APPENDIX E

OTHER GLYCOL ETHERS

Table E-1.—Methyl-based glycol ethers, amides, etc.*

CAS† number	Name
3610-27-3	Methoxytriethylene glycol acetate
3121-61-7	2-Methoxy-ethanol acrylate
24493-59-2	Methoxytriethylene glycol methacrylate
45103-58-0	2-(2 Methoxyethoxy) ethyl methacrylate
6976-93-8	2-Methoxyethyl methacrylate
68133-26-6	N-(5-Amino-2-methoxyphenyl)-beta-alanine, 2-methoxyethyl ester
68133-25-5	N-(2-Methoxy-5-nitrophenyl)-beta-alanine, 2-methoxyethyl ester
16501-01-2	1,2-Benzenedicarboxylic acid, mono (2-methoxyethyl) ester
117-82-8	1,2-Benzenedicarboxylic acid, bis (2-methoxyethyl) ester
106-00-3	Hexanedioic acid, bis (2-methoxyethyl) ester
140-05-6	Ethylene glycol monomethyl ether acetylricinoleate
111-10-4	Ethylene glycol monomethyl ether oleate
111-07-9	Hexadecanoic acid, 2-methoxyethyl ester
70703-47-8	Acetylated ethylene glycol monomethylether hydroxystearate
6522-67-4	N-[5-(Acetylamino)-4-[(2-bromo-4,6-dinitrophenyl)azo]-2 methoxyphenyl]-beta-alanine, 2-methoxyethyl ester
51248-73-8	N-[4-[2-Chloro-4-nitrophenyl)azo]-3-(acetylamino)phenyl]-N-(2-cyanoethyl)-beta-alanine, 2-methoxyethyl ester
49744-35-6	Aminobenzoic acid, 2-(2-methoxyethoxy) ethyl ester

(Continued)

*Adapted from TSCA [1977] and SANSS/CIS [1988].
†Chemical Abstracts Service.

Table E-1 (Continued).—Methyl-based glycol ethers, amides, etc.

CAS number	Name
49744-26-5	4-[5-Cyano-1-ethyl-1,6-dihydro-2-hydroxy-4-methyl-6-oxy-3-pyridinyl)azo] benzoic acid, (2-methoxyethoxy) ethyl ester
42861-47-2	N-Ethyl-N(4-(2-bromo-4,6-dinitrophenyl)azo)-5-(acetylamino)-2-methoxyphenyl)-beta-alanine, 2-methoxyethyl ester
42228-65-9	N-[5-(Acetylamino)-2-methoxyphenyl]-N-ethyl-beta-alanine, 2-methoxyethyl ester
18016-42-7	Cholesteryl 2-(2-methoxyethoxy) ethyl carbonate
40228-74-8	Cholesteryl methoxy ethyl carbonate
68479-79-8	N,N'-(4,8-Dihydroxy-9,10-dioxo-1, 5-anthracenediyl) bis [beta-alanine], bis(2-methoxyethyl) ester
1616-88-2	Carbamic acid, 2-methoxyethyl ester
10143-22-3	Carbamic acid, bis(hydroxymethyl)-, 2-methoxyethyl ester
50883-78-8	Carbamic acid, dimethyl-, 2-methoxyethyl ester
16672-66-5	2-Methoxyethyl methylocarbamate
14983-42-7	Boric acid, tris (2-methoxyethyl) ester
6163-73-1	Phosphoric acid, methoxyethyl ester
42372-33-8	1-Naphthalenesulfonic acid, 6-diazo-5, 6-dihydro-5-oxo-, 2-methoxyethyl ester
17178-10-8	2-Methoxyethyl p-toluenesulfonate
71550-36-2	1-Naphthalenesulfonic acid, 6-diazo-5, 6-dihydro-5-oxo-, 2-(2-methoxyethoxy) ethyl ester

Table E-2.—Butyl-based glycol ether esters, amides, etc.*

CAS† number	Name
124-17-4	Butoxyethoxyethyl acetate
112-07-2	Butoxyethyl acetate
7251-90-3	Acrylic acid, 2-butoxyethoxy ester
5330-17-6	2-Butoxyethyl chloroacetate
27447-53-6	2-Butoxyethyl mercaptoacetate
68797-46-6	Propanic acid, 2-chloro-, 2-butoxyethyl ester
20442-06-2	2-Butoxyethyl butanoate
20442-11-9	2-Butoxyethyl pelargonate
109-37-5	Ethylene glycol monobutyl ether laurate
109-38-6	Butoxyglycol stearate
109-39-7	Ethylene glycol monobutyl ether oleate
65520-45-8	Butanedioic acid, di-2-[2-(2-butoxyethoxy) ethoxy] ethyl ester
65520-42-5	Pentanedioic acid, di-2-[2-(-2-butoxyethoxy) ethoxy] ethyl ester
65520-46-9	Hexanedioic acid, di-2-[2-(2-butoxyethoxy) ethoxy] ethyl ester
141-18-4	Adipic acid, bis (ethylene glycol monobutyl ether) ester
141-17-3	Adipic acid, bis (diethylene glycol monobutyl ether) ester
63021-23-8	Nonanedioic acid, bis (2-butyoxyethyl) ester
70900-47-9	Nonanedioic acid, bis [2-(2-butoxyethoxy) ethyl] ester
70900-46-8	Decanedioic acid, bis [2-(2-butoxyethoxy) ethyl] ester
141-19-5	Decanedioic acid, bis (2-butoxyethyl) ester
117-83-9	1,2-Benzenedicarboxylic acid, bis (2-butoxyethyl) ester
16672-39-2	Phthalic acid, bis [2-(2-butoxyethoxy) ethyl] ester
70900-48-0	1,2,4-Benzenetricarboxylic acid, tris [2-(2-butoxyethoxy) ethyl] ester
62778-23-8	Cholest-5-en-3-ol (3-beta)-, 2-butoxyethyl carbonate
5451-76-3	Benzoic acid, 2-butoxyethyl ester

(Continued)

*Adapted from TSCA [1977] and SANSS/CIS [1988].
†Chemical Abstracts Service.

Table E–2 (Continued).—Butyl-based glycol ether esters, amides, etc.

CAS number	Name
6661-54-7	Ethanol, 2-butoxy-, 4-methylbenzesulfonate
53404-31-2	2-(2,4-Dichlorophenoxy) propionic acid, butoxyethanol ester
19480-43-4	Acetic acid, (4-chloro-2-methylphenoxy)-, 2-butoxyethyl ester
30387-70-3	2,4,5-Trichlorophenoxypropionic acid n-butylglycol ester
32357-46-3	2,4-Dichlorophenoxybutyric acid, butoxyethyl ester
72152-95-5	Carbamic acid, [5-isocyanato-1,3,3-trimethylcyclohexyl) methyl]-, 2-butoxyethyl ester
78-51-3	Butoxyethyl phosphate
7332-46-9	2-(2-Butoxyethoxy) ethanol phosphate
64051-22-5	2-Butoxyethanol, hydrogen phosphate, diethylamine salt
14260-97-0	Dibutoxyethyl phosphate
64051-23-6	2-Butoxyethanol, dihydrogen phosphate, bis(diethylamine) salt
68133-43-7	Ethanol, 2-butoxy-, dihydrogen phosphate, dipotassium salt
14260-98-1	Butoxyethylphosphate

Table E–3.—Branched glycol ether esters, carbamates, etc.*

CAS† number	Name
68413-83-2	N,N-Dimethylol isopropoxyethyl carbamate
67952-46-9	Isopropoxyethyl carbamate
67952-44-7	Carbamic acid, (hydroxymethyl)-, 2-(1-methylethoxy) ethyl ester
16006-09-0	Carbamic acid, (2-isobutoxyethyl) ester
16005-83-7	Carbamic acid, bis (hydroxymethyl)-, 2-isobutoxyethyl ester
1464-69-3	2-Methyl-2-propenoic acid, 2-(ethenyloxy ethyl ether))
16839-48-8	Methacrylic acid, 2-(allyloxy) ethyl ester

*Adapted from TSCA [1977] and SANSS/CIS [1988].
†Chemical Abstracts Service.

Table E–4.—Longer chain (butyl) glycol ether esters, phosphates, etc.*

CAS† number	Name
20207-36-7	Lauric acid, 2-(hexyloxy) ethyl ester
3538-36-1	Ethanol, 2-(hexyloxy)-, hydrogen phosphate
64051-25-8	Ethanol, 2-(hexyloxy)-, dihydrogen phosphate, cmpd. with N-ethylethanamine (1:2)
64051-24-7	Ethanol, 2-(hexyloxy)-, hydrogen phosphate, cmpd. with N-ethylethanamine (1:1)
63294-54-2	Ethanol, 2-(hexyloxy)-, dihydrogen phosphate
68757-58-4	Propanoic acid, 2,2-dimethyl-, 2-(hexyloxy) ethyl ester
3694-74-4	Ethanol, 2-(tetradecyloxy)-, hydrogen sulfate, sodium salt
56049-85-5	Triethylene glycol monohexadecyl ether sulfate ammonium salt
55901-67-2	2-Decyloxyethyl sodium sulfate
61894-66-4	2-Decyloxyethyl hydrogen sulfate
14858-61-8	2-(Octadecyloxy) ethyl sodium sulfate
14858-54-9	2-(Hexadecyloxy) ethyl sodium sulfate
13150-00-0	Ethanol, 2-[2-[2-(dodecyloxy) ethoxy] ethoxy]-, hydrogen sulfate sodium salt
15826-16-1	Ethylene glycol monododecyl ether sulfate sodium salt
25446-80-4	Triethylene glycol monomyristyl ether sodium sulfate
25446-78-0	Sodium tridecyl tri(oxyethyl) sulfate
3088-31-1	Diethylene glycol monododecyl ether sodium sulfate
67923-90-4	Ethanol, 2-[2-[2-(decyloxy)ethoxy]ethoxy]-, hydrogen sulfate, ammonium salt
66104-67-4	2-Butenedioic acid (2)-, mono[2-[2-(dodecyloxy) ethoxy] ethoxy] ethyl]ester
65138-77-4	Ethanol, 2-[20(tridecyloxy) ethoxy]-, dihydrogen phosphate
65087-01-6	Ethanol, 2-[2-(tridecyloxy) ethoxy]-, hydrogen phosphate
57119-83-2	2-[2-[[4-[(2-Bromo-4,6-dinitrophenyl)azo]-1-naphthyl]amino] ethoxy] ethanol, acetate (ester)
57119-69-4	Ethanol, 2-[2-[[4-[(2-chloro-4,6-dinitrophenyl)azo]-1-naphthalenyl] amino]ethoxy]-, acetate (ester)

(Continued)

*Adapted from TSCA [1977] and SANSS/CIS [1988].
†Chemical Abstracts Service.

Table E–4 (Continued).—Longer chain (butyl) glycol ether esters, phosphates, etc.

CAS number	Name
21116-11-0	Ethanol,2-[p-[[4-[(p-hydroxyphenyl)azo]-o-tolyl]azo] phenoxy]-,1-(hydrogen sulfate), monosodium salt
65993-31-5	Dicyclopentyloxyethyl acrylate
66710-97-2	2-Propenoic acid, (1-methylethylidene) bis [(2,6-dibromo-4,1-phenylene) oxy-2, 1-ethanediyl] ester
68400-37-3	7-Amino-4-hydroxy-3-[[4-[2-(sulfooxy)ethoxy]phenyl]azo]-2-napthalenesulfonic acid
68586-19-6	2-Propenoic acid, 2-methyl-, 2-[[2,3,3a,4,7,7a (or 3a,4,5,6,7,7a)-hexahydro-4,7-methano-1H-indenyl]oxy] ethyl ester
70865-23-5	3-[[4-[2-(Sulfoxy)ethoxy]phenyl]azo][1,1′-biphenyl]-4-ol, monosodium salt
71701-31-0	2-Naphthalenesulfonic acid, 4-hydroxy-3-[[4-[2-(sulfooxy)ethoxy]phenyl]azo] -7-[(2,5,6-trichloro-4-pyrimidinyl)amino]-, disodium salt

Table E–5.—Phenoxy ethanol-based glycol esters, maleates, etc.*

CAS† number	Name
68141-05-0	Benzenoctadecanoic acid, 2-phenoxyethyl ester
103-60-6	Ethanol, 2-phenoxy-, isobutyrate
10534-77-7	Di(phenoxyethyl)maleate
46841-90-1	Mono(phenoxyethyl)maleate
48145-04-6	Ethanol, 2-phenoxy-, acrylate
58214-96-3	Butanoic acid, 3-methyl-, 2-phenoxyethyl ester
10595-06-9	2-Propenoic acid, 2-methyl-, 2-phenoxyethyl ester
23495-12-7	Propionic acid, 2-phenoxyethyl ester
23495-13-8	Pentanoic acid, 2-phenoxyethyl ester
23511-70-8	Butanoic acid, 2-phenoxyethyl ester
67845-81-2	Ethanol, 2-(2-phenoxyethoxy)-, benzoate
65379-23-9	Ethanol, 2-phenoxy-, dihydrogen phosphate, dipotassium salt

*Adapted from TSCA [1977] and SANSS/CIS [1988].
†Chemical Abstracts Service.

Table E-6.—Substituted phenoxy ethanol glycol esters, acetates, etc.*

CAS† number	Name
6807-11-0	Ethanol, 2-(4-methylphenoxy)-, acetate
63217-11-8	Ethanol, 2-[2-(4-dodecylphenoxy) ethoxy]-dihydrogen phosphate
52368-50-0	Decanoic acid, 2-[2-(nonylphenoxy) ethoxy] ethyl ester
7347-19-5	2-(2,4,6-Tribromophenoxy) ethyl acrylate
40184-38-1	2-(4'-Aminophenoxy) ethyl hydrogen sulfate
68140-43-2	m-(2-Acetoxyethoxy) phenol
56744-60-6	2-Propenoic acid, 2-methyl-, (1-methylethylidene) bis (4,1-phenyleneoxy-2, 1-ethanediyloxy-2,1-ethanediyl) ester
56361-55-8	2-Propenoic acid, (1-methylethylidene) bis (4,1-phenyleneoxy-2, 1-ethanediyloxy-2, 1-ethanediyl) ester
24447-78-7	2-Propenoic acid, (1-methylethylidene) bis (4,1-phenyleneoxy-2,1-ethanediyl) ester
65133-66-6	2-Propenoic acid, 2-methyl-, 2-[4-[1-methyl-1-[4-[2-[2-[(2-methyl-1-oxo-2-propenyl)oxy] ethoxy]ethoxy] phenyl]ethyl[phenoxy] ethyl ester

*Adapted from TSCA [1977] and SANSS/CIS [1988].
†Chemical Abstracts Service.

Table E-7.—Glycol ether acetals*

CAS† number	Name
5405-88-9	Diethylene glycol monomethyl ether formal
71563-31-0	Propionaldehyde, bis (2-methoxyethyl acetal)
71808-63-4	Butyraldehyde, bis (2-methoxyethyl acetal)
71808-62-3	Isovaleraldehyde, bis (2-methoxyethyl acetal)
71808-60-1	3,3-di (beta-Methoxyethoxy)-2-butanone
71808-59-8	Isobutyraldehyde, bis(2-methoxyethyl acetal)

*Adapted from TSCA [1977] and SANSS/CIS [1988].
†Chemical Abstracts Service.

Table E-8.—Alkyl glycol ethers (methyl)*

CAS† number	Name
52788-79-1	Diethylene glycol methyl tert-butyl ether
112-49-2	1,2 bis(2-Methoxyethoxy)-ethane (Glyme-3)
111-96-6	bis(2-Methoxyethyl) ether
110-71-4	Dimethoxyethane
7382-32-3	2-Butoxyethyl 2-methoxymethyl ether
19685-21-3	Methyl triethylene glycol allyl ether
66728-50-5	1-tert-Butoxy-2-methoxyethane
54303-31-0	3-(2-Methoxyethoxy)-propanenitrile
52808-36-3	2-(2-Methoxyethoxy) ethyl chloride
3970-21-6	2-Methoxyethoxymethyl chloride

*Adapted from TSCA [1977] and SANSS/CIS [1988].
†Chemical Abstracts Service.

Table E-9.—Phenoxy-based glycol ethers*

CAS† number	Name
68385-79-5	N-[3-Amino-4-(2-methoxyethoxy) phenyl] acetamide
67674-33-3	1-[(2-Methoxy)ethoxy]-2,4-dinitrobenze
63810-51-5	2-(2-Methoxyethoxy)-4-nitrobenzenamine
63810-54-8	2-(2-Methoxyethoxy)-5-nitrobenzenamine
68703-73-1	N-[3-(Diethylamino)-4-(2-methoxyethoxy)phenyl] propanamide
68703-72-0	N-[3-(Diethylamino)-4-(2-methoxyethoxy)phenyl] propionamide
68703-71-9	N-[3-(Diethylamino)-4-(2-methoxyethoxy)phenyl] acetamide
71230-65-4	N-[3-Amino-4-(2-methoxyethoxy)phenyl] propionamide
71077-38-8	N-[3-(Ethylamino)-4-(2-methoxyethoxy)phenyl] acetamide
71077-37-7	4-[2-Methoxyethoxy]-1,3-benzenediamine
72175-36-1	2-[2-(2-Methoxyethoxy) ethoxy]-9,10-anthracenedione
17869-10-2	1-Amino-4-hydroxy-2-(2-methoxyethoxy)-9,10-anthracenedione
67846-62-2	N-[2-[(2-Chloro-4,6-dinitrophenyl)azo]-5-(ethylamino)-4-(2-methoxyethoxy) phenyl] propanamide
65059-45-2	1,4-Diamino-9,10-dihydro-N-[3-(2-methoxyethoxy)propyl]-9,10-dioxo-2,3 anthracenedicarboximide
68597-67-5	N-[2-[(2-Chloro-4,6-dinitrophenyl)azo]-5-(ethylamino)-4-(2-methoxyethoxy) phenyl] acetamide
71889-11-7	N-[2-[(2 Bromo-4,6-dinitrophenyl)azo]-5-(diethylamino)-4-(2-methoxyethoxy) phenyl] propionamide
71889-12-8	N-[2-Bromo-4,6-dinitrophenyl)azo]-5-(diethylamino)-4-(2-methoxyethoxy) phenyl] acetamide
72066-86-5	N-[2-[(2-Bromo-4,6-dinitrophenyl)azo]-5-(ethylamino)-4-(2-methoxyethoxy) phenyl] acetamide
72066-87-6	N-[2-[(2-Bromo-4,6-dinitrophenyl)azo]-5-(ethylamino)-4-(2-methoxyethoxy) phenyl] propionamide
75198-92-4	1-Amino-4-[[2-[[[2-chloro-4-(2-methoxyethoxy)1,3,5-triazin-6-yl] amino]methyl]-4-methyl-6-sulfophenyl]amino]-2-anthraquinonesulfonic acid, disodium salt
73398-97-7	4-[[4-[[5-Cyano-2-[(8-methoxyoctyl)amino]-6-[(3-methoxy-propyl)amino]-4-methyl-3-pyridinyl]azo]-2,5-di-methylphenyl]azo]-N-[3-(2-phenoxyethoxy) propyl] benzamide

*Adapted from TSCA [1977] and SANSS/CIS [1988].
†Chemical Abstracts Service.

Table E–10.—Ethoxy-ethanol based glycol ethers*

CAS† number	Name
41771-35-1	1-Chloro-2-(2-ethoxyethoxy) ethane
629-14-1	Ethylene glycol diethyl ether
112-36-7	bis (2-Ethoxyethyl) ether
10143-53-0	Diethylene glycol ethylvinyl ether
51422-54-9	Ethylene glycol tert-butyl ethyl ether
52788-80-4	Diethylene glycol ethyl-tert-butyl ether

*Adapted from TSCA [1977] and SANSS/CIS [1988].
†Chemical Abstracts Service.

Table E–11.—Siloxy glycol ethers

CAS* number	Name
2157-45-1	Silicic acid (H_4SiO_4), tetrakis (2-methoxyethyl) ester
1067-53-4	Tris (2-methoxyethoxy) vinyl silane
45117-69-9	Methylvinylbis (2-methoxyethyl) silane
57069-48-4	[(3-Methacryloxy)propyl] tris (2-methoxyethoxy) silane
17903-05-8	Tris(2-methoxyethoxy) phenyl silane
17980-64-2	Tris(2-methoxyethoxy) methyl silane
73545-23-0	N-[2-[[2-[[2-[(2-Aminoethyl) amino] ethyl] amino] ethyl] amino] ethyl]-N^{1111}-[3-[tris(2-methoxyethoxy) silyl] propyl]nonanamide hydrochloride
24685-89-0	Ethanol, 2-(2-methoxyethoxy)-, tetraester with silicic acid (H_4SiO_4)
18407-94-8	Ethanol, 2-ethoxy-, tetraester with silicic acid (H_4SiO_4)
18765-38-3	Ethanol, 2-butoxy-, tetraester with silicic acid (H_4SiO_4)
68400-59-9	4,7,10-Trioxaundecyldimethylsilyl chloride

*Chemical Abstracts Service.

Table E-12.—Ethoxy-ethanol based glycol ether esters, amides, etc.

CAS* number	Name
112-15-2	Ethanol, 2-(2-ethoxyethoxy)-, acetate
54396-97-3	Propanoic acid, 2-methyl-, 2-ethoxyethyl ester
106-74-1	2-Propenoic acid, 2-ethoxyethyl ester
7328-17-8	2-Propenoic acid, 2-(2-ethoxyethoxy) ethyl ester
2370-63-0	2-Propenoic acid, 2-methyl-, 2-ethoxyethyl ester
39670-09-2	Triethylene glycol monoethyl ether acrylate
104-28-9	2-Propenoic acid, 3-(4-methoxyphenyl)-, 2-ethoxyethyl ester
106-13-8	2-Ethoxyethyl dodecanoate
67906-29-0	Octadecanoic acid, 10-hydroxy-9-sulfo-, 1-(2-ethoxyethyl) ester, monosodium salt
68134-05-4	9-Octadecenoic acid, 2-ethoxyethyl ester
37460-43-8	Ethanol, 2-ethoxy-, 4-nitrobenzoate
605-54-9	Diethylglycol phthalate
624-10-2	Sebacic acid, bis (2-ethoxyethyl) ester
109-44-4	Hexanedioic acid, bis (2-ethoxyethyl) ester
15484-00-1	2-(2-Ethoxyethoxy) ethyl carbonate
68214-66-4	Carbamic acid, [2-[(2-chloro-4-nitrophenyl)azo]-5-(diethylamino)phenyl]-, 2-ethoxyethyl ester
628-65-9	Carbamic acid, (2-ethoxyethyl) ester
21578-97-2	2-Ethoxyethyl N-(7-hydroxynaphth-1-yl) carbamate
70146-08-6	Carbamic acid, [3-(diethylamino)phenyl]-, 2-ethoxyethyl ester

*Chemical Abstracts Service.

Table E–13.—Acids and salts of glycol ethers

CAS* number	Name
67990-17-4	2-[(2-Butoxy)ethoxy] acetic acid, sodium salt
67990-18-5	2-[2-[(2-Hexyloxy)ethoxy]ethoxy] acetic acid, sodium salt
7420-07-7	Butoxyethoxypropionic acid
3139-99-9	2-Methoxyethanol, sodium salt
38321-18-5	Sodium 2-(2-butoxyethoxy) ethanolate
28099-67-4	bis (2-Methoxethoxy) calcium
14064-03-0	Magnesium ethoxyethoxide
52663-57-7	Sodium 2-butoxyethoxide
4084-36-0	Ethoxyethanol, compound with trifluoroborane
109-86-4	beta-Methoxyethanol
111-77-3	Diethylene glycol methyl ether
112-35-6	Methoxytriethylene glycol
111-90-9	Carbitol or 2-(2-ethoxyethoxy) ethanol
112-50-5	Ethoxytriethylene glycol
4353-29-1	3,6,9,12,15-Pentaoxaheptadecan-1-ol
2807-30-9	Ethylene glycol mono-N-propyl ether
6881-94-3	2-(2-Propoxyethoxy) ethanol
109-59-1	beta-Hydroxyethyl isopropyl ether
111-45-5	Ethylene glycol monoallyl ether
33065-62-2	1-(2-Hydroxyethoxy)-3-(2-propenyloxy)-2-propanol
3973-18-0	Ethylene glycol monopropargyl ether
111-76-2	Butoxyethanol
112-34-5	Butoxy diethylene glycol
143-22-6	Triethylene glycol mono-n-butyl ether
4439-24-1	Ethylene glycol isobutyl ether
18912-80-6	Diethylene glycol monoisobutyl ether
1606-85-5	bis(Hydroxyethyl) ether butynediol

(Continued)

*Chemical Abstracts Service.

Table E–13 (Continued).—Acids and salts of glycol ethers

CAS number	Name
112-25-4	Ethylene glycol monohexyl ether
112-59-4	Diethylene glycol hexyl ether
25961-89-1	Triethylene glycol monohexyl ether
16394-44-8	2,2'-(1,4-Cyclohexylenedioxy) diethanol
1559-35-9	Ethylene glycol ethylhexyl ether
1559-37-1	Triethylene glycol 2-ethylhexyl ether
4536-30-5	Ethylene glycol monolauryl ether or lauryl alcohol oxy ethanol
3055-93-4	Lauryl alcohol mono (oxyethylene) ethanol
3055-94-5	Dodecyl triethylene glycol ether
14663-73-1	2-[2(Tridecyloxy) ethoxy] ethanol
4403-12-7	2-[2-[2-(Tridecyloxy) ethoxy] ethoxy] ethanol
56049-80-0	Diethylene glycol monopentadecyl ether
628-89-7	Ethylene glycol mono (2-chloroethyl) ether
68003-29-2	bis [2-(2-Hydroxyethoxy) ethyl] octylamine
53815-85-3	2-(2-(1-Naphthalenylamino) ethoxy) ethanol
1704-62-7	Dimethylaminoethoxyethanol
112-33-4	Diethylene glycol mono (aminopropyl) ether
140-82-9	Diethylaminoethoxyethanol
929-06-6	Aminoethoxyethanol
68141-01-5	2-[2-(3-Aminopropoxy) ethoxy] ethanol hydroxyacetic acid salt
68156-16-1	2-[2-(3-Aminopropoxy) ethoxy] ethanol hydrochloride
622-08-2	Benzyl hydroxyethyl ether
122-99-6	beta-Hydroxethyl phenyl ether
104-68-7	Diethylene glycol phenyl ether
711-82-0	Ethylene glycol alpha-naphthyl ether
901-44-0	Bisphenol A bis (2-hydroxyethyl) ether
15149-10-7	beta-Hydroxyethyl p-methylphenyl ether
104-39-2	2-[2-(p-Tolyloxy) ethoxy] ethanol
104-38-1	p-Di(2-hydroxyethoxy)benzene

(Continued)

Table E–13 (Continued).—Acids and salts of glycol ethers

CAS number	Name
102-40-9	m-bis (2-Hydroxyethoxy) benzene
6382-07-6	2-(p-tert-Pentylphenoxy) ethanol
20427-84-3	Diethylene glycol p-nonylphenyl ether
27176-93-8	Diethylene glycol mono(nonylphenyl) ether
61886-41-7	2-(p-Aminophenoxy) ethanol hydrochloride
18790-97-1	2-[2-[2-(p-Aminophenoxy) ethoxy] ethoxy] ethanol
66422-95-5	2-(2,4-Diaminophenoxy) ethanol dihydrochloride
16365-27-8	2-(p-Nitrophenoxy) ethanol
63134-26-9	2-[2-[2-(4-Nitrophenoxy) ethoxy] ethoxy] ethanol
1892-43-9	p-Chlorophenyl glycol ether
60593-02-4	Hydroxyethyl pentabromophenyl ether
15480-00-9	2-(o-Chlorophenoxy) ethanol
23976-66-1	2-(2,4,6-Tribromophenoxy) ethanol
70715-17-2	2-[3-(6-Methyl-2-pyridinyl) propoxy] ethanol
64346-25-4	2-[(2,2,6,6-Tetramethyl-4-piperidinyl) oxy] ethanol
65104-24-7	2-[2-[[4-[(2-Bromo-4,6-dinitrophenyl) azo]-1-naphthalenyl] amino] ethoxy] ethanol
68039-37-2	2-[(3a,4,5,6,7,7a-Hexahydro-4,7-methano-1H-inden-5-yl)oxy] ethanol
67906-59-6	2-[4-[(4-Amino-5-methoxy-o-tolyl) azo] phenoxy] ethanol
57119-91-2	2-[2-[[4-[(2-Chloro-4,6-dinitrophenyl) azo]-1-napthalenyl] amino] ethoxy] ethanol
2192-20-3	2-[2[[4-(p-Chloro-alpha-phenylbenzyl)-1-piperazinyl] ethoxy] ethanol dihydrochloride
7070-15-7	beta-Hydroxyethyl isobornyl ether
4162-45-2	2,2′-[Isopropylidenebis [(2,6-dibromo-p-phenylene)oxy]] diethanol
2831-60-9	2-(2,4-Dinitrophenoxy) ethanol

Table E-14.—Miscellaneous glycol ethers*

CAS† number	Name
72403-65-7	Chromate (5-), bis [4-[[6-[[4-chloro-6-(2-ethoxyethoxy)-1,3,5-triazin-2-yl] amino]-1-hydroxy-3-sulfo-2-naphthalenyl] azo]-1-hydroxy-7-nitro-1-naphthalenesulfonato(4-)]-, pentasodium
71673-20-6	1-[2-(2-Ethoxyethoxy)ethyl]-2,2,4-trimethyl-1,2,3,4-tetrahydroquinoline
71673-19-3	7-Nitro-1-[2-(2-ethoxyethoxy) ethyl]-2,2,4-trimethyl-1,2,3.4- tetrahydroquinoline
71673-14-8	7-Amino-1-[2-(2-ethoxyethoxy) ethyl]-2,2,4-trimethyl-1,2,3,4- tetrahydroquinoline
71637-13-7	7-Acetamido-6-(2-bromo-4,6-dinitrophenylazo)-1-[2-(2-ethoxyethoxy) ethyl]-1,2,3,4-tetrahydro-22,4-trimethylquinoline
71637-12-6	7-Acetamido-6-(2-cyano-4,6-dinitrophenylazo)-1-[2-(2-ethoxyethoxy) ethyl]-1,2,3,4-tetrahydro-2,2,4-trimethylquinoline
71673-02-4	7-Acetamido -1-[2-(2-ethoxyethoxy) ethyl]-2,2,4-trimethyl -1,2,3,4- tetrahydroquinoline
70210-27-4	1-Amino-4-[[3-[[4-chloro-6-(2-ethoxyethoxy) -1,3,5-triazin-2-yl] amino] -2,4,6-rimethyl -5-sulfophenyl] amino]-9,10-dihydro-9,10-dioxo-2-anthracenesulfonicacid, disodium salt
65208-31-3	N-[2-[(2,6-Dibromo-4-nitrophenyl) azo] -5-[[2-(2-ethoxyethoxy) ethyl] ethylamino]phenyl] acetamide
65916-12-3	4-[(2,6-Dicyano-4-nitrophenol) azo]-N-[2-(2-ethoxyethoxy)ethyl] -N-ethyl-3-acetamidoaniline
67338-58-3	N-[2-(2-Ethoxyethoxy) ethyl] -N-ethyl-m-acetamidoaniline
23119-35-9	1,5-Dihydroxy-4,8-diamino-2-[4-(2-ethoxyethoxy) phenyl] anthraquinone
55993-15-2	2-[2-(2-Ethoxyethoxy) ethyl]-6-hydroxy -5-[(2-methyl 4-nitrophenyl) azo]-1H-benz[de] isoquinoline -1,3 (2H)-dione
68298-23-7	Propanoic acid, 3-(2-butoxyethoxy)-, sodium salt
68140-97-6	Propanoic acid, 3-(2-butoxyethoxy)-, potassium salt
68140-96-5	3-(2-Butoxyethoxy) propanenitrile
52788-78-0	Diethylene glycol butyl tert-butyl ether
1120-23-6	2-Butoxyethyl 2-chloroethyl ether
764-99-8	Diethylene glycol divinyl ether
143-29-3	bis (Butoxyethoxyethoxy) methane

(Continued)

*Adapted from TSCA [1977] and SANSS/CIS [1988].
†Chemical Abstracts Service.

Table E-14 (Continued).—Miscellaneous glycol ethers

CAS number	Name
124-16-3	Butoxyethoxy propanol
112-73-2	Dibutoxy diethylene glycol
51-03-6	alpha-[2-[2-)n-Butoxy)ethoxy] ethoxy] -4,5-methylene dioxy-2-propyltoluene
7529-27-3	Ethylene glycol diallyl ether
57947-82-7	Diethylene glycol bis (allyl) ether
18854-51-8	1-[2-[2-Propenyloxy)ethoxy] butane
68134-24-7	1-(2-(1,1-Dimethylethoxy)ethoxy) butane
112-26-5	Triethylene glycol dichloride
13483-18-6	Ethylene glycol bis (chloromethyl ether)
66028-01-1	1-[2-[2-(2-Chloroethoxy) ethoxy]ethoxy]-4-octyl benzene
66028-00-0	Diisobutylphenoxyethoxyethylchloride
65925-28-2	1-[2-(2-Chloroethoxy)ethoxy]-4-(1,1,3,3-tetramethylbutyl) benzene
2997-01-5	di (3-Aminopropoxy) ethane
4246-51-9	Diethylene glycol bis (3-aminopropyl) ether
5442-83-1	N,N-Dimethyl-2-[2-[4-(1,1,3,3-tetramethyl butyl) phenoxy]ethoxy - ethanamine
21697-94-9	3,3'-(Ethylenedioxy) bis (propylammonium) adipate
66027-99-4	Diisobutylphenoxyethoxyethyldimethylamine
66027-97-2	Diisobutylcresoxyethoxyethyldimethylamine
2224-15-9	Ethylene diglycidyl ether
22397-31-5	Diethylene glycol bis (2-cyanoethyl) ether
3386-87-6	Ethylene glycol bis (2-cyanoethyl) ether
68132-81-0	(Diisobutylphenoxy) ethoxyethoxyethane sulfonic acid, sodium salt
70198-21-9	2-[2-[[2,2,4(or 2,4,4)-Trimethylpentyl]phenoxy]ethoxy] ethanesulfonic acid, sodium salt
71550-69-1	N,N-Dimethyl-2-[2-[2-methyl-4-(1,1,3,3-tetramethylbutyl) phenoxy]ethoxy] ethanamine
61166-00-5	1,2-bis (3-Hydroxyphenoxy) ethane
104-66-5	Ethylene glycol diphenyl ether
3753-05-7	1,2-bis (4-Carboxyphenoxy) ethane
22616-31-5	Benzyldiisobutyl [2-(2-phenoxyethoxy)ethyl] ammonium chloride

(Continued)

Table E–14 (Continued).—Miscellaneous glycol ethers

CAS number	Name
14417-67-5	1,2-bis (Pyridinomethoxy) ethane dichloride
17418-59-6	1-Amino-4-hydroxy-2-(2-phenoxyethoxy) anthraquinone
41312-86-1	1,4-Diamino-2-chloro-3-(2-phenoxyethoxy) anthraquinone
63833-78-3	5-[(2-Cyano-4-nitrophenyl) azo]-6-[2-hydroxyethyl) amino]-4-methyl-2-[[3-(2-phenoxyethoxy) propyl] amino]-3-pyridinecarbonitrile
63281-10-7	5-[[2-Chloro-4-(methylsulfonyl) phenyl] azo]-4-methyl-2,6-bis [[3-(2-phenoxyethoxy) propyl] amino]-3-pyridinecarbonitrile
63281-05-0	4-Methyl-2,6-bis [[3-(2-phenoxyethoxy) propyl] amino]-5-[[4-(phenylazo) phenyl] azo]-3-pyridinecarbonitrile
63281-03-8	5-[[2-Chloro-4-(phenylzap) phenyl] azo]-4-methyl-2,6-bis[[3-(2-phenoxyethoxy) propyl] amino]-3-pyridinecarbonitrile
68299-27-4	Nonabromomonochloro-1,2-diphenoxyethane
121-54-0	p-Diisobutyl(phenoxyethoxy) ethyl] dimethylbenzylammonium chloride
61262-53-1	1,1′- [1,2-Ethanediylbis (oxy)] bis [2,3,4,5,6-pentabromo-benzene
23421-22-9	4,4″-[Oxybis(ethyleneoxy)]bis [2-hydroxy benzophenone]
37853-59-1	1,2-bis(2,4,6-Tribromophenoxy) ethane
67923-87-2	2-[2-[2-(Octylphenoxy) ethoxy] ethoxy] ethanesulfonic acid, sodium salt
72953-52-7	1-Amino-2-[2-(bromophenoxy) ethoxy]-4-hydroxyanthraquinone
72953-51-61	1-Amino-2-[2-(dibromophenoxy) ethoxy] -4-hydroxyanthraquinone

APPENDIX F

BACKGROUND OF METHODS USED FOR ANALYSIS OF EAA and MAA IN URINE

Smallwood et al. [1984]* developed a method for analyzing the glycol ether metabolites EAA and MAA in urine. The method was based on (1) methylene chloride extraction of "spiked" acidified human urine, (2) pentafluorobenzyl bromide (PFBB) derivitization, and (3) gas chromatography analysis using flame ionization detection (FID). Urine (1 ml) was adjusted to pH 2 with HCl and extracted three times with methylene chloride. Phase transfer catalysis (a combination of ion-pair extraction and fluoroanhydride derivitization) was done by adding alkaline tetrabutylammonium hydrogen sulfate and PFBB to the methylene chloride extract. The mixture was rotated for 2 hr. Gas chromatography was employed to analyze 5 μl of the methylene chloride layer (bottom layer) using FID and a 6 ft × 1/4 in (4-mm id) glass column (packed with 1.95% QF-1 and 1.5% OV-17 on 80/100 mesh Supelcoport). Detection limits for MAA and EAA were 11.4 and 5.0 mg/liter of urine, respectively. Average recoveries (and relative standard deviations) were 78% (0.17) for MAA and 91% (0.14) for EAA.

Groeseneken et al. [1986a] developed a method for determining MAA and EAA in urine based on lyophilization of urine samples followed by derivitization with diazomethane. After adjustment of urine specimens to pH 8 to 8.5 with KOH, 1 ml of urine and 50 μg of 2-furonic acid (FA) (internal standard) were added, and the sample was lyophilized. The dry residue was redissolved in 1 ml methylene chloride with added HCl and derivitized with diazomethane in methylene chloride. Gas chromatographic analysis using FID was performed on a fused silica capillary column (CP WAX 57 CB, 25 m × 0.33 mm id) with a split ratio of 10:1. The detection limits of MAA and EAA were 0.15 and 0.07 mg/liter of urine, respectively. Mean recoveries of MAA, EAA, and FA added to "blank" urine samples were 31.4%, 62.5%, and 58.4%, respectively; the recoveries of MAA and EAA were well correlated with those of the internal standard. Day-to-day variability for MAA and EAA was 6.0% and 6.4%, respectively; the corresponding within-day variability was 6.2% and 8.9%.

*See References beginning on page 262.

Smallwood et al. [1988] developed and validated a method for analysis of EAA in urine. Two ml of urine, along with potassium carbonate, tetrabutylammonium hydrogen sulfate, methylene chloride, and PFBB were added to a screw-top culture tube. After 2 hr of mixing on a rotator at 60 rpm, the tube was heated for 20 min in a 50°C water bath. Additional mixing at room temperature, removal of the upper aqueous layer, and washing of the lower methylene chloride layers with distilled water removed unreacted reagents. The methylene chloride extract was dried with anhydrous sodium sulfate and loaded into an autosampler vial. Automated gas chromatographic analysis using FID was conducted with the use of a 6 ft × 4 mm id glass column packed with 4% SE-30 and 6% OV-210 on 100/120 mesh Chromosorb WHP. Standards were prepared in pooled urine. The analytical range for EAA was 5 to 100 mg/liter of urine; the limit of detection was 4 mg/liter; and the limit of quantitation was 7 mg/liter. Within-day variation was 0.5% to 1.8%, and day-to-day variation was 3.0% to 4.7%. Sample stability was confirmed for at least 8 months when specimens were stored at −20°C. The authors stated that the method could also be used for MAA and butoxyacetic acid (BAA) in urine. Preliminary data were presented in the paper indicating that the technique has the potential for assessing EGEE exposure in shipyard painters who use paints containing EGEE.

Groeseneken et al. [1989b] observed that MAA appeared in the chromatogram of control subjects not exposed to EGME. Further investigation revealed that the diazomethane procedure was producing MAA by reacting with the hydroxyl group of naturally occurring glycolic acid. Groeseneken et al. [1989b] further evaluated the existing methods for determining alkoxyacetic acids and concluded that the phase transfer catalysis procedures had the required specificity, without the production of artifacts, but lacked sufficient sensitivity to detect these metabolites at low occupational exposure concentrations. On the other hand, the methods utilizing diazomethane derivitization had the required sensitivity but lacked the specificity. Therefore, Groeseneken et al. [1989a] developed an improved method that combined the best attributes of the two basic existing methods.

The procedure developed by Groeseneken et al. [1989b] was described as follows. Urine was adjusted to pH 7; 1-ml aliquots were placed in small vials with 3-chloropropionic acid (internal standard) and lyophilized overnight. The dry residue was redissolved in methanol containing PFBB, and the vials were capped. The vials were heated at 90°C for 3 hr. After cooling, sample cleanup was done by adding distilled water and extracting the penta-fluorobenzyl-esters (PFB-esters) with methylene chloride. The methylene chloride extract was analyzed by gas chromatography using FID. A fused silica capillary column was used (CP Sil 5, 25 m × 0.32 mm id, 0.21 μm film thickness) with a split ratio of 5:1. Temperature programming was employed. All PFB-esters showed baseline resolution; retention times of 6.53 min (MAA), 7.77 min (EAA), and 8.59 min (internal standard) were observed. A typical gas chromatographic run, including cool-down and equilibration times, required about 30 min.

Optimization studies were done for reagent concentrations as well as for urinary pH and reaction time. After correction for the partial solubility of methylene chloride in the 50:50 methanol:urine phase, recoveries of alkoxyacetic acids from urine averaged 95.0% (MAA), 94.8% (EAA), and 95.1% (BAA). The yield for the derivitization reaction averaged 99.5%

(MAA) and 101.8% (EAA). Standard curves were set up for urine and were linear over the range of 0.1 to 200 mg/liter. The limit of detection, at a signal-to-noise ratio of 5, for the two acids was 0.03 mg/liter. Precision of the method, calculated from triplicate injections of 40 urine samples, averaged 3.5% (RSD), ranging from 1.1% at 25 mg/liter to 20% at 0.1 mg/liter.

NIOSH has not validated the Groeseneken et al. methods [1986a, 1989b].

APPENDIX G

GUIDELINES FOR BIOLOGICAL MONITORING

G.1 Monitoring

The frequency of biological monitoring should be tied to work practices and the use of the glycol ethers. Dermal absorption of glycol ethers can be significant. Compliance with the NIOSH RELs without a biological monitoring evaluation may not protect workers from the potential adverse effects of glycol ethers.

Urine samples should be evaluated for alkoxyacetic acid metabolites using the method of Groeseneken et al. [1989b]* or an equivalent method. Expression of results as milligrams of metabolite per gram of creatinine (mg/g creatinine) is suggested.

Factors that may affect the urinary levels of EAA and MAA include ethanol consumption (which lowers urinary metabolite levels) and dermal contact, heavy work, and nonoccupational exposures (all of which raise urinary levels).

Urine sample collection times are specific for the individual glycol ethers:

- EGEE and EGEEA: Urine samples should be collected at the beginning of the shift on the last working day of the workweek. This specimen would represent the integrated weekly exposure (dermal and inhalation).
- EGME and EGMEA: Urine samples should be collected preshift on the first day of the workweek following a typical workweek of exposure. This specimen would reflect the integrated exposure (dermal and inhalation) from the previous week.

Measurable concentrations of EAA or MAA in the urine are an indication of uptake of the respective glycol ethers by either inhalation or skin exposure. The concentrations reflect nonoccupational as well as occupational exposure and are not likely to correlate with the NIOSH RELs. If concentrations of EAA and MAA exceed the estimated guidelines below, then exposure to glycol ethers has occurred, but not necessarily at concentrations above the NIOSH RELs. A thorough industrial hygiene evaluation, with specific emphasis on possible dermal absorption, should be conducted to determine the source of exposure. The following guidelines are suggested until better documented guidelines are developed.

*See References beginning on page 262.

1. The presence of EAA in urine specimens (collected as specified) above a concentration of approximately 5 mg EAA/g creatinine is evidence for a single EGEE and/or EGEEA inhalation exposure corresponding to an 8-hr exposure to 0.5 ppm EGEE and/or EGEEA at 60 W of exercise. This value was extrapolated from 4-hr experimental exposures at 5 ppm at 60-W workload to an 8-hr exposure at 0.5 ppm at 60-W workload [Groeseneken et al. 1986c, 1987b] using the principle of superposition [Gibaldi and Perrier 1982].

2. The presence of MAA in urine specimens (collected as specified) above a concentration of approximately 1 μg/ml (equivalent to approximately 0.8 mg/g creatinine) is evidence of inhalation-only exposure to EGME and/or EGMEA. This value was extrapolated from 4-hr laboratory exposures at 5.1 ppm EGME at rest to 8-hr exposure to 0.5 ppm at 60-W workload [Groeseneken et al. 1989a]. The excretion of MAA was relatively constant 4 hr after the end of a 4-hr exposure. Therefore, doubling the urinary EAA concentration after a 4-hr exposure is a reasonable estimate of urinary values following an 8-hr exposure (based on Figure 1 [Groesenken et al. 1989a]). Extrapolation to 0.1 ppm may produce MAA levels below the detection limit of the method. There are no data on occupational exposures, but based on EGEE data and on the strong possibility of concurrent dermal absorption of EGME, concentrations of MAA may be higher than 0.8 mg/g creatinine in urine specimens collected from workers.

G.2 Justification For Recommendations

Biological monitoring for glycol ether exposure is recommended, even though no validated guidelines can be provided as to the relationship between airborne exposure to glycol ethers and the alkoxyacetic acid urinary metabolites. The alkoxyacetic acid metabolites (EAA and MAA) are not only an index of exposure or uptake of EGEE or EGME by the worker, but they are also an index of potential adverse health effects from these glycol ethers.

Dermal absorption may be a major route of exposure to EGME and EGEE and their respective acetates. The potential exists for absorption of glycol ether vapors through wet skin.

The influence of workload is significant for inhalation exposure. Doubling the workload results in twice the uptake of the glycol ethers.