub> C <sub>8</sub> H <sub>17</sub> ] [Inhibitor OPS]	Low Oral Toxicity			
Phenyl salicylate [C <sub>6</sub> H <sub>4</sub> OHCOOC <sub>6</sub> H <sub>5</sub> ]	Low Oral Toxicity Oral, rat TD <sub>Lo</sub> : 600 mg/kg Toxic Effect: Reproduc- tive, Fertility	Teratogen		[118-55-8]
p-(1,1,3,3-Tetramethylbutyl)phenyl salicylate [See Octylphenyl salicylate]				

(Continued)

TABLE C-16 (Continued)

<u>Ultraviolet Stabilizers</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>OTHER MISCELLANEOUS AND PROPRIETARY</u>				
AST-1001	Low Oral Toxicity			
Barium metaborate, modified	Low Oral Toxicity			[13701-59-2]
Bis(2,2,6,6-tetramethyl-4-piperidinoxy)sebacate				
Carbon black	Intravenous, mouse LD <sub>50</sub> : 440 mg/kg		3.5 mg/a <sup>3</sup> TWA	[1333-86-4] [7440-44-0]
Chimassorb 944 [Hindered amine]				
C-HDPE-2764 [Hindered amine]				
C-PPR-8004 [Hindered amine]				
C-PPR-8005 [Hindered amine]				
Copper iodide	Moderately Toxic	Inhalation		[7681-65-4]
2,4-Dibenzoyl resorcinol				
3,5-Di-t-butyl-p-hydroxybenzoic acid		Human Mutagen		[1421-49-4]
2,4-Di-t-butylphenyl-3,5-di-t-butyl-4-hydroxybenzoate [UV Chek AM-340]	Low Oral Toxicity			
2,4-Di-t-butylphenyl-3,5-di-t-butyl-4-hydroxybenzoate				
Dimethyl-2-(4-methoxybenzylidene) malonate				
Good-rite UV 3034 [Hindered amine]				
N-Hexadecyl-3,5-di-t-butyl-4-hydroxybenzoate	Low Oral Toxicity			[67845-93-6]

(Continued)

TABLE C-16 (Continued)

<u>Ultraviolet Stabilizers</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>OTHER MISCELLANEOUS AND PROPRIETARY</u> (Continued)				
Hexamethyl phosphoric triamide [Inhibitor HPT]	Toxic Inhalation, rat 400 ppb/35W intermittent Toxic Effect: Carcinogenic	Carcinogen Teratogen Mutagen Tumorigen		[680-31-9]
Hostavin N20				
2-(2-Hydroxy-4-methoxybenzoyl) benzoic acid [Cyasorb UV 207]				
Manganese iodide	May be Toxic			
Parabolix-100	Low Oral Toxicity			
PDI-0199 [benzophenone/hindered amine mixture]				
10328 PE MB, 10359 PE MB				
40375 PP MP [Hindered amine]				
Resorcinol monobenzoate [C <sub>6</sub> H <sub>5</sub> COOC <sub>6</sub> H <sub>4</sub> OH]	Low Oral Toxicity			
Sanduvor EPU [oxalanitide]	Low Oral Toxicity			[35001-52-6]
Sanduvor VSU [oxalanilide]	Low Oral Toxicity			[23949-66-8]
Tinuvin 144 [stearically hindered amine]				
Tinuvin 770 [stearically hindered amine]				[52829-07-9]
Tinuvin 662 [hindered amine]				
Titanium dioxide	Nontoxic Skin, humans 300 ug/3D Toxic Effect: Mild Irritation	Tumorigen Primary Irritant Inhalation	15 mg/m <sup>3</sup> TWA	[1317-80-2] [13463-67-7]

(Continued)

TABLE C-16 (Continued)

<u>Ultraviolet Stabilizers</u>	<u>Toxicity</u>	<u>Concern</u>	<u>OSHA Regulation</u>	<u>[CAS No.]</u>
<u>OTHER MISCELLANEOUS AND PROPRIETARY</u> (Continued)				
UV-Chek 541A	Low Oral Toxicity			
UV-Check AM-595	Low Oral Toxicity			
Vanstay L (phosphate-type stabilizer)				
Zinc oxide	Nontoxic Inhalation, humans TC <sub>Lo</sub> : 600 mg/m <sup>3</sup> Toxic Effect: Pulmonary System	Mutagen Teratogen Primary Irritant	5 mg(fume)/m <sup>3</sup> TWA	[1314-13-2]