US EPA RECORDS CENTER REGION 5
1004973

Appendix C-16
Removed Intentionally

Appendix C-17
Removed Intentionally

Waste Codes Acceptable for Storage Only

Hazardous Waste Code	Chemical Abstract Number	Description
U086	1615-80-1	Hydrazine, 1,2-dimethyl-
U087	3288-58-2	Phosphorodithioic acis, O,O-diethyl
U088	84-66-2	Diethyl Phthalate
U089	56-53-1	Diethylstibesterol
U090	94-58-6	Dihydrosafrole
U091	119-90-4	3,3'-Dimethoxybenzidine
U092	134-40-3	Dimethylamine (I)
U094	57-97-6	7,12-Dimethylbenz[a]anthracene
U095	119-93-7	3,3'-Dimethylbenzidine
U096	80-15-9	Hydroperoxide, 1-methyl-1-phenylethy
U097	79-44-7	Dimethylcarbamoyl chloride
U099	540-73-8	Hydrazine, 1,2-dimethyl-
U101	105-67-9	2,4-Dimethylphenol
U109	122-66-7	Hydrazine, 1,2-dimethyl-
U110	142-84-7	Dipropylamine (I)
U111	621-64-7	Di-n propylnitrosamine
U114	111-54-6	Carbamodithioic acid, 1,2-ethanediyl
U115	75-21-8	Oxirane (I,T)
U116	96-45-7	Ethylenethiourea
U118	97-63-2	Ethyl methacrylate
U119	62-50-0	Ethyl methanesulfonate
U120	206-44-0	Fluoranthene
U121	75-69-4	Methane, trichlorofluoro-
U124	110-00-9	Furfuran (I)
U126	765-34-4	Glycidyladehyde
U127	118-74-1	Hexachlorobenzene
U128	87-68-3	Hexachlorobutadiene
U132	70-30-4	Phenol, 1,1'-methylenebis[3,4,6-tric
U133	302-01-2	Hydrazine (R,T)
U135	7783-06-4	Hydrogen sulfide
U136	75-60-5	Cacodylic acid
U137	193-39-5	Indeno[1,2,3-cd]pyrene
U139	9004-66-4	Iron dextran
U141	120-58-1	Isosafrole
U143	303-34-4	Lasiocarpine
U145	7446-27-7	Lead phosphate
U146	1335-32-6	Lead subacetate
U148	123-33-1	Maleic hydrazide
U149	109-77-3	Malononitrile
U150	148-82-3	Melphalan
U152	126-98-7	Methacrylonitrile (I,T)
U153	74-93-1	Methanethiol (I,T)
U155	91-80-5	Methapyrilene
U156	79-22-1	Methyl chlorocarbonate (I,T)
U157	56-49-5	3-Methylcholanthrene
U158	101-14-4	4,4-Methylenebis(2-chloroaniline)
U162	80-62-6	Methyl methacrylate (I,T)
U163	70-25-7	MNNG
U164	56-04-2	Methylthiouracil
U166	130-15-4	1,4-Naphthalenedione
U170	100-02-7	Phenol, 4-nitro-

Waste Codes Acceptable for Storage Only

Hazardous Waste Code	Chemical Abstract Number	Description
U172	924-16-3	N-Nitrosodi-n-butylamine
U173	1116-54-7	N-Nitrosodiethanolamine
U174	55-18-5	N-Nitrosodiethylamine
U176	759-73-9	Urea, N-ethyl-N-nitroso-
U177	684-93-5	Urea, N-methyl-N-nitroso-
U178	615-53-2	N-Nitroso-N-methylurethane
U179	100-75-4	N-Nitrosopiperidine
U180	930-55-2	Pyrrolidine, 1-nitroso-
U181	99-55-8	5-Nitro-o-toluidine
U182	123-63-7	Paraldehyde
U184	76-01-7	Pentachloroethane
U185	82-68-8	Pentachloronitrobenzene (PCNB)
U186	504-60-9	1-Methylbutadiene (I)
U186	504-60-9	1,3-Pentadiene (I)
U187	62-44-2	Phenacetin
U189	1314-80-3	Phosphorus sulfide (R)
U192	23950-58-5	Pronamide
U193	1120-71-4	1,3-Propane sultone
U194	107-10-8	1-Propanamine (I,T)
U197	1-7-51-4	p-Benzoquinone
U200	50-55-5	Reserpine
U203	94-59-7	Safrole
U206	18883-66-4	Streptozotocin
U216	7791-12-0	Thallium (I) chloride
U217	10102-45-1	Thallium (I) nitrate
U218	62-55-5	Thioacetamide
U219	62-56-5	Thiourea
U222	636-21-5	o-Toluidine hydrochloride
U234	99-35-4	1,3,5-Trinitrobenzene (R,T)
U235	126-72-7	Trist (2,3-dibromopropyl)phosphate
U236	72-57-1	Trypan blue
U238	51-79-6	Ethyl carbamate (urethane)
U240	94-75-7	2,4D, salts & esters
U243	1888-71-7	Hexachloropropene
U246	506-68-3	Cyanogen bromide (CN)Br
U247	72-43-5	Methoxychlor
U249	1314-84-7	Zinc phosphpide Zn_3P_2, when present at concentrations of 10% or less

Waste Codes Acceptable for Storage Only

Hazardous Waste Code	Chemical Abstract Number	Description
P002	591-08-2	Acetamide, n-(aminothioxomethyl)-
P004	309-00-2	Aldrin
P008	504-24-5	4-Aminophyridine
P009	131-74-8	Ammonium picrate (R)
P010	7778-39-4	Arsenic acid H3AsO4
P013	542-62-1	Barium cyanide
P016	542-88-1	Methane, oxybis(chloro-
P017	598-31-2	Bromoacetone
P020	88-85-7	Phenol, 2-(1-methylpropyl)-4,6-nitro
P021	592-01-8	Calcuim cyanide
P024	106-47-8	p-Chloroaniline
P027	542-76-7	3-Chloropropionitrile
P029	544-92-3	Copper cyanide Cu(CN)
P030		Cyanides (soluble cyanide salts)
P031	460-19-5	Cyanogen
P033	507-77-4	Cyanogen chloride
P034	131-89-5	Phenol, 2 cyclohexyl-4,6-dinitro
P036	696-28-6	Dichlorophenylarsine
P038	692-42-2	Diethylarsine
P039	298-04-0	Disulfoton
P040	297-97-2	O,O-Diethyl O-pyrazinyl
P041	311-45-5	Diethyl p-nitrophenyl phosphate
P042	51-43-4	Epinephrine
P043	55-91-4	Diisopropylflourophosphate(DFP)
P044	60-51-5	Dimethoate
P045	39196-18-4	2-Butanone, 3,3 dimenthyl
P046	122-09-8	alpha, alpha-Dimethylphenethylamine
P048	51-28-5	Phenol, 2,4,-dinitro
P049	514-53-7	Dithiobiuret
P054	151-56-4	Aziridine
P057	640-19-7	Fluroacetamide
P058	62-74-8	Fluroacetic acid, sodium salt
P060	465-73-6	Isodrin
P062	757-58-4	Hexaethyl tetraphosphate
P064	624-83-9	Methane, isocyanato-
P066	16752-77-5	Methomyl
P068	60-34-4	Hydrazine, methyl
P069	75-86-5	2-Methyllactonitrile
P071	298-00-0	Methyl parathion
P072	86-88-4	Alpha-Naphthylthiourea
P074	557-19-7	Nickel cyanide
P082	62-75-9	N-Nitrosodimethylamine
P084	4549-40-0	N-Nitrosomethylvinylamine
P088	145-73-3	Endothall
P092	62-38-4	Mercury, (acetato-O)phenyl
P097	52-85-7	Famphur
P098	151-50-8	Potassium cyanide
P099	506-61-6	Potassium silver cyanide
P101	107-12-0	Ethyl cyanide
P102	107-19-7	Propargyl alcohol
P103	630-10-4	Selenourea
P104	506-64-9	Silver Cyanide
P105	26628-22-8	Sodium azide

Waste Codes Acceptable for Storage Only

Hazardous Waste Code	Chemical Abstract Number	Description
P106	143-33-9	Sodium cyanide
P109	3689-24-5	Tetraethyldithiopyrophosphate
P111	107-49-3	Diphosphoric acid, tetraethyl ester
P118	75-70-7	Trichloromethanethiol
P119	7803-55-6	Ammonium vanadate
P121	557-21-1	Zinc Cyanide
P122	1314-84-7	Zinc phosphide Zn3P2

Waste Codes Acceptable for Bulking

Hazardous Waste Code	Chemical Abstract Number	Acceptable For Bulking	Description
U002	67-64-1	Y	Acetone (I)
U003	75-05-8	Y	Acetonitrile (I,T)
U007	79-06-1	Y	Acrylamide
U008	79-10-7Y	Y	Acrylic Acid (I)
U009	107-13-1	Y	Acrylonitrile
U012	62-53-3	Y	Aniline (I,T)
U019	71-43-2	Y	Benzene (I,T)
U025	111-44-4	Y	Dichloroethyl ether
U029	74-83-9	Y	Methyl bromide
U031	71-36-3	Y	n-Butyl alcohol (I)
U036	57-74-9	Y	Chlordane, alpha & gamma isomers
U037	108-90-7	Y	Chlorobenzene
U041	106-89-8	Y	Epichlorohydrin
U044	67-66-3	Y	Chloroform
U045	74-87-3	Y	Methyl chloride (I,T)
U052	1319-77-3	Y	Cresol (Cresylic acid)
U055	98-82-8	Y	Cumene (I)
U056	110-82-7	Y	Cyclohexane (I)
U057	108-94-1	Y	Cyclohexanone (I)
U067	106-93-4	Y	Ethylene dibromide
U070	95-50-1	Y	o-Dichlorobenzene
U071	541-73-1	Y	m-Dichlorobenzene
U072	106-46-7	Y	p-Dichlorobenzene
U073	91-94-1	Y	3,3'-Dichlorobenzidine
U076	75-34-3	Y	Ethane, 1,1-dichloro-
U077	107-06-2	Y	Ethane, 1,2-dichloro-
U078	75-35-4	Y	1,1-Dichloroethylene
U079	156-60-5	Y	1,2-Dichloroethylene
U080	75-09-2	Y	Methylene chloride
U083	78-87-5	Y	Propylene dichloride
U093	60-11-7	Y	p-Dimethylaminoazobenzene
U102	131-11-3	Y	Dimethyl Phthalate
U103	77-78-1	Y	Dimethyl sulfate
U105	121-14-2	Y	2,4-Dinitrotoluene
U106	606-20-2	Y	2,6-Dinitrotoluene
U107	117-84-0	Y	Di-n-octyl phthalate
U108	123-91-1	Y	1,4-Dioxane
U112	141-78-6	Y	Ethyl acetate (I)
U113	140-88-5	Y	Ethyl acrylate (I)
U117	60-29-7	Y	Ethyl ether (I)
U122	50-00-0	Y	Formaldehyde
U123	64-18-6	Y	Formic acid (C,T)
U125	98-01-1	Y	Furfural (I)
U129	58-89-9	Y	Lindane
U131	67-72-1	Y	Hexachloroethane
U134	7664-39-3	Y	Hydrofluoric acid (C,T)
U138	74-88-4	Y	Methyl iodide
U140	78-83-1	Y	Isobutyl alcohol (I,T)
U144	301-04-2	Y	Lead acetate
U147	108-31-6	Y	Maleic anhydride

U151	7439-97-6	Y	Mercury
U154	67-56-1	Y	Methanol (I)

Waste Codes Acceptable for Bulking

Hazardous Waste Code	Chemical Abstract Number	Acceptable For Bulking	Description
U159	78-93-3	Y	Methyl ethyl ketone (MEK)(I,T)
U161	108-10-1	Y	Methyl isobutyl ketone (I)
U165	91-20-3	Y	Naphthalene
U167	134-32-7	Y	1-Naphthalenamine
U168	91-59-8	Y	2-Naphthalenamine
U169	98-95-3	Y	Nitrobenzene (I,T)
U171	79-46-9	Y	Nitropropane
U183	608-93-5	Y	Pentachlorobenzene
U188	108-95-2	Y	Phenol
U190	85-44-9	Y	Phthalic Anhydride
U191	109-06-8	Y	Pyridine, 2-methyl-
U196	110-86-1	Y	Pyridine
U201	108-46-3	Y	Resorcinol
U202	81-06-2	Y	Saccharin, & salts
U204	7783-00-8	Y	Selenious acid
U205	7488-56-4	Y	Selenium sulfide
U207	95-94-3	Y	1,2,4,5-Tetrachlorobenzene
U208	630-20-6	Y	1,1,1,2-Tetrachloroethane
U209	79-34-5	Y	1,1,2,2-Tetrachloroethane
U210	127-18-4	Y	Tetrachloroethylene
U211	56-23-5	Y	Carbon tetrachloride
U213	109-99-9	Y	Tetrahydrofuran (I)
U214	563-68-8	Y	Thallium (I) acetate
U215	6533-73-9	Y	Thallium (I) carbonate
U220	108-88-3	Y	Toluene
U221	25376-45-8	Y	Toluenediamine
U223	26471-62-5	Y	Toluene disocyanate (R,T)
U225	75-25-2	Y	Bromoform
U226	71-55-6	Y	Methyl chloroform
U227	79-00-5	Y	1,1,2-Trichloroethane
U228	79-01-6	Y	Trichloroethylene
U239	1330-20-7	Y	Xylene (I)
U244	137-26-8	Y	Thiram
U248	81-81-2	Y	Warfarin, & salts, when present at concentrations of 3% or less
U328	95-53-4	Y	o-Toluidine
U353	106-49-0	Y	p-Toluidine
U359	110-80-5	Y	Ethylene glycol monoethyl ether

Waste Codes Acceptable for Storage Only

Hazardous Waste Code	Chemical Abstract Number	Description
U001	75-07-0	Acetaldehyde (1)
U004	98-86-2	Acetophenone
U005	53-96-3	2-Acetylaminofluorene
U010	50-07-7	Mitomycin C
U011	61-82-8	Amitrole
U014	492-80-8	Auramine
U015	115-02-6	Azaserine
U016	225-51-4	Benz[c]acridine
U017	98-87-3	Benzal chloride
U018	56-55-3	Benz[a]anthracene
U020	98-09-9	Benzenesulfonic acid chloride (C,R)
U021	92-87-5	Benzidine
U022	50-32-8	Benzo[a]pyrene
U024	111-91-1	Dichloromethoxy ethane
U026	494-03-1	Chlornaphazin
U027	108-60-1	Dichloroisoprophy ether
U028	117-81-7	1,2-Benzenedicarboxylic acid, bis(2-
U030	101-55-3	Benzene, 1-bromo-4-phenoxy-
U032	13765-19-0	Calcium chromate
U033	353-50-4	Carbonic oxyfluoride
U034	75-87-6	Acetaldehyde, Trichloro-
U035	305-03-3	Chlorambucil
U038	510-15-6	Chlorobenzilate
U039	59-50-7	Phenol, 4-chloro-3-methyl-
U042	110-75-8	2-Chloroethyl vinyl ether
U043	75-01-4	Vinyl Chloride
U047	91-58-7	beta-Chloronaphthalene
U048	95-57-8	Phenol, 2-chloro-
U049	3165-93-3	4-Chloro-o-toluidine, hydrochloride
U050	218-01-9	Chrysene
U051		Cresote
U058	50-18-0	Cyclophosphamide
U059	20830-81-3	Daunomycin
U060	72-54-8	DDD
U061	50-29-3	DDT
U062	2303-16-4	Diallate
U063	53-70-3	Dibenz[a,h]anthracene
U064	189-55-9	Dibenzo[a,i]pyrene
U068	74-95-3	Methane, dibromo-
U069	84-74-2	dibutyl phthalate
U074	764-41-0	1,4-Dichloro-2-butene (I,T)
U075	75-71-8	Dichlorodifluoromethane
U081	120-83-2	Phenol, 2,4-dichloro-
U082	87-65-0	Phenol, 2,6-dichloro-
U084	542-75-6	1,3-Dichloropropene
U085	1464-53-5	2,2'-Bioxirane

Dynecol, Inc.
Container Storage Facility - Anticipated Construction Schedule

N = DNR Notification for purposes of site inspection
Revised: January 18, 1990

Description	Weeks (following Permit issuance)																									
	2	4	6	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52
Site Survey & Soil Borings	X	X																								
Finalize Design		X	X																							
Site/Civil Design				X	X																					
Structural/Architectural					X	X																				
Mech/HV Design					X	X	X	X																		
Electrical					X	X	X	X																		
Review Final Design w/Dyn.							X	X																		
Building Permit								X	X	X																
Bid Package Preparation										X	X															
Bid Period								X	X	X	X															
Bid Evaluation/Award											X	X														
Mobilization													X	X	X											
Demolition & Underground Utilities														N	X	X										
Excavation & Foundations															N	X	X	X	X							
Masonry																	N	X	X	X	X					
Structural Steel																			X	X						
Roofing																				X	X	X				
Mechanical Fire Protection																					N	X	X	X	X	
Heating, Ventilation																						X	X	X		
Electrical																						X	X	X	X	
Interior Finishing																					X	X	X	X	X	X
Liner																						N	X	X	X	
Completion of Punch List																									X	N

Table A.1

Hazardous Waste Types for Storage in Containers
(Appendix C.1)

Waste Codes Acceptable for Storage Only

Hazardous Waste Code	Chemical Abstract Number	Description
P002	591-08-2	Acetamide, n-(aminothioxomethyl)-
P004	309-00-2	Aldrin
P008	504-24-5	4-Aminophyridine
P010	7778-39-4	Arsenic acid H_3AsO_4
P013	542-62-1	Barium cyanide
P016	542-88-1	Methane, oxybis(chloro-
P017	598-31-2	Bromoacetone
P021	592-01-8	Calcium cyanide
P024	106-47-8	p-Chloroaniline
P027	542-76-7	3-Chloropropionitrile
P029	544-92-3	Copper cyanide Cu(CN)
P030		Cyanides (soluble cyanide salts)
P031	460-19-5	Cyanogen
P033	507-77-4	Cyanogen chloride
P034	131-89-5	Phenol, 2 cyclohexyl-4,6-dinitro
P036	696-28-6	Dichlorophenylarsine
P038	692-42-2	Diethylarsine
P039	298-04-0	Disulfoton
P040	297-97-2	O,O-Diethyl O-pyrazinyl
P041	311-45-5	Diethyl p-nitrophenyl phosphate
P042	51-43-4	Epinephrine
P043	55-91-4	Diisopropylfluorophosphate (DFP)
P044	60-51-5	Dimethoate
P045	39196-18-4	2-Butanone, 3,3-dimenthyl
P046	122-09-8	alpha, alpha-Dimethylphenethylamine
P048	51-28-5	Phenol, 2,4-dinitro
P049	514-53-7	Dithiobiuret
P054	151-56-4	Aziridine
P057	640-19-7	Fluoroacetamide
P058	62-74-8	Fluoroacetic acid, sodium salt
P062	757-58-4	Hexaethyl tetraphosphate
P066	16752-77-5	Methomyl
P068	60-34-4	Hydrazine, methyl
P069	75-86-5	2-Methyllactonitrile
P071	298-00-0	Methyl parathion
P072	86-88-4	Alpha-Naphthylthiourea
P074	557-19-7	Nickel cyanide
P082	62-75-9	N-Nitrosodimethylamine
P084	4549-40-0	N-Nitrosomethylvinylamine
P088	145-73-3	Endothall
P092	62-38-4	Mercury (acetato-O)phenyl
P097	52-85-7	Famphur
P098	151-50-8	Potassium cyanide
P099	506-61-6	Potassium silver cyanide
P101	107-12-0	Ethyl cyanide
P102	107-19-7	Propargyl alcohol
P103	630-10-4	Selenourea
P104	506-64-9	Silver cyanide
P105	26628-22-8	Sodium azide
P106	143-33-9	Sodium cyanide
P109	3689-24-5	Tetraethyldithiopyrophosphate
P111	107-49-3	Diphosphoric acid, tetraethyl ester
P118	75-70-7	Trichloromethanethiol
P119	7803-55-6	Ammonium vanadate
P121	557-21-1	Zinc cyanide
P122	1314-84-7	Zinc phosphide Zn_3P_2

Waste Codes Acceptable for Bulking

Hazardous Waste Code	Chemical Abstract Number	Acceptable for Bulking	Description
U002	67-64-1	Y	Acetone (I)
U003	75-05-8	Y	Acetonitrile (I,T)
U007	79-06-1	Y	Acrylamide
U008	79-10-7	Y	Acrylic Acid (I)
U009	107-13-1	Y	Acrylonitrile
U012	62-53-3	Y	Aniline (I,T)
U019	71-43-2	Y	Benzene (I,T)
U025	111-44-4	Y	Dichloroethyl ether
U029	74-83-9	Y	Methyl bromide
U031	71-36-3	Y	n-Butyl alcohol (I)
U036	57-74-9	Y	Chlordane, alpha & Gamma isomers
U037	108-90-7	Y	Chlorobenzene
U041	106-89-8	Y	Epichlorohydrin
U044	67-66-3	Y	Chloroform
U045	74-87-3	Y	Methyl chloride (I,T)
U052	1319-77-3	Y	Cresol (Cresylic acid)
U055	98-82-8	Y	Cumene (I)
U056	110-82-7	Y	Cyclohexane (I)
U057	108-94-1	Y	Cyclohexanone (I)
U067	106-93-4	Y	Ethylene dibromide
U070	95-50-1	Y	o-Dichlorobenzene
U071	541-73-1	Y	m-Dichlorobenzene
U072	106-46-7	Y	p-Dichlorobenzene
U076	75-34-3	Y	Ethane, 1,1-dichloro-
U077	107-06-2	Y	Ethane, 1,2-dichloro-
U078	75-35-4	Y	1,1-Dichloroethylene
U079	156-60-5	Y	1,2-Dichloroethylene
U080	75-09-2	Y	Methylene chloride
U083	78-87-5	Y	Propylene dichloride
U093	60-11-7	Y	p-Dimethylaminoazobenzene
U102	131-11-3	Y	Dimethyl Phthalate
U103	77-78-1	Y	Dimethyl sulfate
U105	121-14-2	Y	2,4-Dinitrotoluene
U106	606-20-2	Y	2,6-Dinitrotoluene
U107	117-84-0	Y	Di-n-octyl phthalate
U108	123-91-1	Y	1,4-Dioxane
U112	141-78-6	Y	Ethyl acetate (I)
U113	140-88-5	Y	Ethyl acrylate (I)
U117	60-29-7	Y	Ethyl ether (I)
U122	50-00-0	Y	Formaldehyde
U123	64-18-6	Y	Formic acid (C,T)
U125	98-01-1	Y	Furfural (I)
U129	58-89-9	Y	Lindane
U131	67-72-1	Y	Hexachloroethane
U134	7664-39-3	Y	Hydrofluoric acid (C,T)
U138	74-88-4	Y	Methyl iodide
U140	78-83-1	Y	Isobutyl alcohol (I,T)
U144	301-04-2	Y	Lead acetate
U147	108-31-6	Y	Maleic anhydride
U151	7439-97-6	Y	Mercury
U154	67-56-1	Y	Methanol (I)

Waste Codes Acceptable for Bulking

Hazardous Waste Code	Chemical Abstract Number	Acceptable for Bulking	Description
U159	78-93-3	Y	Methyl ethyl ketone (MEK)(I,T)
U161	108-10-1	Y	Methyl isobutyl ketone (I)
U165	91-20-3	Y	Naphthalene
U167	134-32-7	Y	1-Naphthalenamine
U168	91-59-8	Y	2-Naphthalenamine
U169	98-95-3	Y	Nitrobenzene (I,T)
U171	79-46-9	Y	Nitropropane
U183	608-93-5	Y	Pentachlorobenzene
U188	108-95-2	Y	Phenol
U190	85-44-9	Y	Phthalic Anhydride
U191	109-06-8	Y	Pyridine, 2-methyl-
U201	108-46-3	Y	Resorcinol
U202	81-06-2	Y	Saccharin & salts
U204	7783-00-8	Y	Selenious acid
U205	7488-56-4	Y	Selenium sulfide
U207	95-94-3	Y	1,2,4,5-Tetrachlorobenzene
U208	630-20-6	Y	1,1,1-2-Tetrachloroethane
U209	79-34-5	Y	1,1,2,2-Tetrachlorethane
U210	127-18-4	Y	Tetrachloroethylene
U211	56-23-5	Y	Carbon tetrachloride
U213	109-99-9	Y	Tetrahydrofuran (I)
U214	563-68-8	Y	Thallium(I) acetate
U215	6533-73-9	Y	Thallium(I) carbonate
U220	108-88-3	Y	Toluene
U22`	25376-45-8	Y	Toluenediamine
U225	75-25-2	Y	Bromoform
U226	71-55-6	Y	Methyl chloroform
U227	79-00-5	Y	1,1,2-Trichloroethane
U228	79-01-6	Y	Trichloroethylene
U239	1330-20-7	Y	Xylene (I)
U244	137-26-8	Y	Thiram
U248	81-81-2	Y	Warfarin & salts, when present at concentrationsof 3% or less
U328	95-53-4	Y	o-Toluidine
U353	106-49-0	Y	p-Toluidine
U359	110-80-5	Y	Ethylene glycol monoethyl ether

Waste Codes Acceptable for Storage Only

Hazardous Waste Code	Chemical Abstract Number	Description
U001	75-07-0	Acetaldehyde (1)
U004	98-86-2	Acetophenone
U005	53-96-3	2-Acetylaminofluorene
U010	50-07-7	Mitomycin C
U011	61-82-8	Amitrole
U014	492-80-8	Auramine
U015	115-02-6	Azaserine
U016	225-51-4	Benz(c)acridine
U017	98-87-3	Benzal chloride
U018	56-55-3	Benz(a)anthracene
U020	98-09-9	Benzenesulfonic acid chloride (C,R)
U021	92-87-5	Benzidine
U022	50-32-8	Benzo(a)pyrene
U024	111-91-1	Dichloromethoxy ethane
U026	494-03-1	Chlornaphazin
U027	108-60-1	Dichloroisoprophy ether
U028	117-81-7	1,2-Benzenedicarboxylic acid, bis(2-
U030	101-55-3	Benzene, 1-bromo-4-phenoxy-
U032	13765-19-0	Calcium chromate
U033	353-50-4	Carbonic oxyfluoride
U034	75-87-6	Acetaldehyde, Trichloro-
U035	305-03-3	Chlorambucil
U038	510-15-6	Chlorobenzilate
U039	59-50-7	Phenol, 4-chloro-3-methyl-
U042	110-75-8	2-Chloroethyl vinyl ether
U043	75-01-4	Vinyl chloride
U047	91-58-7	beta-Chloronaphthalene
U048	95-57-8	Phenol, 2-chloro-
U049	3165-93-3	4-Chloro-o-toluidine, hydrochloride
U050	218-01-9	Chrysene
U051		Cresote
U058	50-18-0	Cyclophosphamide
U059	20830-81-3	Daunomycin
U060	72-54-8	DDD
U061	50-29-3	DDT
U062	2303-16-4	Diallate
U063	53-70-3	Dibenz(a,h)anthracene
U064	189-55-9	Dibenzo(a,i)pyrene
U068	74-95-3	Methane, dibromo-
U069	84-74-2	dibutyl phthalate
U074	764-41-0	1,4-Dichloro-2 butene (I,T)
U075	75-71-8	Dichlorodifluoromethane
U081	120-83-2	Phenol, 2,4-dichloro-
U082	87-65-0	Phenol, 2,6-dichloro-
U084	542-75-6	1,3-Dichloropropene
U085	1464-53-5	2,2'-Bioxirane

Waste Codes Acceptable for Storage Only

Hazardous Waste Code	Chemical Abstract Number	Description
U086	1615-80-1	Hydrazine, 1,2-dimethyl-
U087	3288-58-2	Phosphorodithioic acid, O,O-diethyl
U088	84-66-2	Diethyl phthalate
U089	56-53-1	Diethylstibesterol
U090	94-58-6	Dihydrosafrole
U091	119-90-4	3,3'-Dimethoxybenzidine
U092	134-40-3	Dimethylamine (I)
U094	57-97-6	7,12-Dimethylbenz(a)anthracene
U095	119-93-7	3,3'-Dimethylbenzidine
U096	80-15-9	Hydroperoxide, 1-methyl-1-phenylethy
U097	79-44-7	Dimethylcarbamoyl chloride
U099	540-73-8	Hydrazine, 1,2-dimethyl-
U101	105-67-9	2,4-Dimethylphenol
U109	122-66-7	Hydrazine, 1,2-dimethyl-
U110	142-84-7	Dipropylamine (I)
U111	621-64-7	Di-n propylnitrosamine
U114	111-54-6	Carbamodithioic acid, 1,2-ethanediyl
U116	96-45-7	Ethylenethiourea
U118	97-63-2	Ethyl methacrylate
U119	62-50-0	Ethyl methanesulfonate
U120	206-44-0	Fluoranthene
U121	75-69-4	Methane, trichlorofluoro-
U124	110-00-9	Furfuran (I)
U126	765-34-4	Glycidylaldehyde
U127	118-74-1	Hexachlorobenzene
U128	87-68-3	Hexachlorobutadiene
U132	70-30-4	Phenol, 1,1'-methylenebis(3,4,6-tric
U133	302-01-2	Hydrazine (R,T)
U135	7783-06-4	Hydrogen sulfide
U136	75-60-5	Cacodylic acid
U137	193-39-5	Indeno (1,2,3-cd)pyrene
U139	9004-66-4	Iron dextran
U141	120-58-1	Isosafrole
U143	303-34-4	Lasiocarpine
U145	7446-27-7	Lead phosphate
U146	1335-32-6	Lad subacetate
U148	123-33-1	Maleic hydrazide
U149	109-77-3	Malononitrile
U150	148-82-3	Melphalan
U152	126-98-7	Methacrylonitrile (I,T)
U153	74-93-1	Methanethiol (I,T)
U155	91-80-5	Methapyrilene
U156	79-22-1	Methyl chlorocarbonate (I,T)
U157	56-49-5	3-Methylcholanthrene
U158	101-14-4	4,4-Methylenebis(2-chloroaniline)
U162	80-62-6	Methyl methacrylate (I,T)
U163	70-25-7	MNNG
U164	56-04-2	Methylthiouracil
U166	130-15-4	1,4-Naphthalenedione
U170	100-02-7	Phenol, 4-nitro-

Waste Codes Acceptable for Storage Only

Hazardous Waste Code	Chemical Abstract Number	Description
U172	924-16-3	N-Nitrosodi-n-butylamine
U173	1116-54-7	N-Nitrosodiethanolamine
U174	55-18-5	N-Nitrosodiethylamine
U176	759-73-9	Urea, N-ethyl-N-nitroso-
U177	684-93-5	Urea, N-methyl-N-nitroso-
U178	615-53-2	N-Nitroso-N-methylurethane
U179	100-75-4	Nitrosopiperidine
U180	930-55-2	Pyrrolidine, 1-nitroso-
U181	99-55-8	5-Nitro-o-toluidine
U182	123-63-7	Paraldehyde
U184	76-01-7	Pentachlorothane
U185	82-68-8	Pentachloronitrobenzene (PCNB)
U186	504-60-9	1-Methylbutadiene (I)
U186	504-60-9	1,3-Pentadiene (I)
U187	62-44-2	Phenacetin
U189	1314-80-3	Phosphorus sulfide (R)
U192	23950-58-5	Pronamide
U193	1120-71-4	1,3-Propane sultone
U194	107-10-8	1-Propanamine (I,T)
U197	1-7-51-4	p-Benzoquinone
U200	50-55-5	Reserpine
U203	94-59-7	Safrole
U206	18883-66-4	Streptozotocin
U216	7791-12-0	Thallium(I) chloride
U217	10102-45-1	Thallium(I) nitrate
U218	62-55-5	Thioacetamide
U219	62-56-5	Thiourea
U222	636-21-5	o-Toluidine hydrochloride
U234	99-35-4	1,3,5-Trinitrobenzene (R,T)
U235	126-72-7	Trist (2,3-dibromopropyl) phosphate
U236	72-57-1	Trypan blue
U238	51-79=6	Ethyl carbamate (urethane)
U240	94-75-7	2,4D, salts & esters
U243	1888-71-7	Hexachloropropene
U246	506-68-3	Cyanogen bromide (CN) Br
U249	1314-84-7	Zinc phosphide Zn_3P_2, when present at concentrations of 10% or less

Hazardous Waste Codes from Specific Sources

K Waste Codes Acceptable for Bulking

K001	K017	K029	K116	K037	K049
K002	K018	K095	K117	K038	K050
K003	K019	K096	K118	K039	K051
K004	K020	K030	K136	K040	K052
K005	K021	K083	K071	K041	K062
K006	K022	K103	K073	K098	K100
K008	K023	K104	K106	K042	K084
K009	K024	K085	K031	K043	K101
K010	K093	K105	K032	K099	K102
K011	K094	K111	K033	K123	K086
K013	K025	K112	K034	K124	K087
K014	K026	K113	K097	K125	
K015	K027	K114	K035	K126	
K016	K028	K115	K036	K048	

K Waste Codes Acceptable for Storage Only

K007
K060
K061
K069

Waste Codes Acceptable for Bulking

Hazardous Waste Code	Acceptable for Bulking	Waste Description
D001	Y	Characteristic of ignitability with flashpoint $\geq 90^{o}F$
D002	Y	Inorganic solutions, pH ≤ 2.0 or pH ≥ 12.5
D004	Y	Inorganic solution & sludges, arsenic
D005	Y	Inorganic solution & sludges, barium
D006	Y	Inorganic solution & sludges, cadmium
D007	Y	Inorganic solution & sludges, chromium
D008	Y	Inorganic solution & sludges, lead
D009	Y	Inorganic solution & sludges, mercury
D010	Y	Inorganic solution & sludges, selenium
D011	Y	Inorganic solution & sludges, silver
D012	Y	Characteristic of EP toxicity, Endrin
D013	Y	Characteristic of EP toxicity, Lindane
D014	Y	Characteristic of EP toxicity, Methoxychlor
D015	Y	Characteristic of EP toxicity, Toxaphene
D016	Y	Characteristic of EP toxicity, 2,4-D
D017	Y	Characteristic of EP toxicity, 2.4.5-TP
001D	Y	Inorganic solution & sludges, copper
003D	Y	Inorganic solution & sludges, zinc

Waste Codes Acceptable for Storage Only

Hazardous Waste Code	Waste Description
D001	Characteristic of ignitability with flashpoint $<90^{o}F$
D003	Characteristic of reactivity

APPENDIX C.1

Acceptable Hazardous Waste Types - Container Storage Facility

TABLE L.3

SAMPLE PRESERVATION AND ANALYTICAL PROCEDURES

Measurement	Container[a]	Preservative[b]	Holding Time[c]	Sample Size (ml)	Reference
Mercury, arsenic selenium	P,G 0.05% $K_2Cr_2O_7$	HNO_3 to pH<2	28 days	100(for all 3)	303E; F(1)
Metals[d], except above	P,G	HNO_3 to pH<2	6 months	100 each 303 A-E (1)	200-289 (2)
ChlorideP,G	None required	28 days	50	407 A;B;D(1)	
Nitrate P,G	Cool, 4°C	48 hours	100	418 C; F (1)	
Bicarbonate alkalinity	P,G	Cool, 4°C	14 days	250	403 (1)
Sulfate P,G	Cool, 4°C	28 days	50	407 A; B; D (1)	
Specific conductance	P,G	Cool, 4°C	28 days	100	205 (1)
Hydrogen ion (pH)	P,G	Determine on site	2 hours	25	423 (1)

a Polyethylene (P) or glass (G).

b Sample preservation should be performed immediately upon sample collection. For composite samples, each aliquot should be preserved at the time of collection. When use of an automatic sampler makes it impossible to preserve each aliquot, then samples may be preserved by maintaining at 4°C until compositing and sample splitting is completed.

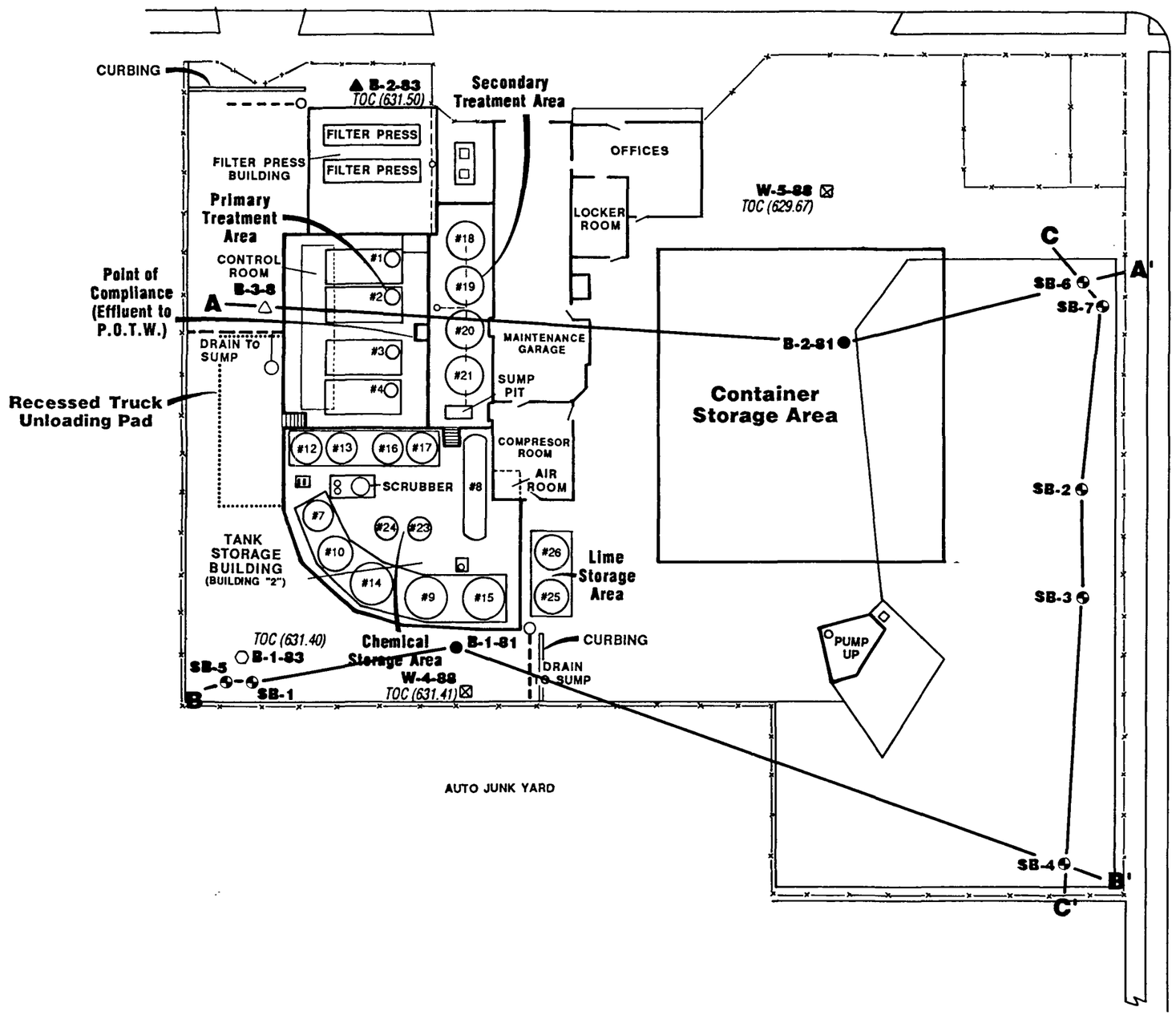
c Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still be considered valid. Samples may be held for longer periods only if the permitted, or monitoring laboratory, has data on file to show that the specific types of samples under study are stable for the longer time. Some samples may not be stable for the maximum time period given in the table. A permitted, or monitoring laboratory, is obligated to hold the sample for a shorter time if knowledge exists to show this is necessary to maintain sample stability.

d Samples should be filtered immediately on site before adding preservative for dissolved metals.

Source: Guidelines Establishing Test Procedures for the Analysis of Pollutants; Proposed Regulations. 40 CFR, Part 136, October 26, 1984.

Method References

(1) "Standard Methods for the Examination of Water and Wastewater", 15th edition; APHA, AWWA, QWPCF, 1980.
?) "Methods for Chemical Analysis of Water and Wastes", USEPA-600/4-79-020; revised March, 1982.



LEGEND

- ● Soil Boring (previous study)
- △ Soil Boring Converted to Monitoring Well (7/81)
- ▲ Monitoring Welll (previous study)
- ◐ Soil Boring
- ⊠ Monitoring Well
- TOC (631.40) Top of Casing Elevation in Feet (USGS)
- A—A' Cross Section Trace
- ○ Piezometer

N

0 20 40 80

Scale in Feet

Figures A.2, E.2, G.1, I1, L.1, F.1

Site Map

Dynecol, Inc.
Detroit, Michigan

March, 1988 20878

EDI Engineering & Science

E-1 INTRODUCTION

The Dynecol, Inc. facility, formerly called Waste Acid, Inc., functions as a commercial hazardous waste treatment facility located in Detroit, Michigan (Figure E.1). Dynecol currently receives wastes, typically corrosive and metal-bearing aqueous waste streams , which are treated on site. The treated effluent is discharged to the City of Detroit sanitary sewer system. Any sludges resulting from the process are disposed of in either a hazardous or solid waste landfill. Waste treatment activities at Dynecol involve primarily pickle liquor neutralization. The process consists of metals and solids removal and pH adjustment. ~~As part of this Act 64 Operating License Reapplication, Dynecol is transferring storage capacity from the existing tank storage and treatment facility to a~~ container storage area.

All treatment and storage of waste materials at Dynecol's facility is carried out in enclosed tanks. These tanks rest upon treated concrete slabs and are contained within concrete walled dikes. Specific dimensions and containment volumes of the diked areas within the treatment facility are outlined in Section D, Process Information. The truck unloading operations take place upon a recessed concrete pad (Figure E.2). This pad is further contained by curbed perimeter and lateral, recessed drains which flow to recovery sumps.

The following is a hydrogeological investigation in support of the Act 64 Operating License Reapplication for Dynecol's facility.

E-1a Site Location

The Dynecol facility occupies approximately 1.7 acres of land in the SE 1/4 of the SW 1/4 of Section 21, Township 1 S, Range 12 E, Wayne County Michigan (Figure E.3). The site is located approximately one mile east of Hamtramck, Michigan in a mixed industrial/residential area (see Figure E.4). A more thorough description of land use in the surrounding area can be found in Section J, Environmental Assessment.

E-1b Purpose

The purpose of this hydrogeological report is to fulfill the requirements associated with Dynecol's Operating License Reapplication including the requirements for a hazardous waste container storage area/transfer station. The following are the goals of the hydrogeological report as they relate to Dynecol's facility:

- determine the areal and vertical extent of soils which may assimilate and transmit hazardous waste constituents in the event of a release;

HCl of 5.0 ppm. In response to a spill of this magnitude, the employees would implement the Contingency Plan/Emergency Procedures as identified in the Section G. Employees will be provided with personal protective equipment, as specified in Section G.

Because the vapor pressures of both sulfuric and nitric acid are much less than the vapor pressure of HCl, massive spills of these materials would pose no air quality problems for employees or the general public.

The vapor pressure of hydrochloric acid at 40°C and 5 percent concentration is 0.0043 mmHg. The concentration of HCl in air immediately above and in equilibrium with this HCl solution is:

$$0.0043 \text{ mm Hg}/760 \text{ mm Hg} = 5.7 \times 10^{-6} \text{ mole HCl/mole air}$$
$$= 5.7 \text{ ppm of HCl}$$

Note that the concentration of HC1 would theoretically equal this value in a very thin layer of air above the solution. Dilution with air above this thin layer will result in HCl concentration at breathing level, about five feet above the spill, to be much less than the theoretically calculated concentration.

D-2e(vi) Potential for Waste Material to Damage the Structural Integrity of a Containment Vessel

There is little potential for waste material or treatment reagents to damage the structural integrity of the vessels used to store or treat the hazardous wastes processed at this facility. All vessels are either constructed of corrosion-resistant material or are lined with corrosion-resistant linings. Materials handled at the facility and placed in tanks will not react with or otherwise damage the integrity of the tanks.

D-2f Containment and Detection of Releases

Concrete dike walls that have been lined with a corrosion-resistant coating completely surround and enclose the process and storage tanks, providing secondary containment capacity of 150% of the total volume of the hazardous wastes contained in the tanks. The four 20,000-gallon primary treatment tanks are located within a concrete diked structure that provides secondary containment for 100,159 gallons (five times the capacity of the largest container). The four 20,000-gallon secondary treatment tanks are located within a building possessing concrete secondary containment for 32,948 gallons (more than 150% of the capacity of the largest container). The storage tanks are located in Building A within a containment structure that is able to contain 98,032 gallons (more than 150% the capacity of the largest tank).

Appendix D-2d contains illustrations, dimensions, and calculations for the secondary containment structures that are provided for the treatment and storage tanks at the Dynecol facility.

The dewatering and filtration process is carried out in batches staggered among any of the three filter presses. After secondary treatment is complete, the contents of a secondary treatment vessel are pumped into the filter press by means of an air diaphragm pump. The completion of the filtration cycle is indicated by the feed pump discharge whenever a pressure of 100 psi is reached and no more liquid can be pumped. The filter is then opened, and dewatered sludge is allowed to fall into the sludge-hauling trailer or roll-off box located directly below each filter. The dewatered sludge is transported to an acceptable facility for ultimate disposal.

The dewatered sludge roll-off box area below the filter presses is cleaned daily and additionally as necessary to prevent the track-out of sludges. Wash waters are collected in the sump and reprocessed through the treatment system.

The listed hazardous wastes, F006 and F019, generate a sludge which is by definition a hazardous waste. These waste streams are segregated from all other waste streams delivered to the Dynecol facility. To assure proper segregation of these listed wastes during treatment and disposal, the following procedures have been implemented.

- Waste loads delivered to the facility which are identified as F006 and F019 and are found to be acceptable for treatment, are unloaded into Tank #1 for primary treatment. Tank #2 may, if necessary, be used for segregated primary treatment as a backup.

- After primary treatment in Tank #1 (or Tank #2), the listed waste is pumped into Tank #18 for secondary treatment. Tank #19 may, if necessary, be used for segregated treatment as a backup.

- After secondary treatment in Tank #18 (or Tank #19), the treated waste is dewatered through Filter Press B. The dewatered solids from Filter B are collected in a container designated for disposal at a licensed hazardous waste facility.

- To decontaminate all process tankage and equipment used in the treatment of F006 or F019 wastes, the following procedure is used:

    (1) Perform a visual inspection of tankage and equipment to determine its condition and presence of residues.

    (2) Estimate the volume of all tank heel material.

    (3) Flush the tank system with a volume of clean water greater than the heel estimated in #2.

(4) Pump off this cleaning solution.

(5) Flush a second time with clean water as in #3 and pump off.

(6) If pH is of concern regarding incompatibility, a lime slurry of at least the estimated tank heel from #2 will be added to the tank system.

Dewatered solids from the decontamination process are collected and handled in the same manner as the F006 and F019 dewatered solids.

The contents of this container are manifested as F006 and F019, as appropriate, and shipped to a licensed hazardous waste facility for disposal. An operating log is used to track the movement of each waste load received at the facility. This log is used by operating personnel to track and control the movement of F006 and F019 waste loads through the process equipment, and to repeat the process cycle through the same equipment during the decontamination cycle. The log is also used by management to verify that segregation and decontamination procedures are being properly implemented.

D-2d Tank Management Practices [40 CFR 270.16(d) and (e), 264.194(b)]

Various operating practices and controls are implemented by Dynecol to prevent overfilling. Waste material is transferred manually from the primary treatment tank to a designated secondary treatment vessel through a flexible hose and the use of a ten horsepower pump. Each treatment tank has its own pipeline with fittings and valves properly labeled. The following equipment and devices are used for monitoring and controlling safety cut-off during material flows: level switch, pneumatic activated valve with manual override and limit switches, manual valve, and solenoid valve. To control the pressure, the following devices are used: pressure indicating transmitter, manual pumping, and atmospheric vents. High level alarms and indicator lights are automatically activated whenever a secondary tank reaches capacity during material feeding. Common valves and pipes are designed so that material flows cannot cross over. An alarm will sound, which cannot be easily silenced, whenever a sequence of events is not followed during material flow.

In the primary treatment tanks a high-level sensor control activates/deactivates the solenoid control valve on the compressed air piping system. Since compressed air is used to off-load tanks to the primary tanks, this control system will automatically prevent the overfill of the primary tanks.

TABLE C.8
CHEMICAL CHARACTERIZATION HIERARCHY
FOR STORAGE IN THE HAZARDOUS WASTE CONTAINER STORAGE FACILITY

Waste Characterization	PCB	Cyanide	Oxidation Potential	pH	Flash Point	Water Reactive	Non-Flam Organic	Label
Radioactive	*	*	*	*	*	*	*	Reject
Dioxins	*	*	*	*	*	*	*	Reject
Explosive	*	*	*	*	*	*	*	Reject
Extremely Hazardous Material**	*	*	*	*	*	*	*	Reject
PCB	≥50ppm	*	*	*	*	*	*	Reject
Cyanide	<50ppm	20ppm	*	*	*	*	*	Cyanide Waste
Corrosive Oxidizer	<50ppm	<20ppm	≥50mV	0-2	*	*	*	Corrosive Oxidizer
Non-Corrosive Oxidizer	<50ppm	<20ppm	≥50mV	3-14	*	*	*	Non-Corrosive Oxidizer
Corrosive Acid	<50ppm	<20ppm	<50mV	0-2	*	*	*	Corrosive Acid
Corrosive Base	<50ppm	<20ppm	<50mV	12.5-14	*	*	*	Corrosive Base
Flammable	<50ppm	<20ppm	<50mV	3-12.5	≥ 100°F	*	*	Flammable Waste
Water Reactive	<50ppm	<20ppm	<50mV	3-12.5	<100°F	Yes	*	Water-Reactive Waste
Non-Flammable	<50ppm	<20ppm	<50mV	3-12.5	<100°F	No	Yes	Non-Flammable Organic
Dilute Aqueous Waste	<50ppm	<20ppm	<50mV	3-12.5	<100°F	No	No	Dilute Aqueous Waste

* Result irrelevant: prior category has greater importance.

** Extremely hazardous wastes are considered to be those hazardous wastes which are not found in Table A.1, Section A, "Approved Hazardous Wastes for Container Storage"

- Extremely Hazardous Wastes (refer to the approved waste code listing in Section A, Table A.1). "Extremely hazardous wastes" are considered to be those wastes which are not found in Table A.1).

- PCB Wastes over 50 parts per million (ppm)

2. Cyanide Wastes are defined as those wastes containing greater than 20 ppm cyanide and are stored in a separate bay labeled "Cyanide Waste". This bay is located in one corner of the container storage building and acid-bearing wastes are not stored adjacent to or across the aisle from the cyanide bay.

3. Wastes with an oxidation potential of 50 millivolts (mV) or higher when measured in a 0.001 Normal solution of ferrous ammonium sulfate are considered to be oxidizing wastes. Waste with a pH of less than two standard units are labeled a "Corrosive Oxidizer", whereas wastes with a pH greater than 2 are labeled "Non-Corrosive Oxidizer".

4. Wastes with a pH of two or less will be stored in a bay labeled "Corrosive Acid". Wastes having a pH of 12.5 or higher are labeled and stored as "Corrosive Base".

5. Flammable wastes are defined as having a flash point of less than 100ÁF. All flammable wastes are isolated in a bay labeled "Flammable Waste".

6. All wastes which exhibit reactive characteristics with water are stored separately in a bay labeled "Water-Reactive Wastes".

7. Wastes considered organic and non-flammable are stored in a bay labeled "Non-Flammable Organics".

C-4b(iv) Storage Requirements

The containerized wastes are stored solely for the purpose of the accumulation of such quantities of hazardous wastes as necessary to facilitate proper treatment or disposal. These wastes are not stored for more than one year. All containers are clearly marked to identify their contents and storage start dates.

C-4b(v) Recordkeeping

Dynecol maintains a copy of the notice required by the generator under 40 CFR 268.7 in the operating records. Waste analysis data is also kept on file.

Dynecol maintains copies of all notices, certifications, demonstrations, waste analysis data, and other applicable documentation for treatment residues which are sent to off-site treatment, storage, or disposal facilities. These files are kept for a minimum of 5 years.

C-5 Compatibility Evaluation Procedure for Containerized Storage Facility

Many containerized wastes which may be potentially stored at Dynecol are considered incompatible and must be properly segregated even during short-term storage to minimize or eliminate the potential for release of toxic gases, explosion or fire. Dynecol adheres to the following compatibility evaluation to maintain the proper segregation of containerized wastes stored in the container storage facility.

Since the waste characteristics must be fully defined prior to acceptance of a waste, Dynecol's "Waste Analysis Form" which is completed by the generator is the primary source of waste characterization information. Table C.8 summarizes the waste characterization criteria and the order of consideration Dynecol uses to screen and label each waste prior to storage. In addition, randomly selected containers from each arriving load are sampled to confirm the waste characteristics presented by the generator as described in Section C-2e.

C-5a CHARACTERIZATION SCHEME

Wastes are evaluated according to the following characterization scheme and either rejected or placed into a storage bay labeled for that waste type.

1. Initial Acceptability Test: The following waste types are not accepted under any circumstances:

    - Radioactive Wastes
    - Dioxin Wastes
    - Explosive Wastes

Comparison to Retained Reference Sample. A recent sample of the waste stream typically produced by generator which is contained in a clear plastic 8 ounce jar and labeled with the name of the generator, the date of the sample, and the hazardous waste number of the material is provided by the generator. The appearance of the sample as determined by visual inspection is compared with that of the retained sample of the material including:

- color,
- clarity,
- phase separation, and
- suspended and settled solids

Sample Odor. Odor of the sample compared with that of the retained sample including:

- organic or solvent type odors and
- any other unusual odor

Inspection and testing procedures are modified slightly whenever a load of F006 or F019 waste is delivered to the facility which has not been certified to contain no detectable amount of cyanide. The odor of a sample of this material is not inspected, and cyanide testing is conducted prior to unloading.

pH. pH of the sample is compared to both the retained sample and the waste characterization analysis. pH is determined by using a calibrated pH meter in accordance with Method 9040 of SW846 or by using litmus paper sensitive to 0.5 pH units.

Fingerprint Analyses. Each waste shipment that passes the initial inspection steps outlined above will be sampled, and the samples will be analyzed for waste verification parameters. The selection of these waste verification parameters is based on the need to identify restricted wastes and waste characteristics that will affect the treatability of the wastes at Dynecol. Sampling procedures are described in Section C-2c(ii) of this Waste Analysis Plan.

Waste verification parameters are a subset of the parameters required for proper waste characterization. The waste verification parameters and tests for wastes to be treated at Dynecol are pH, volatile organic compounds, percent solids, pumpability, and cyanide (for F006 and F019 wastes only).

Waste shipments are only accepted for treatment when the following finger print analyses criteria are met:

- the pH of a normally acidic waste stream is less than 7.0;
- the pH of a normally alkaline waste stream is greater than 7.0;
- the waste exhibits no evidence of organic contamination such as phase separation;

- the waste exhibits no uncharacteristic, organic, or solvent odor;
- the solids content of the waste is within ± 10 percent of the solids content of the retained sample and the waste characterization analysis;
- the pumpability of the waste is within ± 10 percent of the pumpability of the normal waste stream as indicated in the waste characterization records; and
- the F006 or F019 wastes contain less than 20 ppm of cyanide.

In addition to these waste characterization procedures, the generator's site and processes are reviewed prior to accepting a waste for treatment to determine all potential hazardous contaminants, as well as possible variations in the levels of contaminants and the proper hazardous waste designation. Management personnel are interviewed regarding the description and characterization of the materials and any variations that may occur.

For electroplating and aluminum conversion coating process wastes that are being considered for treatment at Dynecol, the generator's facility is inspected and evaluated in order to determine the potential for cyanide contamination in the waste stream. If there is no possibility of cyanide or cyanide compounds in the waste stream, it will be so designated in the waste characterization report and will be verified by the initial waste analysis.

If there is a possibility of cyanide or its compounds entering the waste stream the wastes must be analyzed to determine if the waste containing greater than 20 ppm of cyanide or its compounds. Wastes that exceed this concentration will not be accepted for treatment at Dynecol.

Wastes Accepted for Storage in Container Storage Area. Randomly selected containers from each arriving load of a waste from a generator are sampled. The frequency of sampling will be based upon the following criterion: ten percent of all containers per waste code, per generator and per shipment. Drums are selected for sampling using the simple random sampling methods for containers described in "Test Methods for Evaluating Solid Wastes Physical/Chemical Methods", 3rd Edition (U.S. EPA Office of Water and Waste Management, SW-846, 1986) Section 1.4.1. Simple random sampling requires use of the random numbers table and procedures presented in Table C.4.

The volume of the containers is typically 30 or 55 gallons and the contents are accessible for sampling through the opened top or bung. Since each load of similar material from a generator is considered homogeneous, representative samples can be obtained by sampling a vertical volume from a randomly selected subset of drums in the shipment. For shipments of less than 100 drums the number of samples taken equals square root of the number of drums in the shipment. For shipments of 100 or more drums, 10 percent of the drums are sampled.

Lab-packs are always packed at the generator's facility and are packed by trained chemists using specific procedures. An inventory of all wastes put in each lab pack is made at the time of packing, and this inventory is the information that is used to screen the waste .

Hazardous Waste Codes from Specific Sources

K Waste Codes Acceptable for Bulking

K001	K017	K029	K116	K037	K049
K002	K018	K095	K117	K038	K050
K003	K019	K096	K118	K039	K051
K004	K020	K030	K136	K040	K052
K005	K021	K083	K071	K041	K061
K006	K022	K103	K073	K098	K062
K008	K023	K104	K106	K042	K069
K009	K024	K085	K031	K043	K100
K010	K093	K105	K032	K099	K084
K011	K094	K111	K033	K123	K101
K013	K025	K112	K034	K124	K102
K014	K026	K113	K097	K125	K086
K015	K027	K114	K035	K126	K087
K016	K028	K115	K036	K048	

K Waste Codes Acceptable for Storage Only

K007
K060

Waste Codes Acceptable for Bulking

Hazardous Waste Code	Acceptable for Bulking	Waste Description
D002	Y	Inorganic solutions, pH $\leq$ 2.0 or pH $\geq$ 12.5
D004	Y	Inorganic solution & sludges, arsenic
D005	Y	Inorganic solution & sludges, barium
D006	Y	Inorganic solution & sludges, cadmium
D007	Y	Inorganic solution & sludges, chromium
D008	Y	Inorganic solution & sludges, lead
D009	Y	Inorganic solution & sludges, mercury
D010	Y	Inorganic solution & sludges, selenium
D011	Y	Inorganic solution & sludges, silver
D012	Y	Characteristic of EP toxicity, Endrin
D013	Y	Characteristic of EP toxicity, Lindane
D014	Y	Characteristic of EP toxicity, Methoxychlor
D015	Y	Characteristic of EP toxicity, Toxaphene
D016	Y	Characteristic of EP toxicity, 2, 4-D
D017	Y	Characteristic of EP toxicity, 2.4.5-TP
001D	Y	Inorganic solution & sludges, copper
003D	Y	Inorganic solution & sludges, zinc

Waste Codes Acceptable for Storage Only

Hazardous Waste Code	Waste Description
D001	Characteristic of ignitability
D003	Characteristic of reactivity

APPENDIX C.1

Acceptable Hazardous Wastes Types - Container Storage Facility

APPENDIX D.1c

MATERIAL SPECIFICATIONS; INSTALLATION METHODS FOR PROPOSED CONTAINER STORAGE FACILITY

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Division

SECTION 03300 CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 DESCRIPTION:

A. The work includes all cast-in-place concrete.

1.02 SUBMITTALS:

A. Submit proposed mix design prepared by an approved independent testing firm for each class of concrete. Proportions shall be selected according to ACI 301-84, SECTION 3.9, Method 1 or Method 2. No concrete shall be placed until approval is obtained from the ENGINEER.

B. Submit shop drawings showing all fabrication dimensions and locations for placing the reinforcing steel and accessories. Approval from the ENGINEER shall be obtained before fabrication. Details of reinforcement and accessories not covered herein shall be in accordance with ACI 315.

C. Submit certifications for the following:
   1. Cement.
   2. Aggregates.
   3. Admixtures.
   4. Reinforcement: Mill test report.

1.03 REFERENCES:

A. ACI 211.1, "Recommended Practice for Selecting Proportions for Normal Weight Concrete".

B. ACI 212, "Guide for Use of Admixtures in Concrete".

C. ACI 302, "Recommended Practice for Floor and Slab Construction".

D. ACI 347, "Recommended Practice for Concrete Form work".

E. ACI 304, "Recommended Practice for Measuring, Mixing and Placing Concrete".

F. ACI 304.2R "Placing Concrete by Pumping Methods".

G. ACI 305, "Recommended Practice for Hot-Weather Concreting".

H. ACI 306, "Recommended Practice for Cold-Weather Concreting".

I. ACI 309, "Consolidation of Concrete".

J. ACI 308, "Recommended Practice for Curing Concrete".

K. ACI 318, "Building Code Requirements for Reinforced Concrete".

L. ACI 301, "Specifications for Structural Concrete for Buildings".

1.04 JOB CONDITIONS:

A. Construction loads shall not exceed the superimposed load which any member, with necessary supplemental support, is capable of carrying safely and without damage.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Concrete:

1. Cement shall conform to ASTM C150 or ASTM C595 (maximum fly ash content shall be 20% by weight). All cement used in exposed concrete shall be of the same brand from the same mill.
2. Coarse aggregate shall conform to MDOT 6A or 6AA.
3. Fine aggregate shall conform to MDOT 2NS.
4. Mixing water shall be clean, fresh, and potable.
5. Admixtures, if used, shall conform to the appropriate specifications listed below:
   a. Air-entraining admixtures: ASTM C260.
   b. Pozzolanic admixtures: ASTM C618, Type F, except that loss on ignition shall not exceed 4%.
   c. Water Reducing Admixture: "Eucon WR-75" by the Euclid Chemical Co., "Pozzolith 200N" by Master Builders or "Plastocrete 160" by Sika Chemical Corp. The admixture shall conform to ASTM C494, Type A and not contain more chloride ions than are present in municipal drinking water.
   d. High Range Water Reducing Admixture (Superplasticizer): "Eucon 37" by Euclid Chemical Co., "Rheobuild" by Master Builders, or "Sikament" by Sika Chemical Corp. The admixture shall conform to ASTM C494, Type F or G, and not contain more chloride ions than are present in municipal drinking water.
   e. Water Reducing, Retarding Admixture: "Eucon by Master Builders or "Plastiment" by Sika Chemical Corp. The admixture shall conform to ASTM C494, Type D and not contain more chloride ions than are present in municipal drinking water.
   f. Non-Corrosive, Non-Chloride Accelerator: The admixture shall conform to ASTM C494, Type C or E, and not contain

more chloride ions than are present in municipal drinking water.

g. Prohibited admixtures: Calcium chloride, thiocyanates or admixtures containing more than 0.05% chloride ions are not permitted.

6. All materials used in the work shall be of the same composition as used in establishing the mix design.

B. Reinforcement:

1. Reinforcing bars shall be deformed bars conforming to ASTM A615 or A616, Grade 60.
2. Welded wire fabric shall conform to ASTM A185.

C. Accessories:

1. Tie wire: Minimum 16 gage annealed type.
2. Chains, bar supports, bolsters, spacers: Per CRSI Manual of Standard Practice, Class C for structural slabs, Class A, for slabs-on-grade.
3. Form ties: Water seal snap form ties with minimum 1 inch diameter steel or neoprene collar at mid-point required for walls subject to hydrostatic pressure.

D. Premolded Joint Filler:

1. Shall conform to ASTM D1751 (non-extruding, bituminous type) for exterior applications.
2. Shall conform to ASTM D1752 (non-extruding, non-bituminous type) for interior applications.

E. Joint Sealant: Semi-rigid, non-tracking type: W.R. Meadows "Sealtight Gardox", or equal.

F. Vapor Barrier: 6 mil clear polyethylene film, below grade application.

G. Bonding and Repair Materials:

1. Bonding Adhesive: The compound shall be a polyvinyl acetate, rewettable type, "Euco Weld" by Euclid Chemical Co., or "Sonocrete" by Sonneborn-Contech, or "Weldcrete" by Larsen Co. Use only in areas not subject to moisture.
2. Epoxy Bonding Adhesive: The compound shall be a two (2) component, 100% solids, 100% reactive compound suitable for use on dry or damp surfaces, "Euco Epoxy #452MV or #620 by Euclid Chemical Co., or "Sonobond" by Sonneborn-Contech, or "Sikadur Hi-Mod" by Sika Chemical Corp.
3. Bonding Admixture: The compound shall be a latex, non-rewettable type, "SBR Latex" or "Flex-con" by Euclid Chemical Co., "Intralok" by W.R. Meadows, or "Daraweld C" by W.R. Grace.

4. Underlayment Compound: Free-flowing, self-leveling, pumpable cementitious base compound.

H. Curing Compounds (SODIUM SILICATE COMPOUNDS ARE PROHIBITED):

1. Curing and Sealing Compound: The compound shall be a clear styrene acrylate type, 30% solids content minimum, conforming to ASTM C309 and Federal Spec. TT-C-800A. Curing compound shall be "Super Rez Seal" or "Super Pliocure" by Euclid Chemical Co., "CR-26-GSA" by W.R. Meadows, or "Masterkure" by Master Builders.
2. Dissipating Resin Curing Compound: The compound shall be a dissipating resin type compound, conforming to ASTM C309, Type I, "Kurez DR" by Euclid Chemical Co. or approved equal. The film must chemically break down in a two-to-four week period.

I. Sealer/Dustproofer: The compound shall be a water-based acrylic latex system, 20% solids content minimum with a maximum moisture loss of 0.034 gm/cm^2.

J. Non-Slip Finish: Aluminum oxide or granitic type, "Non-Slip Aggregate" by Euclid Chemical Co., "Toxgrip" by Toch, or "Frictex" by Sonneborn-Contech. The aggregate shall be graded in standard No. 8 - No. 30 size.

K. Wall Finish: Thoro "Thoroseal" applied according to manufacturer's instructions may be substituted for a grout cleaned finish specified in SECTION 3.10.D of this Specification.

2.02 PROPORTIONING CONCRETE:

A. Proportions shall be selected using ACI 301-84, Section 3.9, Method 1 or Method 2.

B. Proportions and materials shall conform to Schedule A, Specification Requirements for Concrete, herein.

C. Use of all admixtures must be approved by the ENGINEER. All admixtures shall be used in accordance with the manufacturers' instructions except as otherwise directed by the ENGINEER.

D. If the CONTRACTOR intends to place concrete by pumping, the mix design shall be prepared in accordance with these specification sand the recommendations of ACI 304.2R

2.03 FABRICATING REINFORCEMENT:

A. Fabricate in accordance with approved shop drawings and ACI 315.

B. Locate reinforcing splices not indicated on drawings. Location and class of splices is to be approved by the ENGINEER.

PART 3 EXECUTION

3.01 ERECTION OF FORM WORK:

A. Forms shall be used, wherever necessary, to confine the concrete and shape it to the required dimensions. Forms shall have sufficient strength to withstand the pressure resulting from placement and vibration of the concrete, and shall have sufficient rigidity to maintain specified tolerances.

B. Earth cuts shall not be used as forms.

C. The design and engineering of the form work, as well as its construction, shall be the responsibility of the CONTRACTOR.

D. The form work shall be designed for the loads, lateral pressure, and allowable stresses outlined in "Recommended Practice for Concrete Form work" (ACI 347) and for design considerations, wind loads, allowable stresses, and other appliable requirements of the controlling local building code.

E. Forms shall be sufficiently tight to prevent loss of mortar from the concrete. Chamfer strips shall be placed in the corners of forms to produce beveled edges on permanently exposed surfaces. Interior corners on such surfaces and the edges of formed joints will not require beveling.

F. To maintain the specified tolerances, the form work shall be cambered to compensate for anticipated deflections in the formwork prior to hardening of the concrete.

G. Positive means of adjustment (wedges or jacks) of shores and struts shall be provided and all settlement shall be taken up during concrete placing operation. Forms shall be securely braced against laterial deflections.

H. Temporary openings shall be provided at the base of column forms and wall forms and at other points where necessary to facilitate cleaning and observation immediately before concrete is placed.

I. Form accessories to be partially or wholly embedded in the concrete, such as ties and hangers, shall be of a commercially manufactured type. Nonfabricated wire shall not be used.

Form ties shall be constructed so that the ends or end fasteners can be removed without causing appreciable spalling at the faces of the concrete. After the ends or end fasteners of form ties have been removed, the embedded portion of the ties shall terminate not less than 2 inch diameters or twice the minimum dimension of the tie from the formed faces of concrete to be permanently exposed to view except that in no case shall this distance be less than 3/4 inch. When the formed face of the concrete is not to be permanently exposed to view, form ties may be cut off flush with the formed surfaces.

J. At construction joints, contact surface of the form sheathing for flush surfaces exposed to view shall overlap the hardened concrete in the previous placement by not more than one inch. The forms shall be held against the hardened concrete to prevent offsets or loss of mortar at the construction joint and to maintain a true surface.

K. Obtain ENGINEER's permission before framing openings in structural members, which are not indicated on drawings.

L. Wood forms for wall openings shall be constructed to facilitate loosening, if necessary, to counteract swelling of the forms.

M. Wedges used for final adjustment of the forms prior to concrete placement shall be fastened in position after the final check.

N. Form work shall be so anchored to shores or other supporting surfaces or members that upward or lateral movement of any part of the form work system during concrete placement will be prevented.

O. Runways for moving equipment shall be provided with struts or legs and shall be supported directly on the form work or structural member without resting on the reinforcing steel.

P. Unless otherwise specified by the ENGINEER, form work shall be constructed so that the concrete surfaces will conform to the tolerance limits listed in Schedule B herein.

Q. All surfaces of forms and embedded materials shall be cleaned of any accumulated mortar or grout from previous concreting and of all other foreign material before concrete is placed in them.

R. Apply form release agent on form work in accordance with manufacturer's recommendations. Apply prior to placing reinforcing steel, anchoring devices and embedded items.

S. Do not apply form release agent where concrete surfaces are to receive special finishes or applied coverings which are affected by agent. Soak inside

surfaces of untreated forms with clean water. Keep surfaces wet prior to placing concrete.

T. Excess release agent material shall not be allowed to stand in puddles in the forms nor shall such coating be allowed to come in contact with hardened concrete against which fresh concrete is to be placed.

U. Clean forms as erection proceeds, to remove foreign matter. Remove cuttings, shavings and debris from within forms. Flush completely with water to remove remaining foreign matter. Ensure that water and debris drain to exterior through cleanout ports.

V. During cold weather, remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out completed forms, unless form work and concrete construction proceed within a heated enclosure. Use compressed air or other means to remove foreign matter.

W. Inspect and check completed form work, shoring and bracing to ensure that work is in accordance with form work design, and that supports, fastenings, wedges, ties and parts are secure.

X. Inform ENGINEER when form work is complete and has been cleaned, to allow for inspection. Obtain approval prior to placing concrete.

3.02 PLACEMENT OF REINFORCEMENT:

A. Place reinforcement as indicated on approved shop drawings and to the following tolerances:

Clear distance to formed surfaces: +1/4 inch.
Minimum spacing between bars: -1/4 inch.

Top bars in slabs and beams:
Members 8 inches deep or less: ± 1/4 inch.
Members more than 8 inches but not over 2 feet deep: ± 1/2 inch.
Members more than 2 feet deep: ± 1 inch.
Crosswise of members: spaced evenly within 2 inches.
Lengthwise of members: ± 2 inches.

B. Bars may be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items. If bars are moved more than one bar diameter, or enough to exceed the above tolerances, the resulting arrangement of bars shall be subject to approval.

C. Unless indicated otherwise on the drawings, minimum concrete protective covering for reinforcement, shall be as follows:

Concrete deposited against the ground: 3 inches.
Formed surfaces exposed to weather or in contact with the ground: 2 inches for reinforcing bars #6 or larger; 1-1/2 inches for reinforcing bars less than #6.
Interior surfaces: 1-1/2 inches for beams, girders, and columns; 3/4 inch for slabs, walls and joists with #11 bars or smaller, and 1-1/2 inches with #14 and #18 bars.

D. All reinforcement, at the time concrete is placed, shall be free of mud, oil or other materials that may adversely affect or reduce the bond. Reinforcement with rust, mill scale or a combination of both will be accepted as being satisfactory without cleaning or brushing provided the dimensions and weights, including heights of deformations, or a cleaned sample shall not be less than required by the applicable ASTM specification.

E. All reinforcement shall be supported and fastened together to prevent displacement by construction loads or the placing of concrete beyond the tolerances of Schedule B. On ground, where necessary, supporting concrete blocks may be used.
Over form work, concrete, metal, plastic or other approved bar chairs and spacers shall be used. Where the concrete surface will be exposed to the weather in the finished structure, the portions of all accessories within 1/2 inch of the concrete surface shall be noncorrosive or protected against corrosion.

F. Welded wire fabric shall be overlapped wherever successive mats or rolls are continuous in such a way that the overlap measured between outermost cross wires of each fabric sheet is not less than the spacing of the cross wires plus 2 inches. It shall be supported as required for reinforcing bars. The fabric shall extend across supporting beams and walls and to within 4 inches of concrete edges. It may extend through control joints. It shall be adequately supported during placing of concrete to insure its proper position in the slab.

G. All splices not shown in the contract documents shall be subject to approval. Mechanical connectors for reinforcing bars shall not be used.

H. Unless permitted by the ENGINEER, reinforcement shall not be bent after being embedded in hardened concrete.

I. Where indicated on the drawings, weld reinforcing in accordance with applicable requirements of AWS D12.1. No welding is permitted without specific approval of the ENGINEER. No welding of crossing bars (tack welding) shall be permitted.

3.03 CONSTRUCTION JOINTS:

A. Place formed construction joints in floor slabs and walls as shown on drawings or at maximum 20 foot intervals. Secure to resist movement of wet concrete.

B. Joints not shown on the drawings shall be so made and located as least to impair the strength of the structure and shall be approved. In general, they shall be located near the middle of the spans of slabs, beams, and girders unless a beam intersects a girder at this point, in which case the joint in the girder shall be offset a distance equal to twice the width of the beam. Joints in walls and columns shall be at the underside of floors, slabs, beams, or girders and at the tops of footings or floor slabs. Beams, girders, brackets, column capitals, haunches, and drop panels shall be placed at the same time as slabs. Joints shall be perpendicular to the main reinforcement.

C. All reinforcement shall be continued across joints. Keys and inclined dowels shall be provided as directed by the ENGINEER. Longitudinal keys at least 1-1/2 inches deep shall be provided in all joints in walls and between walls and slabs or footings.

D. The surface of the concrete at all joints shall be thoroughly cleaned and all laitance removed prior to placing adjoining concrete.

E. When joining new concrete to existing concrete, bond shall be obtained by one of the following methods:
   1. The use of an approved bonding agent. Use epoxy bonding agent in joints exposed to moisture or below grade. Use latex bonding agent in other applications.
   2. Roughening the surface of the concrete in an approved manner which will expose the aggregate and will not leave laitance, loosened particles of aggregate or damaged concrete at the surface.

3.04 EXPANSION/ISOLATION JOINTS:

A. Reinforcement or other embedded metal items bonded to the concrete (except dowels in floors bonded on only one side of joints) shall not be permitted to extend continuously through any expansion joint.

B. Premolded expansion joint filler shall be of the type required by the contract documents.

3.05 EMBEDDED ITEMS:

A. Provide formed openings where required for pipes, conduits, sleeves and other work to be embedded in and passing through concrete members.

B. Accurately locate and set in place items which are to be cast directly into concrete.

C. Co-ordinate work of other sections and co-operate with trade involved in forming and/or setting openings, slots, recesses, chases, sleeves, bolts, anchors and other inserts. Do not perform work unless specifically indicated on drawings or approved prior to installation.

D. Install all concrete accessories in accordance with drawings and manufacturer's recommendations; straight, level, and plumb. Ensure items are not disturbed during concrete placement.

E. Voids in sleeves, inserts, and anchor slots shall be filled temporarily with a readily removable material to prevententry of concrete into the voids.

F. No aluminum items shall be embedded in concrete.

G. Placement tolerances: Anchor bolts:
   1. Locate accurately, ±1/8 inch horizontal tolerance, ±1/4 inch vertical tolerance. Positioning templates shall be used to set all anchor bolts.
   2. Secure to prevent displacement during concrete pours.
   3. Replace all bolts not placed to the above tolerance, by chipping out, resetting, and grouting with non-shrink grout.

3.06 CONCRETE PRODUCTION:

A. General:
   1. All concrete shall be ready-mixed and shall be batched, mixed and transported in accordance with "Specifications for Ready-Mixed Concrete" (ASTM C94). Plant equipment and facilities shall conform to the "Check List for Certification of Ready Mixed Concrete Production Facilities" of the National Ready Mixed Concrete association.
   2. Concrete shall be mixed only in quantities for immediate use. Batch-to-discharge time shall not exceed 60 minutes. Concrete which has set shall not be retempered, but shall be discarded.
   3. When concrete arrives at the project with slump below that suitable for placing, as indicated by the specifications, water may be added only if neither the maximum permissible water-cement ratio nor the maximum slump is exceeded. The water shall be incorporated by additional mixing equal to at least half of the total mixing required.

An addition of water above that permitted by the limitation on water-cement ratio shall be accompanied by a quantity of cement sufficient to maintain the proper water-cement ratio. Such addition shall be accomplished only upon authorization of the ENGINEER. Additional slump may only be achieved with the use of the specified high-range water reducing admixture (superplasticizer).

B. Cold weather:

1. In cold weather, the temperature of the concrete when delivered at the site of the work shall conform to the following temperature limitations.

Air Temperature deg F		Minimum concrete temperature, deg F	
		For sections with least dimension less than 12 in.	For sections with least dimension 12 in. or greater
30 to 45	60		50
0 to 30	65		55
Below 0	70		60

2. If water or aggregate is heated above 100 degrees F, the water shall be combined with the aggregate in the mixer before cement is added. Cement shall not be mixed with water or with mixtures of water and aggregate having a temperature greater than 100 degrees F.
3. Cold weather concreting shall follow the recommendations of ACI 306, except as otherwise directed by the ENGINEER.

C. Hot weather:

1. The ingredients shall be cooled before mixing, or flake ice or well-crushed ice of a size that will melt completely during mixing may be substituted for all or part of the mixing water if, due to high temperature, low slump, flash set or cold joints are encountered.
2. Hot weather concreting shall follow the recommendations of ACI 305, except as otherwise directed by the ENGINEER.

3.07 PLACING CONCRETE - GENERAL:

A. Preparation:

1. Hardened concrete and foreign materials shall be removed from the inner surfaces of the conveying equipment.
2. Form work shall have been completed; snow, ice and water shall have been removed; reinforcement shall have been secured in place; expansion joint material, anchors,and other embedded items shall have been positioned; and the entire preparation shall have been approved.

3. Concrete shall not be placed on frozen ground.

B. Conveying:

1. Concrete shall be handled from the mixer to the place of final deposit as rapidly as practicable by methods which will prevent segregation or loss of ingredient sand in a manner which will assure that the required quality of the concrete is maintained.
2. Conveying equipment shall be approved and shall be of a size and design such that detectable setting of concrete shall not occur before adjacent concrete is placed. Conveying equipment shall be cleaned at the end of each operation or work day. Conveying equipment and operation shall conform to the following additional requirements:
   a. Truck mixers, agitators, and nonagitating units and their manner of operation shall conform to the applicable requirements of "Specifications for ready-Mixed Concrete" (ASTM C94).
   b. Belt conveyors shall be horizontal or at a slope which will not cause excessive segregation or loss of ingredients. Concrete shall be protected against undue drying or rise in temperature. An approved arrangement shall be used at the discharge end to prevent apparent segregation. Mortar shall not be allowed to adhere to the return length of the belt. Long runs shall be discharged into a hopper or through a baffle.
   c. Chutes shall be metal or metal-lined (aluminum is not permitted) and shall have a slope not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal. Chutes more than 20 feet long and chutes not meeting the slope requirements may be used provided they discharge into a hopper before distribution.
   d. Pumping or pneumatic conveying equipment shall be of suitable kind with adequate pumping capacity. Pneumatic placement shall be controlled so that segregation is not apparent in the discharged concrete. The loss of slump in pumping or pneumatic conveying equipment shall not exceed 2 inches. Concrete shall not be conveyed through pipe made of aluminum or aluminum alloy.

C. Depositing:

1. General: Concrete shall be deposited continuously or in layers of such thickness (maximum 2 feet) that no concrete will be deposited on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness within the section. No interruption shall exceed 45 minutes. If a section cannot be placed continuously, construction joints shall be located as shown in the contract documents or as approved. Placing shall be carried on at such a rate that the concrete which is being integrated with fresh concrete is still plastic. Concrete which has partially hardened or has been contaminated by

foreign materials shall not be deposited. Temporary spreaders in forms shall be removed when the concrete placing has reached an elevation rendering their service unnecessary. They may remain embedded in the concrete only if made of metal or concrete and if prior approval has been obtained.

2. Placing: Placing of concrete in supported elements shall not be started until the concrete previously placed in columns and walls is no longer plastic and has been in place at least two hours.
3. Segregation: Concrete shall be deposited as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. Concrete shall not be subjected to any procedure which will cause segregation. Maximum vertical drop shall be 5 feet.
4. Consolidation: All concrete shall be consolidated by vibration, spading, rodding or forking so that the concrete is thoroughly worked around the reinforcement around embedded items, and into corners of forms, eliminating all air or stone pockets which may cause honeycombing, pitting, or planes of weakness. Consolidation shall begin within 10 minutes of placement. Internal vibrators shall have a minimum frequency of 8000 vibrations per minute and sufficient amplitude to consolidate the concrete effectively. They shall be operated by competent workmen. Use of vibrators to transport concrete within forms shall not be allowed. Vibrators shall be inserted and withdrawn at points approximately 18 inches apart. At each insertion, the duration shall be sufficient to consolidate the concrete but not sufficient to cause segregation, generally from 5 to 15 seconds. A spare vibrator shall be kept on the job site during all concrete placing operations. Where the concrete is to have an as-cast finish, a full surface of mortar shall be brought against the form by the vibration process, supplemented if necessary by spading to work the coarse aggregate back from the formed surface.

D. Protection:

1. Unless adequate protection is provided and approval is obtained, concrete shall not be placed during rain, sleet, or snow.
2. Rainwater shall not be allowed to increase the mixing water nor to damage the surface finish.
3. Placing temperature: When the temperature of the surrounding air is expected to be below 40 degrees F during placing or within 24 hours thereafter, the temperature of the plastic concrete, as placed, shall be no lower than 55 degrees F for sections less than 12 inches in any dimension nor 50 degrees F for any other sections. The temperature of the concrete as placed shall not be so high as to cause difficulty from loss of slump, flash set, or cold joints and should not exceed 90 degrees F. When the temperature of the concrete exceeds 90 degrees F, precautionary measures approved by the ENGINEER shall be put into effect. When the temperature of the steel is greater than 120

degrees F, steel forms and reinforcement shall be sprayed with water just prior to placing the concrete.

E. Bonding:

1. When joining new concrete to existing concrete, the surface of joints shall be prepared in accordance with one of the methods specified in SECTION 3.03.E.
2. The hardened concrete of construction joints and of joints between footings and walls or columns, between walls or columns and beams or floors they support, joints in unexposed walls and all others not mentioned below shall be dampened (but not saturated) immediately prior to placing of fresh concrete.
3. The hardened concrete of joints in exposed work; joints in the middle of beams, girders, joists, and slabs; and joints in work designed to contain liquids shall be dampened (but not saturated) and then thoroughly covered with a coat of cement grout of similar proportions to the mortar in the concrete. The grout shall be as thick as possible on vertical surfaces and at least 1/2 inch thick on horizontal surfaces. The fresh concrete shall be placed before the grout has attained its initial set.
4. Joints receiving a bonding agent shall have been prepared and agent applied in accordance with the manufacturer's recommendations prior to placing of fresh concrete.

F. Concreting under water:

1. When required or permitted, concrete shall be deposited under water by an approved method in such a way that the fresh concrete enters the mass of previously placed concrete from within, causing water to be displaced with minimum disturbance at the surface of the concrete.

3.08 REMOVAL OF FORM WORK:

A. Notify ENGINEER prior to removing form work.

B. Do not remove forms, shores and bracing until concrete has gained sufficient strength to carry its own weight, and construction and design load which are liable to be imposed upon it. Verify strength of concrete by compressive test results.

C. Remove form work progressively and in accordance with code requirements and so that no shock loads or unbalanced loads are imposed on structure.

D. Loosen forms carefully. Do not wedge pry bars, hammers or tools against concrete surfaces.

E. Leave forms loosely in place, against vertical surfaces, for protection until complete removal is approved by ENGINEER.

F. Remove forms not directly supporting weight of concrete as soon as stripping operations will not damage concrete.

3.09 REPAIR OF SURFACE DEFECTS:

A. Surface defects, including tie holes, unless otherwise specified by the contract documents, shall be repaired immediately after form removal.

B. Repair of defective areas:

1. All honeycombed and other defective concrete shall be removed down to sound concrete. If chipping is necessary the edges shall be perpendicular to the surface or slightly undercut. No featheredges will be permitted. The area to be patched and an area at least 6 inches wide surrounding it shall be dampened to prevent absorption of water from the patching mortar. A bonding grout shall be prepared using a mix of approximately 1 part cement to 1 part fine sand passing a No. 30 mesh sieve, mixed to the consistency of thick cream, and then well brushed into the surface.
2. The patching mixture shall be made of the same materials and of approximately the same proportions as used for the concrete, except that the coarse aggregate shall be omitted and the mortar shall consist of not more than 1 part cement to 2-1/2 parts sand and by damp loose volume. White portland cement shall be substituted for a part of the gray portland cement on exposed concrete in order to produce a color matching the color of the surrounding concrete, as determined by a trial patch. The quantity of mixing water shall be no more than necessary for handling and placing. The patching mortar shall be mixed in advance and allowed to stand with frequent manipulation with a trowel, without addition of water, until it has reached the stiffest consistency that will permit placing.
3. After surface water has evaporated from the area to be patched, the bond coat shall be well brushed into the surface. When the bond coat begins to lose the watersheen, the premixed patching mortar shall be applied. The mortar shall be thoroughly consolidated into place and struck off so as to leave the patch slightly higher than the surrounding surface. To permit initial shrinkage, it shall be left undisturbed for at least one hour before being finally finished. The patched area shall be kept damp for 7 days. Metal tools shall not be used in finishing a patch in a formed wall which will be exposed.

C. Tie holes: After being cleaned and thoroughly dampened, the tie holes shall be filled solid with patching mortar.

D. All structural repairs shall be made with prior approval of the ENGINEER as to method and procedure.

E. If permitted or required, proprietary compounds for adhesion or as patching ingredients may be used in lieu of or in addition to the foregoing patching procedures. Such compounds shall be used in accordance with the manufacturer's recommendations.

3.10 FINISHING OF FORMED SURFACES:

A. For all unexposed concrete, provide a rough form finish: No selected form facing materials shall be specified for rough form finish surfaces. Tie holes and defects shall be patched. Fins exceeding 1/4 inch in height shall be chipped off or rubbed off. Otherwise, surfaces shall be left with the texture imparted by the forms.

B. For all exposed concrete, provide a smooth form finish: The form facing material shall produce a smooth, hard, uniform texture on the concrete. It may be plywood, tempered concrete-form-grade hardboard, metal, plastic, paper, or other approved material capable of producing the desired finish. The arrangement of the facing material shall be orderly and symmetrical, with the number of seams kept to the practical minimum. It shall be supported by studs or other backing capable of preventing excessive deflection. Material with raised grain, torn surfaces, worn edges, patches, dents, or other defects which will impair the texture of the concrete surface shall not be used. Tie holes and defects shall be patched. All fins shall be completely removed.

C. Tops of walls or buttresses, horizontal offsets, and similar uniformed surfaces occurring adjacent to formed surfaces shall be struck smooth after concrete is placed and shall be floated to a texture reasonably consistent with that of the formed surfaces. Final treatment on formed surfaces shall continue uniformly across the unformed surfaces.

D. For all concrete which is to be coated or painted, provide a grout cleaned finish on a smooth form finish: No cleaning operations shall be undertaken until all contiguous surfaces to be cleaned are completed and accessible, however cleaning as the work progresses shall not be permitted. Mix one part Portland cement and one and one-half parts fine sand with sufficient water to produce a grout having the consistency of thick paint. White Portland cement shall be substituted for a part of the gray Portland cement in order to produce a color matching the color of the surrounding concrete, as determined by a trial patch. Wet the surface of the concrete sufficiently to prevent absorption of water from the grout and apply the grout uniformly with brushes or a spray gun. Immediately after applying the grout, scrub the surface vigorously with a cork float or stone to coat the surface and fill all air bubbles and holes. While the grout is still plastic, remove all excess grout by working the surface

with a rubber float, sack, or other means. After the surface whitens from drying (about thirty minutes at normal temperatures), rub vigorously with clean burlap. The finish shall be kept damp for at least 36 hours after final rubbing.

3.11 PLACING AND FINISHING CONCRETE-SLABS:

A. Preparation of subgrade for slabs on ground:

1. The subgrade shall be well drained and of adequate and uniform load bearing nature. The in-place density of the subgrade soils shall be at least the minimum required in the specifications. The bottom of an undrained granular base course shall not be lower than the adjacent finished grade.
2. The subgrade shall be free of frost before concrete placing begins. If the temperature inside a building where concrete is to be placed is below freezing it shall be raised and maintained above 50 degrees F long enough to remove all frost from the subgrade.
3. The subgrade shall be moist at the time of concreting. If necessary, it shall be dampened with water in advance of concreting but there shall be no free water standing on the subgrade nor any muddy or soft spots when the concrete is placed.

B. Edge forms and screeds:

1. Edge forms and intermediate screed strips shall be set accurately to produce the designated elevations and contours of the finished surface, and shall be sufficiently strong to support vibrating screeds or rollerpipe screeds if the nature of the finish specified requires the use of such equipment. The concrete surface shall be aligned to the contours of screedstrips by the use of strike-off templates or approved compacting type screeds.
2. When form work is cambered, screeds shall be set to a like camber to maintain the proper concrete thicknesses.

C. Placement:

1. Mixing and placing shall be carefully coordinated with finishing. Concrete shall not be placed on the subgrade or forms more rapidly than it can be spread,straight edged, and darbied or bull floated. These operations must be performed before bleeding water has an opportunity to collect on the surface.
2. To obtain good surfaces and avoid cold joints, the size of finishing crews shall be planned with due regard for the effects of concrete temperature and atmospheric conditions on the rate of hardening of the concrete.

D. Jointing:

1. Joints in slabs on grade shall be located and detailed as indicated in the contract documents. If saw-cut joints are required or permitted, cutting shall be timed properly with the set of the concrete. Cutting shall be started as soon as the concrete has hardened sufficiently to prevent aggregates being dislodged by the saw, and shall be completed before shrinkage stresses become sufficient to produce cracking.

E. Consolidation:

1. Concrete in slabs shall be thoroughly consolidated. Internal vibration shall be used in beams and girders of framed slabs and along the bulkheads of slabs on grade. Consolidation of slabs shall be obtained with vibrating screeds, roller pipe screeds, internal vibrators, or other approved means.

F. Finishes:

1. When type of finish is not specified otherwise in the contract documents, the following finishes shall be used as applicable:
   a. Floated finish: For surfaces intended to receive roofing, waterproofing membranes, or sand bed terazzo.
   b. Troweled finish: For floors intended as walking surfaces or for reception of floor coverings.
   c. Broom or belt finish: For sidewalks and garage floors and ramps.
   d. Nonslip finish: For exterior platforms, steps, and landings; and for exterior and interior pedestrian ramps.

2. Finishing tolerances:
   a. Finishes with Class A tolerances shall be true planes within 1/8 inch in 10 feet as determined by a 10-foot straightedge placed anywhere on the slab in any direction.
   b. Finishes with Class B tolerance shall be true planes within 1/4 inch in 10 feet as determined by a 10-foot straightedge placed anywhere on the slab in any direction.

3. Descriptions:
   a. Floated finish: After the concrete has been placed, consolidated, struck off, and leveled, the concrete shall not be worked further until ready for floating. Floating shall begin when the watersheen has disappeared and when the surface has stiffened sufficiently to permit the operation. During or after the first floating, planeness of surface shall be checked with a 10-foot straightedge applied at not less than 2 different angles. All high spots shall be cut down and all low spots filled during this procedure to produce a surface within Class B tolerance

throughout. The slab shall then be refloated immediately to a uniform sandy texture.

b. Troweled finish: The surface shall first be float-finished. It shall next be power troweled, and finally hand troweled. The first troweling after power floating shall produce a smooth surface which is relatively free of defects but which may still show some trowel marks. Additional trowelings shall be done by hand after the surface has hardened sufficiently. The final troweling shall be done when a ringing sound is produced as the trowel is moved over the surface. The surface shall be thoroughly consolidated by the hand troweling operations. The finished surface shall be essentially free of trowel marks, uniform in texture and appearance and shall be planed to a Class A tolerance. On surfaces intended to support floor coverings, any defects of sufficient magnitude to show through the floor covering shall be removed by grinding.

c. Broom or belt finish: Immediately after the concrete has received a float finish. It shall be given a coarse transverse scored texture by drawing a broom or burlap belt across the surface.

d. Nonslip finish: Where the contract documents require a nonslip finish, the surface shall be given a "dry shake" application, as specified above, of crushed ceramically bonded aluminum oxide or other specified selected abrasive particles. The rate of application of such material shall be not less than 25 pounds per 100 square feet.

3.12 CURING AND PROTECTION:

A. Beginning immediately after placement, concrete shall be protected from premature drying, excessively hot or cold temperatures, and mechanical injury and shall be maintained with minimal moisture loss at a relatively constant temperature for the period necessary for hydration of the cement and hardening of the concrete. The materials and methods of curing shall be subject to approval.

B. For concrete surfaces not in contact with forms, one of the following procedures shall be applied immediately after completion of placement and finishing:

1. Ponding or continuous sprinkling.
2. Application of absorptive mats or fabric kept continuously wet.
3. Application of waterproof sheet materials, conforming to "Specifications for Waterproof Sheet Materials for curing Concrete" (ASTM C171).
4. Application of other moisture-retaining covering as approved.

5. Application of specified curing and sealing compound. The compound shall be applied in accordance with the recommendations of the manufacturer immediately after any water sheen which may develop after finishing has disappeared from the concrete surface. It shall not be used on any surface against which additional concrete or other material is to be bonded. On these areas use the specified dissipating resin curing compound.

C. Apply a coat of the specified clear sealer/dustproofing compound to all exposed interior concrete floors where indicated on the drawings. The compound shall be applied in strict accordance with the directions of the manufacturer and just prior to completion of construction.

D. Moisture loss from surfaces placed against wooden forms or metal forms exposed to heating by the sun shall be minimized by keeping the forms wet until they can be safely removed. After form removal the concrete shall be cured until the end of the time prescribed in Section 3.12.E by one of the methods of Sections 3.12.B or 3.12.C.

E. Curing in accordance with Sections 3.12.B.1 or 3.12.B.2. shall be continued for at least 7 days in the case of all concrete except high-early-strength concrete for which the period shall be at least 3 days. Alternatively, if tests are made of cylinders kept adjacent to the structure and cured by the same methods, moisture retention measures may be terminated when the average compressive strength has reached 70 percent of the specified strength. If one of the curing procedures of SECTIONS 3.12.B.1 or 3.12.B.2. is used initially, it may be replaced by one of the other procedures of SECTION 3.12.B anytime after the concrete is 1 day old provided the concrete is not permitted to become surface dry during the transition.

F. Cold weather: When the mean daily outdoor temperature is less than 40 degrees F, the temperature of the concrete shall be maintained between 50 degrees and 70 degrees F for the required curing period of SECTION 3.12.E. When necessary, arrangements for heating, covering, insulating, or housing the concrete work shall be made in advance of placement and shall be adequate to maintain the required temperature without injury due to concentration of heat. Combustion heaters shall not be used during the first 24 hours unless precautions are taken to prevent exposure of the concrete to exhaust gases which contain carbon dioxide.

G. Hot weather: When necessary, provision for windbreaks, shading, fog spraying, sprinkling, ponding or wet covering with a light colored material shall be made in advance of placement, and such protective measures shall be taken as quickly as concrete hardening and finishing operations will allow.

H. Rate of temperature change: Changes in temperature of the air immediately adjacent to the concrete during and immediately following the curing period shall be kept as uniform as possible and shall not exceed 5 degrees F in any 1 hour or 50 degrees F in any 24-hour period.

I. During the curing period, the concrete shall be protected from damaging mechanical disturbances, such as load stresses, heavy shock, and excessive vibration. All finished concrete surfaces shall be protected from damage by construction equipment, materials, or methods, by application of curing procedures, and by rain or running water. Self-supporting structures shall not be loaded in such a way as to over stress the concrete.

3.13 FIELD QUALITY CONTROL:

A. Field inspection and testing is to be performed by a firm appointed and paid for by the Owner. When additional testing of materials or concrete is necessary because of their failure by test or inspection to meet specification requirements, the cost of the additional testing shall be paid for by the CONTRACTOR.

B. Provide access to all portions of the work and any necessary assistance in obtaining and handling samples at the project or other material sources. Three concrete test cylinders will betaken for every 50 cubic yards, or fraction thereof, for each class of concrete placed in any one day. One additional cylinder will be taken during cold weather concreting and be cured on the project site under the same conditions as the concrete it represents. One slump test will be taken for each set of cylinders taken.

SECTION 04200 UNIT MASONRY

PART 1 - GENERAL

1.01 DESCRIPTION:

A. The work includes concrete masonry work with horizontal wall reinforcing.

1.02 SUBMITTALS:

A. Provide certified test reports indicating concrete masonry units conform to ASTM C90 and ASTM C426.

B. Provide product data for wall reinforcing with items for this project clearly marked.

1.03 DELIVERY AND STORAGE:

A. Masonry units to be delivered on manufacturer's standard pallets with storage off the ground, covered for protection from weather.

B. Reinforcement to be delivered in manufacturer's original packing with all labels intact and legible with storage off the ground in covered area.

1.04 RELATED WORK:

A. SECTION 05590 metal fabrications built into masonry work.

B. SECTION 07900 caulking and sealants for joints.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Concrete Masonry Units: Aggregate, ASTM C33. Linear shrinkage, maximum 0.4 percent, ASTM C426. Moisture content, maximum 40 percent at time of delivery, ASTM C427. Size, 8 inches x 16 inches face, thickness as shown. Curing, autoclave at minimum 5 hours at 120 psi steam pressure and delivery 30 days after curing. Dry net weight per cubic foot, 120 pounds. Concrete blocks, ASTM C90 hollow core, non-load bearing; ASTM C145 solid core load bearing; Grade N, Type 1. Provide bull nose units for exposed external corners, and other standard shapes.

B. Mortar: Portland cement, ASTM C175, Type 1A. Gray color. Masonry cement, ASTM C91, Type II. Sand, ASTM C144, sand obtained from one source for project. Hydrated lime, ASTM C207, Type S.Quick lime, ASTM C5. Water, clean and free from injurious amounts of oil, alkali, organic matter or other deleterious material. Mortar mix, ASTM C270, Type N.

C. Masonry wire reinforcement: Truss type galvanized steel construction with No. 9 gauge deformed side rods and No. 9 gauge cross rods. The width of the unit to be 1-1/2 inches less than the total width of the wall.

D. Anchors: 3/16 inch x 2 inches x 12 inches including 2 inches send bends, corrugated and galvanized.

E. Concrete for corefill: 3600 psi concrete at 28 days, 3 inch slump, ASTM C150, Type I, and aggregates same as concrete masonry units.

F. Horizontal joint filler, closed cell sponge neoprene; 50% self expanding 1/2 inch x 6 inch wide x maximum lengths.

G. Vertical joint filler: Black precompressed open cell polyester polyurethane foam sealant rolls, 1 inch wide.

H. Building paper: Heavy red rosin paper.

PART 3 - EXECUTION

3.01 PREPARATION:

A. Ensure items built-in by other trades for this work are properly located and sized.

B. Establish lines, levels and coursing. Protect from disturbances.

3.02 INSTALLATION:

A. Thoroughly mix mortar ingredients, in quantities needed for immediate use. Anti-freeze compounds not permitted. Use mortar within two (2) hours of mixing. Retemper mortar within two (2) hours of mixing to replace water lost by evaporation. Thorough remixing is required. Do not retemper after two (2) hours of mixing.

B. Place masonry in accordance with lines and levels indicated on drawings.

C. Fully bond external and internal corners and intersections.

D. Buttering corners of joints, deep or excessive furrowing of mortar joints is not permitted.

E. Do not shift or tap masonry after mortar has taken initial set.

F. Perform jobsite cutting of masonry with power tools to provide straight and true, unchipped edges.

G. Concrete masonry partitions and back-up shall extend to underside of structural beams or deck, stop masonry short 1/2 inch to allow for live load deflection. Fill joint with horizontal joint filler of width one inch less than wall, then caulk remaining open joints exposed to view.

H. Ensure masonry courses are of uniform height. Make vertical and horizontal joints equal and of uniform thickness. Lay first course in full bed of mortar, with face shells in mortar bedding thereafter properly jointed with other work.

I. Remove excess mortar and projections. Take care to prevent breaking masonry corners.

J. Control Joints: Build as indicated. Provide (building paper) (joint filler) as noted. Joints closed with sealant.

K. Lay concrete block in running bond. Course 1 block unit and 1 mortar joint to equal 8 inches. Form neat vee mortar joints exposed to view.

L. Maintain flush face on unexposed masonry surfaces.

M. Bond each block course at corners and break vertical joints at least 2 inches. Intersecting walls shall have vertical continuous joints; tie with two corrugated anchors in shells of abutting block at each course. These joints shall be ready for caulking.

N. Concrete masonry units laid with longitudinal masonry reinforcing one course above and below openings. Lap longitudinal wire 32 diameters at splices. At corners cut inside rod and bend to proper angle. Break reinforcing at control joints.

O. Provide sealant recesses at exterior perimeter of doors, windows, and other openings; depth 1/2 inch, width 1/4 inch.

P. As work progresses, build-in hollow metal frames, steel lintels, anchor bolts, plates, and other items supplied by other trades. Build-in items plumb and true. Bed anchors of hollow metal frames in mortar joints. Fill frame voids solid with mortar.Fill masonry cores with grout minimum 8 inches from framed openings.

Q. Cut and fit concrete block for pipes, conduit, sleeves, and grounds. Cooperate fully with other sections of work to ensure correct size, shape and location. Obtain ENGINEER's review prior to cutting or fitting any area which is not

indicated on drawings, or which may impair appearance or strength of masonry work.

3.03 PROTECTION:

A. Prevent mortar from staining faces of concrete masonry and other work. Remove mortar from work immediately.

B. Cold weather protection includes preparation heating masonry bed until surface is dry to the touch. Heat sand and mixing water.Provide heat sources both sides of wall, in heated enclosures to maintain temperatures at working surfaces at not less than 50 degrees F. Maintain materials and surrounding air temperature to minimum 50 degrees F. prior to, during and 48 hours after completion of masonry work.

3.04 POINTING AND CLEANING:

A. Point up all exposed masonry, fill all holes and joints, and repair defective joints. Match adjacent work.

B. Clean soiled surfaces using a non-acid solution which will not harm masonry or adjacent materials. Consult masonry manufacturer for acceptable cleaners. Use nonmetallic tools in cleaning operations.

SECTION 05210 STEEL JOISTS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. The work includes all open web steel joists, with required anchorages, bridging, bearing plates and angles, and other related accessories.

1.02 SUBMITTALS:

A. Submit shop and erection drawings for approval.
   1. Indicate sizes, spacing and location of joists, connections, bridging, reinforcing, anchorages, cambers and loads.
   2. Indicate welded connections using standard AWS welding symbols. Indicate net weld lengths.
   3. Connections shall support half of the total uniform capacity of the joist for the span shown, plus concentrated loads where indicated.

B. Submit weldor certifications as required.

1.03 REFERENCES:

A. Steel Joist Institute, "Standard Specifications for Open Web Steel Joists, H-Series".

B. Steel Joist Institute, "Standard Specifications for Long Span Steel Joists, LH-Series and Deep Long Span Steel Joists, DLH-Series".

C. AISC, "Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings" and current supplements.

D. AWS D1.1, Structural Welding Code.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Open Web Joist Members: AISC and SJI Standard Specifications.

B. Anchor Bolts and Required Nuts and Washers: ASTM A307.

C. Welding Materials: Applicable AWS D1.1 provisions, type required for materials being welded.

2.02 FABRICATION:

A. Fabricate steel joists in accordance with approved shop drawings and AISC and SJI Standard Specifications. Verify drawing dimensions and conditions prior to commencing fabrication.

B. Provide bottom and top joist chord extensions where indicated.

C. Camber joists to accommodate for dead load deflection.

D. Bridging shall be diagonal type.

E. Shop prime all joists where primer compatible with finish coats. See SECTION 09900.

or

E. Shop prime all joists with manufacturer's standard primer.

PART 3 - EXECUTION

3.01 ERECTION:

A. Erect steel joists in accordance with approved erection drawings and AISC and SJI Standard Specifications.

B. Extend joist seats to center line of beams when bearing on both sides, and minimum 1 inch past center line when bearing on oneside only.

C. During erection, provide temporary bracing required as a result of induced loads and stresses.

D. Coordinate proper placement of anchorages in concrete and masonry construction as required for the support of bearing plates and angles.

E. Field weld joist seat to bearing plates and angles after alignment and positioning.

F. Do not permit erection of decking until joists are sufficiently braced.

G. Obtain ENGINEER's review prior to field cutting or altering of joists or bridging.

H. After erection, prime welds, abrasions and surfaces not shop primed. Use primer consistent with shop coat.

I. All field welding is to be done by weldors certified in accordance with AWS specifications.

SECTION 05311 STEEL ROOF DECK

PART 1 - GENERAL

1.01 DESCRIPTION:

A. The work includes all steel roof deck and related accessories.

1.02 SUBMITTALS:

A. Submit shop drawings showing decking plan, deck type, dimensions, attachment details, supports, openings and reinforcement, finishes, and applicable details and accessories. Layout shall be such that decking will span at least three spaces wherever possible.

B. Submit product data, if required.

1.03 REFERENCES:

A. Steel Deck Institute, "Design Manual for Floor Decks and Roof Decks".

B. AISI, "Specification for the Design of Cold-Formed Steel Structural Members".

C. AWS D1.1, "Structural Welding Code".

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Steel Roof Deck and Accessories:
   1. Shall be manufactured from steel conforming to ASTM A446. Grade A or ASTM 611, Grade C.
   2. Deck shall be SDI standard wide rib deck, 1-1/2 inches deep, 20 gauge, minimum thickness = 0.034 inch, 6 inch pitch, minimum weight = 2.08 psf, minimum I = 0.203 $inch^4$, minimum S = 0.244 $inch^3$. Accessories shall be minimum 20 gauge,except roof sump plates and pans which shall be minimum 14 gauge.
   3. Acceptable manufacturers include: Bowman, Epic, Wheeling, Inland - Ryerson.
   4. Finish shall be phosphatized and primed.

      or

   4. Finish shall be hot-dip galvanized in accordance with ASTM A525, Class G90.

B. Steel angles used to reinforce opening shall conform to ASTM A36. Finish shall be consistent with that of the deck.

PART 3 - EXECUTION

3.01 ERECTION:

A. Erect deck as recommended by the Steel Deck Institute. Properly align and level on supports.

B. Allow a minimum 1-1/2 inch bearing when supported on structural steel and a minimum 4 inch bearing when supported by masonry.

C. Weld side laps at maximum 18 inches on center. Side laps shall be a minimum 2 inches.

D. Fasten deck to steel framework at ends and intermediate supports with 3/4 inch fusion welds at maximum 12 inches on center.

E. Reinforce openings 6 inches to 18 inches in size with L2 x 2 x 1/4 steel angles. Place angles perpendicular to flutes, extended minimum two flutes each side of openings and weld to deck.

F. Reinforce openings over 18 inches in size in accordance with structural framing details.

G. Install minimum 6 inch wide cover plates where deck changes direction. Spot weld in place at maximum 12 inches on center.

H. Install strip closures at slab edges as required to contain poured concrete. Ensure closures are of sufficient strength to maintain in place without distortion.

I. Install closure strips and angle flashings as required to close openings between deck and walls, columns, and openings.

J. Immediately after installation, touch-up welds, burned areas, and damaged spots with prime paint consistent with shop finish.

or

J. Immediately after installation, touch-up welds, burned areas, and damaged spots with paint recommended for galvanized surfaces.

SECTION 09900 PAINTING

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK:

A. The work includes painting and finishing of interior and exterior exposed items and surfaces throughout project, except as otherwise indicated.

B. Surface preparation, priming and coats of paint specified are in addition to shop priming and surface treatment specified under other sections of work.

C. The work also includes painting of exposed bare and covered pipes and ducts (including color coding), and of hangers, exposed steel and iron work, and primed metal surfaces of equipment installed under mechanical and electrical work, except as otherwise indicated.

D. "Paint" as used herein means all coating systems materials, including primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats.

E. Paint exposed surfaces whether or not colors are designated in "color schedules", except where natural finish of material is specifically noted as a surface not to be painted. Where items or surfaces are not specifically mentioned, paint same as adjacent similar materials or areas. If color or finish is not designated, ENGINEER will select these from standard colors available for materials systems specified.

F. Pre-Finished Items: Unless otherwise indicated, do not include painting when factory-finishing or installer-finishing is specified for such items as, but not limited to, metal toilet enclosures, prefinished partition systems, acoustic materials, architectural woodwork and casework, finished mechanical and electrical equipment including light fixtures, switchgear and distribution cabinets, elevator entrance frames, doors and equipment.

G. Concealed Surfaces: Unless otherwise indicated, painting is not required on surfaces such as walls or ceilings in concealed areas and generally inaccessible areas, furred areas, pipe spaces, duct shafts, dumbwaiter and elevator shafts.

H. Shop Priming: Unless otherwise specified, shop priming of ferrous metal items is included under various sections for structural steel, miscellaneous metal, hollow metal work, and shop-fabricated or factory-built mechanical and electrical equipment or accessories.

I. Finish Metal Surfaces: Metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze, and similar finished materials will not require finish painting;, unless otherwise indicated.

J. Operating Parts and Labels. Moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkage, sinkages, sensing devices, motor and fan shafts will not require finish painting, unless otherwise indicated.

K. Do not paint over any code-required labels, such as Underwriters' Laboratories and Factory Mutual, or any equipment identification, performance rating, name, or nomenclature plates.

1.02 SUBMITTALS:

A. Manufacturer's product data and technical information including paint label analysis and application instructions for each material proposed for use.

B. Samples for ENGINEER's selection from manufacturer's full range of colors and texture (if any). On actual wall surfaces and other exterior and interior building components, duplicate specified painted finishes in selected colors. On at least 10 square feet of surface provide full-coat finish samples until required sheen, color and texture is obtained; simulate finished lighting conditions for review of in-place work.

1.03 DELIVERY AND STORAGE:

A. Deliver materials to job site on original, new and unopened packages and containers bearing manufacturer's name and label, and following information:
1. Name and title of material.
2. Fed. Spec. number, if applicable.
3. Manufacturer's stock number and date of manufacture.
4. Manufacturer's name.
5. Contents by volume, for major pigment and vehicle constituents.
6. Thinning instructions.
7. Application instructions.
8. Color name and number.

B. Provide adequate storage facilities. Store paint materials at minimum temperature of 50 degrees F. in well ventilated areas. Take precautionary measures to prevent fire hazards and spontaneous combustions.

1.04 JOB CONDITIONS:

A. Apply water-base paints only when temperature of surfaces to be painted and surrounding air temperatures is between 50 degrees F and 90 degrees F, unless otherwise permitted by paint manufacturer's printed instructions.

B. Apply solvent-thinned paints only when temperature of surfaces to be painted and surrounding air temperature are between 45 degrees F and 95 degrees F, unless otherwise permitted by paint manufacturer's printed instructions.

C. Do not apply paint in snow, rain, fog or mist; or when relative humidity exceeds 85 percent; or to damp or wet surfaces; unless otherwise permitted by paint manufacturer's printed instructions.

D. Painting may be continued during inclement weather if areas and surfaces to be painted are enclosed and heated within temperature limits specified by paint manufacturer during application and drying periods.

PART 2 - PRODUCTS

2.01 COLORS AND FINISHES:

A. Paint colors, surface treatments, and finishes, are indicated in "color schedules" of the contract documents.

B. Color Pigments: Pure, non-facing, applicable types to suit substrates.

C. Paint Coordination: Provide finish coats which are compatible with prime paints used. Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates. Upon request from other trades, furnish information on characteristics of finish materials proposed for ruse, to ensure compatible prime coats are used. Provide barrier coats over incompatible primers or remove and reprime as required. Notify ENGINEER in writing of any anticipated problems using specified coating systems with substrates primed by others.

2.02 MATERIAL QUALITY:

A. Provide best quality grade of various types of coatings as regularly manufactured by acceptable paint materials manufacturers. Materials not displaying manufacturer's identification as a standard, best-grade product will not be acceptable.

B. Federal Specifications establish minimum acceptable quality for paint materials. Provide written certification from paint manufacturer that materials provided meet or exceed those minimums.

PART 3 - EXECUTION

3.01 EXECUTION:

A. Applicator must examine areas and conditions under which painting work is to be applied and notify ENGINEER in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Applicator.

B. Starting of painting work will be construed as Applicator's acceptance for surfaces and conditions within any particular area.

C. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces. or conditions otherwise detrimental to formation of a durable paint film.

3.03 SURFACE PREPARATION:

A. General: Perform preparation and cleaning procedures in accordance with paint manufacturer's instructions and as herein specified, for each particular substrate condition.

B. Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish-painted, or provide surface applied protection prior to surface preparation and painting operations. Remove, if necessary, for complete painting of items and adjacent surfaces. Following completion of painting of each space or area, reinstall removed items.

C. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program cleaning and painting so that contaminants from cleaning process will not fall onto wet, newly-painted surfaces.

D. Clean concrete floor surfaces scheduled to be painted with a commercial solution of muriatic acid, or other etching cleaner. Flush floor with clean water to neutralize acid, and allow to dry before painting.

E. Wood: Clean wood surfaces to be painted of dirt, oil, or other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sandpaper smooth those finished surfaces exposed to view, and dust off. Scrape and clean small, dry, seasoned knots and apply a thin coat of white shellac or other recommended knot sealer, before application of priming coat. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood-filler. Sandpaper smooth when dried.

F. Ferrous Metals: Clean ferrous surfaces, which are not galvanized or shop coated, of oil, grease, dirt, loose mill scale and other foreign substances by solvent or mechanical cleaning.

G. Touch-up shop-applied prime coats wherever damaged or bare, where required by other sections of these specifications. Clean and touch-up with same type shop primer.

H. Galvanized Surfaces: Clean free of oil and surface contaminants with non-petroleum based solvent.

3.03 MATERIALS PREPARATION:

A. Mix and prepare painting materials in accordance with manufacturer's directions.

B. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing and application of paint in a clean condition, free of foreign materials and residue.

C. Stir materials before application to produce a mixture of uniform density, and stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.

3.04 APPLICATION:

A. General: Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

B. Apply additional coats when undercoats, stains or other conditions show through final coats of paint, until paint film is of uniform finish, color and appearance.

C. Paint interior surfaces of ducts, where visible through registers or grilles, with a flat, non-specular black paint.

D. Finish exterior doors on tops, bottoms and side edges same as exterior faces, unless otherwise indicated.

E. Sand lightly between each succeeding enamel or varnish coat.

F. Omit first coat (primer) on metal surfaces which have been shop-primed and touch-up painted.

G. Scheduling Painting: Apply first-coat material to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

H. Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and application of another coat of paint does not cause lifting of loss of adhesion of the undercoat.

I. Minimum Coating Thickness: Apply materials at not less than manufacturer's recommended spreading rate, to establish a total dry film thickness as specified under paragraph 3.07 or as recommended by coating manufacturer.

J. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to those items exposed in mechanical and electrical equipment rooms and in occupied spaces.

K. Prime Coats: Apply prime coat of material which is required to be painted or finished, and which has not been prime coated by others. Recoat primed and sealed surfaces where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.

L. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverages. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

M. Transparent (Clear) Finishes: Use multiple coats to produce glass-smooth surface film of even luster. Provide a finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, or other surface imperfections. Provide satin finish for final coats, unless otherwise indicated.

3.05 CLEAN-UP AND PROTECTION:

A. Clean-Up: During progress of work, remove from site discarded paint materials, rubbish, cans and rags at end of each work day.

B. Upon completion of painting work, clean window glass and other paint-spattered surfaces. Removed spattered paint by recognized methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

C. Protection: Protect work by other trades, whether to be painted or not, against damage by cleaning, repairing or replacing, and acceptable to the ENGINEER.

D. Provide "Wet Paint" signs as required to protect newly-painted finishes. Remove temporary protective wrappings provided by others for protection of their work, after completion of painting operations.

3.06 MAINTENANCE MATERIALS:

A. Leave on premises one gallon each color used. Containers to be tightly sealed and clearly labelled for identification.

3.07 PAINTING SCHEDULE:

A. Exterior Paint Systems:

	Dry Mils
1. Ferrous Metal:	
1st Coat - Zinc yellow iron oxide primer (TT-P-57, Type II)	2.0
2nd Coat - Epoxy-Polyamide (MIL-P-24441, Type II)	2.0
3rd Coat - Epoxy-Polyamide (MIL-P-24441, Type II)	2.0
First coat not required on items delivered shop primed.	
2. Zinc Coated Metal:	
1st Coat - Zinc dust-zinc oxide primer (TT-P-641)	2.0
2nd Coat - Epoxy-Polyamide (MIL-P-24441, Type II)	2.0
3rd Coat - Epoxy-Polyamide (MIL-P-24441, Type II)	2.0

B. Interior Paint Systems:

1. Concrete Masonry Units:	
1st Coat - Surface filler (TT-F-1098)	-
2nd Coat - Enamel undercoater (TT-E-543)	2.0
3rd cost - Semi-gloss alkyd enamel (TT-E-509)	2.0
Apply filler coat at a rate to ensure complete coverage with pores filled.	
2. Gypsum Drywall:	
1st Coat - Latex primer (TT-P-650)	2.0
2nd Coat - Interior latex emulsion (TT-P-29)	2.0
3rd Coat - Interior latex emulsion (TT-P-29)	2.0
3. Ferrous Metals:	
Epoxy-Polyamide (TT-P-57, Type II)	2.0
Epoxy-Polyamide (MIL-P-24441, Type II)	2.0
Epoxy-Polyamide (MIL-P-24441, Type II)	2.0
First coat not required on items that are shop primed.	

4. Zinc Coated Metal:

1st Coat - Zinc dust-zinc oxide primer (TT-P-641)	2.0
Epoxy-Polyamide (MIL-P-24441, Type II)	2.0
Epoxy-Polyamide (MIL-P-24441, Type II)	2.0

5. Stained Woodwork:

1st Coat - Interior oil stain (14-8460)	-
2nd Coat - High build sealer (14-7043)	1.0
3rd Coat - Lacquer top coat (14-7044)	1.0
4th Coat - Lacquer top coat (14-7044)	1.0

Numbers for stained woodwork by Guardsman. No substitutions allowed.

6. Pipe Insulation Covering:

1st (Size) Coat - Interior latex emulsion (TT-P-29)	2.0
2nd Coat - Interior latex emulsion (TT-P-29)	2.0

Add fungicidal agent to render fabric mildew-proof.

SECTION 09910 CORROSION RESISTANT LININGS

PART 1 - GENERAL

1.01 DESCRIPTION:

A. This item includes all work necessary to construct corrosion resistant linings.

B. Corrosion resistant linings are required for:
1. Floors and walls of container storage area.
2. Upper floor area of truck dock.
3. Truck dock drainage area including sump.

1.02 JOB CONDITIONS:

A. Corrosion resistant linings shall be constructed only by applicators licensed by the material manufacturer.

B. The applicator shall inspect surfaces prior to beginning his work. Defects which will adversely affect the lining shall be reported to the ENGINEER. Application of linings shall not begin until defects have been corrected.

C. Acceptable Manufacturers: Ceilcote, Corrosion Specialists, Inc.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Corrosion Resistant Linings: Ceilcrete 695B by Ceilcote or approved equal.

PART 3 - EXECUTION

3.01 PREPARATION:

A. Concrete shall be a minimum of 28 days old before lining work is begun.

B. Clean all concrete surfaces. Itch with 1:3 hydrocloric acid solution, flush with clear water, and allow to dry.

C. Comply with manufacturer's recommendations.

3.02 INSTALLATION:

A. Prime concrete surfaces as recommended with manufacturer.

B. Install lining system in accordance with manufacturer's recommendations.

C. Provide temporary enclosures, heating and ventilation, as required to comply with manufacturer's temperature, humidity and safety requirements.

D. Leave area in a neat, clean condition. Remove unused materials, containers, etc. from site.

PART 1-GENERAL

1.01 DESCRIPTION:

A. The work in this section includes furnishing basic materials and installation methods for process piping and valve systems, compressed air systems, natural gas systems, and plumbing systems.

B. Materials and accessories furnished and installed under this section shall be fabricated, assembled, and placed in proper operating condition in full conformity with drawings, specifications, engineering data, instructions and recommendations/requirements of the manufacturer as approved by the ENGINEER.

1.02 SUBMITTALS:

A. Shop drawings, five sets. The shop drawing submittal package shall include details, specifications, cuts, schedules, and drawings necessary for furnishing and installing the process piping and valve systems, compressed air systems, and plumbing systems.

B. Product data, five sets.

C. Operation and maintenance data, five sets.

1.03 EQUIPMENT GENERAL PROVISIONS:

A. All information presented in the Equipment General Provisions (Section 11200) or specific process equipment specifications (11200 sections) shall apply to materials and equipment furnished under this section.

1.04 DELIVERY, STORAGE AND HANDLING:

A. Protect all materials and equipment during delivery and during storage on site. Storage shall be on suitable blocking to maintain ground clearance and shall be covered to insure drainage of all rainwater.

PART 2-PRODUCTS

2.01 PIPE AND PIPE FITTINGS:

A. Galvanized Pipe
   1. Galvanized piping conforming to ASTM A-53 or API-5L; Sch. 40 continuous furnace butt weld.

2. Fittings;
   a. 2" and Smaller: 150# malleable galvanized fittings. Use threaded connections to valves and equipment.
   b. 2 -1/2" - 4": mechanically grooved pipe connected using Victaulic type fittings.
      (1) Couplings: Malleable or ductile iron, galvanized, ASTM A-220 or A-536, Victaulic style HP-70 coupling with grade T gasket. Equal by Gustin Bacon also acceptable.
      (2) Elbows, tees, reducers, crosses: Victaulic grooved end fittings of malleble or ductile iron, ASTM A-47 or A-536, grooved for HP-70 coupling. Equal by Gustin Bacon also acceptable.
      (3) Flanges: Victaulic Style 741 Vic-flange, malleble or ductile iron, with Buna-N gasket; ANSI class 150 drilling. Equal by Gustin Bacon also acceptable.
   c. Elbows: long radius design.
   d. Weldolets and threadolets: not permitted for branch take-offs. Use reducing tees or Victaulic Style 921 (or equal) mechanical bolted branch outlet.

B. Steel Pipe
1. Std. weight ERW Steel piping conforming to ASTM A-53 or API-5L Gr. B,; continuous furnace butt weld.
2. Fittings;
   a. Elbows, tees, reducers, crosses: Standard weight seamless steel welding fittings, ASTM A-234 GR WPB, ANSI B16.9.
   b. Flanges: 150 lb. raised face flange, ASTM A-105, ANSI B16.5.
   c. Elbows: long radius design.

C. Teflon Lined Piping
1. Conforming to ASTM F 423-75 for PTFE lined piping systems.
2. Liner:
   a. Liner to be polytetrafluoroethylene (TFE).
   b. Thickness: nominal 0.125 inches.
3. Housing: Schedule 10 carbon steel.
4. Fittings:
   a. Piping: 150 lb. ductile iron Van Stone flanged. Connections to all equipment, hose, etc, to be flanged.
   b. Fittings: 150 lb. ductile iron flanges lined per above with TFE liner.

2.02 PIPING SPECIALTIES:

A. Bolt, Studs and Nuts:
1. Steel bolts, studs and nuts: Comply with the current ASTM A307, Grade B.
2. Threads: American National form right hand machine cut threads complying with the current American Standard for Screw Threads ANSI B1-1, Coarse Thread Series, Class 2 fit.
3. Provide galvanized or cadmium plated carbon steel bolts and nuts for flanged pipe joints.
4. Bolt heads and nuts: Semi-finished, hexagonal, complying with the dimensions for the current American Standard for Wrench Head Bolts and Nuts and Wrench Openings, ANSI B18.2, Heavy Series.

B. Pipe Sleeve:
1. Material: Seamless pipe, galvanized, ASTM A-120 for floors and roofs and seamless ASTM A-53 elsewhere.
2. Sleeve size: Large enough to accommodate the pipe and its covering, wall sleeves to be flush on both sides, and floor sleeves to be extended 1 inch above floor level. Where escutcheon plates are required, extend the sleeves 1/4 inch above the floor.
3. Modular mechanical type seal: Use for the annular space between pipes and sleeves to seal against water or earth, consisting of interlocking synthetic rubber links compressed to positive seal by through bolts bearing on delrin plastic pressure plates. Provide 316 stainless steel bolts.

2.03 PIPE HANGERS AND SUPPORTS:

1. Hangers for pipe sizes 1/2 inch to 1 1/2 inch: adjustable wrought steel ring.
2. Hangers for hot pipe sizes 2 inches to 4 inches and cold pipe sizes 6 inches and over: adjustable wrought steel clevis.
3. Hangers for hot pipe sizes 6 inches and over: adjustable steel yoke and cast iron roll.
4. Multiple or trapeze hangers: steel channels with welded spacers and hanger rods, cast iron roll and stand for hot pipe size 6 inches and over.
5. Wall support for pipe sizes to 3 inches: cast iron hook.
6. Wall support for pipe sizes 4 inches and over: welded steel bracket and wrought steel clamp, adjustable steel yoke and cast iron roll for hot pipe sizes 6 inches and over.
7. Vertical support: steel riser clamp.
8. Floor support for pipe sizes to 4 inches and all cold pipe sizes: cast iron adjustable pipe saddle, locknut nipple, floor flange and concrete pier to steel support.
9. Floor support for hot pipe sizes 6 inches and over: adjustable cast iron roll and stand, steel screws and concrete pier or steel support.

10. Design hangers to impede disengagement by movement of supported pipe.
11. Acceptable manufacturers: Carpenter and Paterson, Fee and Mason, Elcen, and Grinnel.

2.04 VALVES COCKS AND FAUCETS:

A. Gate Valves:
   1. Hot or cold water systems: 125# brass with solid wedge disc.

B. Ball Valves: (for air service only)
   1. Two piece body, double ball seat, with stem seal provided by Belleville washers.
   2. Materials of Construction:
      a. Body: brass
      b. Ball: 316 stainless steel
      c. Stem: 316 stainless steel
      d. Stem seal: TFE
      e. Seats: TFE
      f. Handle: stainless steel
   3. Manufacturer: Jamesbury Model 2000 or equal.

C. Lined Check Valves:
   1. Lined Check valves: poppet type check valve; bolted bonnet.
   2. Body material: cast steel, ANSI class 150 rating.
   3. Liner: PVDF (kynar) or PTFE (teflon)

D. Plug Valves:
   1. 150# (ANSI) ductile iron body, TFE lined body and plug. Acceptable manufacturers: Durco T-line, Tufline 061, Unichem type VIL.
   2. Operators:
      a. 2 inch and smaller shall be lever handle, unless shown otherwise on drawings, 4-inch and larger shall be gear operated.

E. Roof Drainage Systems:
   1. Roof sumps shall have threaded outlets and clamping rings.
   2. Roof sumps used with metal deck construction shall have deck clamps and shall be flashed with 4# lead, 36" square sheet.
   3. Roof sumps set in concrete construction shall have anchoring flanges and shall be flashed with 16 oz. copper, 36" square sheet.
   4. Roof sumps shall consist of a painted cast iron body with clamping flange, gravel stop, insulation extension sleeve, and a 12 1/2" cast iron dome strainer. Acceptable manufacturers: Zurn Z-100, Josam 4110, Wade W-3010, Smith 1010.
   5. Six-inch outlet roof sumps shall consist of a painted cast iron body with clamping flange, gravel stop, insulation extension sleeve,

parabolic drainage weirs, and a 12 1/2" cast iron dome strainer. Approved manufacturer: Zurn A-105-10 ERC.

PART 3-EXECUTION

3.01 PIPE AND FITTINGS:

A. Preparation: ream pipes and tubes, clean off scale and dirt, inside and outside, before assembly. Remove welding slag or other foreign material from piping.

B. Connection: screw joint steel piping up to and including 2 inches. Weld piping 2 1/2 inches and larger, including branch connections.

C. Make screwed joints with full cut standard taper pipe threads with red lead and linseed oil or other approved non-toxic joint compound applied to make threads only.

D. Use main sized saddle type branch connections or directly connecting branch lines to mains in steel piping if main is at least one pipe size larger than the branch for up to 6 inch mains and if main is at least two pipe sizes larger than branch for 8 inches and larger mains. Do not project branch pipes inside the main pipe.

E. Provide gasket and clamp type mechanical fastener for plain end pipe joints.

F. Use grooved mechanical couplings and mechanical fasteners only in accessible locations.

G. Make connections to equipment and branch mains with unions or flanges.

H. Provide non-conducting type connections wherever jointing dissimilar metals in open systems. Brass adapters and valves are acceptable.

3.02 PIPE HANGERS AND SUPPORTS:

A. Support horizontal steel and copper piping as follows:

Nominal Pipe Size (inches)	Max. Distance Between Support (feet)
1/2	6
3/4 to 1 1/2	6
2 & 2 1/2	10
3 & 4	12
6 to 12	14

B. Install hangers to provide minimum 1/2 inch clear space between finished covering and adjacent work.

C. Place a hanger within one foot of each horizontal elbow.

D. Use hangers which are vertically adjustable 1 1/2 inch minimum after piping is erected.

E. Support horizontal soil pipe near each hub, with 5 feet maximum spacing between hangers.

F. Support vertical piping at every other floor. Support vertical soil pipe at each floor at hub.

G. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

H. Where practical, support riser piping independently of connected horizontal piping.

3.03 FLASHING:

A. Flash and counterflash where mechanical equipment passes through weather or waterproofed walls, floors, and roofs.

B. Flash vent and soil pipes projecting 3 inch minimum above finished roof surface with lead worked 1 inch minimum into hub, 8 inch minimum clear on sides with minimum 24 inch sheet size. For pipes through outside walls turn flange back into wall and caulk.

3.04 SLEEVES:

A. Set sleeves in position in advance of concrete work. Provide suitable reinforcing around sleeves.

B. Install seals and provide floor plate.

C. Where piping or ductwork passes through floor, ceiling or wall where no potential moisture exists, close off space between pipe or duct and construction with non-combustible insulation. Provide tight fitting metal caps on both sides and caulk.

3.05 VALVES, COCKS AND FAUCETS:

A. General:
   1. Provide valves of same manufacturer throughout where possible.

2. Provide valves with manufacturer's name and pressure rating clearly marked on outside of body.
3. Statically ground all valves.

B. Installation:
1. Install valves with stems upright or horizontal, not inverted.
2. Install gate valves for shut-off and isolating service, to isolate equipment, part of systems or vertical risers.

3.06 TESTING:

A. General:
1. Each system of piping and control tubing tested by installer under superintendence of CONTRACTOR.
2. Provide pumps, gauges, instruments, test equipment personnel and clean auxiliary water. After tests have been made, remove all test equipment and drain all pipes.
3. Submit a complete test report to the ENGINEER.
4. Operate pumps which have mechanical seal only with water in the system.
5. Test prior to painting, installation and insulation, or concealment.
6. Tests may be made on sections of piping as installed.
7. Re-test repaired or revised piping.

B. Domestic water.
1. Testing with compressed air or gas is prohibited.
2. Test pressure: 150 percent of the operating pressure.
   a. Minimum pressure: 50 psi.
   b. Test period: 2 hours minimum.

C. Compressed Air Systems
1. Compressed air piping to be tested with compressed air.
   a. Remove all regulators, filters and lubricators from line prior to testing.
   b. Fill air lines with compressed air up to designated pressure.
   c. After line is up to pressure, test all fittings for leaks with commercially available soap solution. If leak is evident, repair and retest.
2. Test pressure: 110 psi.
   a. Test period: 1 hour minimum (i.e. test joints after line has been pressurized for greater than 1 hour.

C. Gravity Systems:
1. Waste, drain, and vent systems, downspouts, rain leaders and their branches.

2. Entire System: Close all openings except the highest and fill system with water to point of overflow.
3. Sections: Close all openings in section except highest, and provide a head of 10 feet. In testing successive sections, at least the upper 10 feet of next preceding section shall be included so that every joint and pipe in the whole system (except the uppermost 10 feet) shall have been subjected to a head of ten feet of water.
4. After system or section under test has been filled with water, wait at least 15 minutes before starting inspection.
5. After 2 hours (minimum) there shall be no evidence of leakage.
6. Test waste, drain and vent pipe system before fixtures are installed and re-test after fixtures have been installed.

3.07 LUBRICATION:

A. Ensure that all motors and equipment, as required, are properly lubricated before such items are accepted by the OWNER.

3.08 PIPE AND EQUIPMENT IDENTIFICATION:

A. Label all piping showing contents and direction of flow.

B. Place label adjacent to each valve and branch takeoff, at each side of a wall or partition through which pipe passes, and at 25 feet 0 inch spacing on straight runs.

C. Label manufacturers: Seton Name Plate Corporation, W.H. Brady, Topflight Tape Company, James H. Matthews.

D. Paint or stencil 1 1/2 inch high black enamel block type letters or numerals on all equipment items.

3.09 VALVE IDENTIFICATION:

A. Brass Tags: 1 inch diameter, secured to each valve with brass S-hook and stamped with system designation and assigned number.

B. Provide a printed schedule, in duplicate, describing each valve by number, giving location and service for which used.

3.10 CLEANING OF PIPING SYSTEMS:

A. Domestic Water: Flush with chlorine solution - AWWA C601-68 "Disinfecting Water Mains".

B. Compressed Air: Blow clear of chips and scale with 100 psi air prior to installation of filter, lubricator, or regulator.

C. Transfer lines: Blow clean with compressed air then flush line with clean water. Continue flushing with clean water until no evidence of scale, debris, etc., exists.

CEILCOTE

February, 1985
Supersedes November, 1982

Ceilcrete® 695 S and B
HM 200

TECHNICAL BULLETIN 5-13.7

FLOORING FOR CONCENTRATED SULFURIC ACID SERVICE

Ceilcrete 695 is a protective system for concrete or steel that demonstrates excellent resistance to acids such as 98% sulfuric, and 73% nitric. Ceilcrete 695 is also suitable for other inorganic acids such as concentrated phosphoric and hydrochloric. It will withstand spillage of 1-50% alkali hydroxides. This system is designed to withstand intermittent exposure to these solutions, ranging from dilute to concentrated, at ambient temperatures.

PHYSICAL PROPERTIES

Tensile (ASTM C-307-55) ..... 2200 psi (15 MPa)
Compressive
(ASTM C-306-55) ..... 12,900 psi (89 MPa)
Coefficient of expansion
(in/in/°F) range
70°—210° reinforced
with type H Cloth ..... 12-15 x $10^{11/11}$/°F.

USES

Storage Tank Dikes	Acid Unloading Areas
Chlorine Drying Areas	Acid Pump Bases
Water Treating Areas	Chemical Mixing Rooms

FLASH POINTS (Pensky-Martens Closed Cup)

695 Basecoat Liquid	83°F. (28°C.)
695 Topcoat Liquid	82°F. (28°C.)
Hardener No 2	175°F. (89°C.)
T-431 Smoothing Liquid	131°F. (55°C.)
Solvent T-410	52°F. (11°C.)

CHEMICAL PERFORMANCE

When exposed to 98% sulfuric acid, Ceilcrete 695 forms a protective barrier which resists chemical attack thereby extending service life. Washdown will remove this barrier and slightly reduce topcoat thickness.

Acid spills are immediately made apparent by a color change upon exposure

Where severe acid leaking exists, Ceilcote's HM 200 can be applied over Ceilcrete 695 to substantially extend the service life of the system. HM 200 is a low cost maintenance material which remains soft after application; therefore, use should be limited to non-traffic areas.

STORAGE

Ceilcrete Liquid and Hardener should be stored in a cool place away from flames. The liquid may harden after 3 months at 70°F., 1 month at 80-90°F. Life may be extended by removing container cover and stirring once a week, and then replacing cover

ORDERING INFORMATION

NOTE: If area is inside a building or in a warm climate where winter temperatures seldom get below 32°F. (0°C.), the light-duty version can be used.

ESTIMATED AS LBS./SQ. FT.

For heavy duty version order "F" Cloth, light duty order "H" Cloth. Basecoat liquid is also used for priming.

	Heavy Duty	Light Duty
Basecoat Liquid	.52	.37
Hardener No 2	.014	.011
Type S-1 Powder	.82	.82
Topcoat Liquid	.16	.16
Type "F" or "H" Glass Cloth	1.05 sq. ft.	1.05 sq. ft.
T-431 Smoothing Liquid	.005 gal	.005 gal.
Cleaning Solvent T-410*	.02 gal.	.02 gal.

*Cleaning Solvent can be adjusted for size of job.

HM 200 - Available in 10 lb. packages that will cover approximately 150 sq. ft. at 10 mil thickness.

Standard Packaging

Basecoat Liquid	5 gal. (44 lbs.); 55 gal (450 lbs.)
Hardener No. 2	4 oz.; 1 lb.; 8 lbs.; 20 lbs.
Type S-1 Powder	50 lb. bags
Type B Powder	80 lb. bags
Topcoat Liquid	5 gal. (32 lbs.); 55 gal (360 lbs.)
Type "F" or "H" Glass Cloth	As Needed
T-431 Smoothing Liquid	1 gal (6# 5 oz.); 5 gal (31# 9 oz)
Cleaning Solvent T-410	1 gal.; 5 gal.; 55 gal.

SURFACE PREPARATION

Ceilcrete 695 requires well cured concrete with surface tensile strength no less than 275 psi. If concrete is in an area exposed to winter temperatures below 0°F., the surface strength should be minimum 300 psi This is tested using Ceilcote Method CTP 142. Contact Ceilcote regarding this procedure

Concrete exposed to concentrated acids should have a slope of ¼" to ½" per foot for good drainage

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The new concrete floors should preferably be cured for at least 2 s, then treated with 1:2 concentrated hydrochloric acid: olution, flushed with clear water and allowed to dry prior to applying the primer. The acid treatment will remove any glaze present, cement which is uncured because of surface drying, and dust. Where the floor is exposed to outside weather conditions sandblasting or scarifying is the preferred method of preparation.

Ceilcote's recommended construction practice for floors is found in Bulletin CP-17 (Specification 3-2.1). Complete recommendations for surface preparation are found in Bulletin CP-14.

APPLICATION PROCEDURE - Abbreviated

CAUTION: Temperature of concrete during installation and curing must be not less than 60°F.

1. Prepare and dry concrete.
2. Prime and let cure (6-12 hrs.).
3. Trowel on approximately 1/16" basecoat.
4. Immediately press glass cloth into basecoat, brushing with a dry, stiff brush to get good contact.
5. Immediately saturate and let cure (overnight).
6. Trowel on not less than 1/16", and not over 1/8" topcoat, then smooth by brushing with a soft brush dampened with T-431 Smoothing Liquid. Let cure 5 days at 70°F, concrete temperature or 2 days in hot sun before contact with concentrated acid.

Contact Ceilcote for detailed installation procedures.

I) APPLICATION

C lly melt HM 200 in a 5 gal. pail or other container using a propane torch or hot plate. Adjust temperature to about 300°F Use a 3-4" natural bristle brush (no plastic bristles) to apply HM 200 at approximately 10 mils thickness to the dry, dust-free surface

SAFETY

Ceilcrete systems contain polyester resin and styrene monomer. The hardener is an organic peroxide. Ceilcrete system components have been formulated to optimize physical lining characteristics while minimizing hazardous physical and health factors encountered during application. A concerned effort is made to be aware of the latest chemical toxicological information and to apply this knowledge in a responsible manner to insure product safety.

During application of the Ceilcrete system materials always wear gloves and appropriate work clothing to minimize contact. Ventilation is required with special consideration for enclosed or confined areas. Air movement must be designed to insure turnover at all locations in work area and adjacent areas to avoid buildup of heavy vapors. Use caution when handling flammable liquids, eliminate sources of ignition from work areas, and empty containers with residues.

Observe safe storage practices by separating resins from hardeners, by keeping solvents and hardeners in a cool area free of sources of ignition, and by observing a special Ceilcote warning on red and yellow labeled products. The Ceilcote red labels represent amine-type chemicals, and the Ceilcote yellow labels represent organic peroxide-type chemicals which should not be stored adjacent or mixed together because of the possible violent reaction between them.

Product Material Safety Data Sheets and installation bulletins are available and should be consulted when handling products. These products are for industrial and professional use; application directions must be followed.

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THIS WARRANTY IS IN LIEU OF ANY OTHER WARRANTY OR OBLIGATION EXPRESSED OR IMPLIED AND NO LIABILITY IS ASSUMED BY THE CEILCOTE COMPANY EXCEPT AS IS EXPRESSLY STATED ABOVE

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CEILCOTE

Monolithic Linings

Monolithic Flooring

Industrial Coatings

Organic Grouting

Acid Proof Brick, Mortars and Membranes

FRP and Thermoplastic Laminates

Ceilcote Master Corrosion Resistance Guide

Coatings Selection Guide

This chart provides easy reference to the chemical resistance and physical properties of Ceilcote coatings. For more specific product recommendations, consult your Ceilcote representative.

LEGEND

O — OUTSTANDING
E — EXCELLENT
VG — VERY GOOD
G — GOOD
F — FAIR
L — LIMITED
P — POOR
A — ALL COLORS
N/R — NOT RECOMMENDED

PRODUCT NAME	TYPE	ATMOSPHERIC ENVIRONMENTS				SPLASH & SPILL				PHYSICAL PROPERTIES			
		ACIDS	ALKALIS	OXIDANTS	SOLVENTS	ACIDS	ALKALIS	OXIDANTS	SOLVENTS	ABRASION RESISTANCE	HEAT STABILITY	AVAILABLE COLORS	GLOSS RETENTION
POLYESTERS													
Flakeline 211/212	Polyester	E	L	E	G	E	L	E	G	E	E	L	F
Flakeline 222 H.T.	Vinyl Ester	O	L	O	VG	O	L	O	VG	E	O	L	F
Flakeline 232	Vinyl Ester	E	F	E	G	E	F	E	G	E	E	L	F
Flakeline 242	Vinyl Ester	E	F	E	L	E	F	E	L	E	E	L	F
Flakeline 251/252	Polyester	E	G	E	G	E	G	E	G	E	E	L	F
Flakeline 262	Polyester	E	L	E	G	E	L	E	G	E	G	L	F
Flakeline 300/350	Polyester	E	L	E	G	E	L	E	G	E	E	L	F
EPOXIES													
Flaketar	Coal Tar Epoxy	E	E	L	L	G	G	N/R	N/R	L	E	L	P
Flakeline 600	Epoxy Adduct	G	E	L	G	F	E	L	G	G	G	A	F
650 H.B.	Epoxy Polyamide	G	E	L	G	P	E	N/R	F	G	G	A	G
650 F D.A.	Epoxy Polyamide	G	E	L	G	P	E	N/R	F	G	G	A	G
660	C.T.E. Polyamide	E	E	L	L	G	G	N/R	N/R	L	E	L	P
670	Epoxy Polyamide	G	E	L	G	P	E	N/R	F	G	G	A	G
900	Epoxy Ester	F	F	P	L	N/R	N/R	N/R	N/R	F	F	A	G
VINYLS													
700	Vinyl Copolymer	E	E	E	L	VG	VG	G	N/R	G	L	A	F
742	Vinyl Copolymer	E	E	E	L	VG	VG	G	N/R	G	L	A	F
750	Vinyl Chloride	E	E	E	L	VG	VG	G	N/R	G	L	A	F
CHLORINATED RUBBER													
550	Chlorinated Rubber	G	G	G	L	N/R	N/R	N/R	N/R	F	F	A	F
URETHANES													
470	Aliphatic Acrylic Polyurethane	VG	E	L	E	G	G	N/R	E	O	G	A	E
480	Aliphatic Polyester Polyurethane	VG	E	L	E	G	G	N/R	E	O	G	A	E
ALKYDS													
930	Alkyd Medium Oil	F	P	F	L	N/R	N/R	N/R	N/R	F	F	A	F
932	Silicone Alkyd	F	P	F	L	N/R	N/R	N/R	N/R	F	G	A	F
940	Alkyd Medium Oil	F	P	F	L	N/R	N/R	N/R	N/R	F	F	A	F
SILICONES (Aluminum)													
810	Silicone 1,000 °F	L	L	L	L	N/R	N/R	N/R	N/R	L	E	L	G
850	Silicone 500 °F	L	L	L	L	N/R	N/R	N/R	N/R	L	E	L	G
870	Silicone 1,000 °F	L	L	L	L	N/R	N/R	N/R	N/R	L	O	L	G

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Corrosive Environment Tables

	LININGS				COATINGS					FLOOR TOPPINGS						
	Flakeline 100 Series	Lining Series	Ceilcrete Series	Coroline Series	Flakeline 200 Series	Flakeline 222HT	Flakeline 300	Flakeline 600	Flaketar	Ceilcrete Series	Coroline Series	681, 685 Floors	682, 683 Floors	687 Floors	Corocrete SR	Sealants
Acetaldehyde	T	T	T	T	T	T	N	N	N	D2	D2	T	N	D2	N	N
Acetic Acid - 10%	C1	C1	C1	T	D1	D1	D3	N	D2	A2	D2	D2	D2	B2	N	D2
Acetic Acid 1-50%	D1	D1	D1	N	D2	D2	D3	N	D3	C2	N	N	N	C2	N	N
Acetic Acid 50% to (Glacial)	T	D1	D1	N	C2	C2	D3	N	N	D2	N	N	N	D2	N	N
Acetic Anhydride	D1	D1	D1	N	T	T	D3	N	N	D2	N	N	N	D2	N	N
Acetone	T	T	T	T	D2	D2	T	N	N	D2	D2	D2	D2	D2	D2	T
Acetyl Bromide	T	T	T	T	N	N	T	N	N	D2	T	N	N	T	N	N
Acetyl Chloride	T	T	T	T	T	T	T	N	N	D2	D2	N	T	T	N	N
Acrylic Acid	D1	D1	D1	T	T	T	D2	N	N	D2	T	N	N	D2	N	N
Acrylonitrile	T	N	T	N	N	N	N	N	N	T	N	N	N	T	N	N
Adipic Acid - 25%	D1	D1	D1	D1	D1	D1	D2	T	T	D2	D2	D2	D2	D2	T	T
Allyl Alcohol	D1	D1	D1	T	D1	D1	T	T	N	D2	T	T	T	T	T	T
Allyl Chloride	D1	D1	D1	T	D1	D1	T	N	N	D2	T	N	T	T	N	N
Alum (Saturated Solution)	C1	C1	C1	C1	D1	D1	D1	D2	D1	A2	A2	A2	A2	B2	D2	A2
Aluminum Bromide	A1	A1	A1	T	D1	D1	D1	D1	D1	A2	A2	A2	D2	B2	D2	A2
Aluminum Chloride	A1	A1	A1	D1	D1	D1	D1	D1	D1	A2	A2	A2	A2	B2	D2	A2
Aluminum Fluoride*	T	D1	A1	A1	C2	C2	C2	T	A2	A2	A2	D2	A2	D2	D2	A2
Aluminum Sulfate	C1	C1	C1	C1	D1	D1	D1	D1	D1	A2	A2	A2	A2	B2	C2	A2
Ammonia (Dry)	C1	C1	C1	A1	D3	D3	T	C3	C3	C2	A2	D3	A2	A3	D3	D3
Ammonium Chloride	A1	A1	A1	A1	D1	C1	D1	D1	D1	A2	A2	A2	A2	A2	C2	A2
Ammonium Cocoampholyte - 30%	C1	C1	C1	C1	D1	D1	D2	D2	D2	A2	A2	D2	A2	D2	D2	D2
Ammonium Fluoride*	T	C1	A1	A1	D1	D2	D2	T	T2	C2	C2	D2	D2	C2	T	D2
Ammonium Hydroxide - 20%	D1	C1	C1	B1	D1	C1	N	D2	D2	C2	A2	D2	A2	B2	D2	A2
Ammonium Lauryl Sulfate - 30%	D1	D1	D1	D1	D1	D1	D2	D2	D2	C2	C2	D2	C2	C2	D2	D2
Ammonium Nitrate	A1	A1	A1	A1	D1	C1	D1	D1	D1	A2	A2	A2	A2	A2	C2	A2
Ammonium Persulfate	A1	A1	A1	D1	D1	C1	D1	D1	D1	A2	D2	A2	D2	B2	D2	D2
Ammonium Sulfate	A1	A1	A1	A1	D1	C1	D1	D1	D1	A2	A2	A2	A2	A2	C2	A2
Ammonium Sulfide	A1	A1	A1	A1	D1	C1	N	D1	D1	A2	A2	A2	A2	A2	C2	D2
Ammonium Sulfite	A1	A1	A1	A1	D1	C1	D1	D1	D1	A2	A2	A2	A2	A2	C2	A2
Ammonium Xylene Sulfonate - 40%	C1	C1	C1	C1	D1	C1	C2	D2	T	C2	C2	D2	D2	C2	D2	D2
Amyl Acetate	D1	D1	D1	T	D1	D1	N	N	N	D2	D2	N	D2	D2	N	T
Amyl Alcohol	C1	C1	C1	D1	D1	C1	D2	N	D2	A2	D2	C2	C2	C2	D2	D2
Aniline	D1	D1	D1	N	D1	D1	N	N	N	D2	D2	N	N	T	N	N
Aniline Hydrochloride	D1	D1	D1	C1	D1	D1	D2	N	N	D2	C2	D2	C2	T	N	D2
Anodizing-Chromic	See Chromic Acid - 10%															
Anodizing-Sulfuric	See Sulfuric Acid - 20-50%															
Antimony Chloride (tri)	A1	A1	A1	C1	D1	C1	C2	C2	C2	A2	A2	A2	A2	B2	C2	A2
Aqua Regia	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Arsenous Acid	D1	C1	A1	T	D1	C1	C2	T	T	C2	A2	O2	A2	T	D2	D2
Barium Chloride	A1	A1	A1	C1	D1	C1	C2	C2	D2	A2	A2	A2	A2	A2	C2	A2
Barium Hydroxide	D1	D1	C1	A1	D1	C1	N	D1	D1	C2	A2	A2	A2	A2	C2	A2
Barium Sulfide	A1	A1	A1	B1	D1	C1	C2	D1	D1	A2	A2	A2	A2	A2	C2	D2
Benzal Chloride	T	T	T	D1	T	T	T	T	N	D2	D2	T	T	D2	T	T
Benzaldehyde	T	T	T	T	T	T	N	N	N	D2	D2	N	T	D2	N	T
Benzene (Benzol)	D1	D1	D1	D1	D1	D1	N	N	N	D2	D2	D2	D2	D2	D2	N
Benzene Sulfonic Acid 50-100%	C1	C1	C1	T	D1	C1	T	N	N	A2	D2	D2	D2	C2	D2	D2
Benzene Thiol	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Benzyl Alcohol	D1	D1	D1	D1	D1	C1	N	T	T	D2	C2	D2	D2	D2	D2	D2
Benzoic Acid	A1	A1	A1	C1	D1	C1	C2	D2	D1	A2	C2	A2	A2	T	T	A2
Benzoyl Chloride	T	T	T	D1	T	T	T	T	T	C2	D2	D2	D2	T	T	T
Benzyl Chloride	T	T	T	D1	T	T	T	T	T	D2	D2	D2	D2	A2	D2	N
Black Liquor (Paper)	C1	C1	C1	A1	D1	C1	C2	C2	D2	A2	A2	A2	A2	B2	C2	A2
Boric Acid	B1	C1	C1	C1	D1	C1	C2	C2	D2	D2	D2	D2	D2	A2	N	A2
Bromine, Wet Gas	D3	D3	D3	N	D3	D3	N	N	N	D3	T	N	N	T	N	N
Bromine, Dry Gas	D3	D3	D3	N	D3	D3	N	N	D3	D3	T	N	N	T	N	N
Bromine Water - 5%	D1	D1	D1	N	D1	D1	N	N	N	C2	T	N	N	T	N	N
Butanol	C1	C1	D1	C1	D1	D1	D2	N	N	D2	C2	D2	D2	D2	D2	D2
Butyl Acetate	D1	D1	D1	T	D1	D1	N	N	N	D2	D2	N	D2	T	N	N

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Corrosive Environment Tables

	MORTARS MEMBRANES						GROUTS		DURACOR® FRP LAMINATES						DURACOR THERMOPLASTIC LAMINATES				
	Bric Bond (Reg.) & Carbon	Compobond	Corobond	Polyester	Epoxy	Ceilcote 8303, 8305, HM 195	640 Grout	Epoxy Grouts	Isophthalic Polyester	Bisphenol Polyester	Chlorinated Polyester	Vinyl Ester	Epoxy	Furan	Polyvinyl Chloride (PVC)	Polyvinyl Dichloride (CPVC)	Polypropylene (PP)	Kynar (PVDF)	Armalon (Teflon)
Acetaldehyde	D2	A1	A1	D2	D2	N	D2	D2	N	N	N	T	T	D1	N	N	D1	C1	C1
Acetic Acid - 10%	C1	A1	A1	B1	C2	D1	B2	D2	D1	B1	B1	B1	N	A1	C1	C1	A1	A1	A1
Acetic Acid 1-50%	D2	A1	A1	D1	N	N	C2	N	D2	C1	D1	B1	N	D1	C1	C1	C1	A1	A1
Acetic Acid 50% to (Glacial)	N	A1	A1	D2	N	N	D2	N	N	D1	T	D1	N	A1	N	N	D1	B1	A1
Acetic Anhydride	D2	A1	N	D2	N	N	D2	N	D3	D1	D2	D1	N	D1	N	N	N	C1	A1
Acetone	N	A1	A1	T	D2	N	D2	D2	N	T	N	T	T	D1	N	N	C1	N	C1
Acetyl Bromide	D2	A1	T	T	T	N	T	D2	D3	T	D3	T	D3	N	N	N	N	D1	C1
Acetyl Chloride	D2	A1	A1	T	D2	N	T	D2	T	T	T	T	N	D1	N	N	N	D1	C1
Acrylic Acid	N	A1	A1	D1	T	N	D2	N	D3	D1	T	D1	N	D1	N	N	N	D1	A1
Acrylonitrile	N	A1	A1	N	N	N	T	N	N	N	N	T	N	B1	N	N	N	D1	B1
Adipic Acid 25%	D1	D1	D1	D1	D1	D1	D2	D2	D1	D1	D1	B1	D1	D1	A	A	A1	A1	A1
Allyl Alcohol	T	A1	A1	D1	T	T	T	T	N	N	N	D1	T	D1	D1	D1	D1	A1	A1
Allyl Chloride	N	A1	D1	D1	T	N	T	T	N	T	N	D1	T	D1	N	N	A1	A1	A1
Alum (Saturated Solution)	C1	A2	A1	C1	C1	D1	B2	A2	D1	C1	C1	C1	C1	A1	N	A	A1	A1	A1
Aluminum Bromide	C1	A1	C2	A1	T	A1	B2	A2	C1	B1	C1	B1	A2	D1	A1	A1	A1	A1	A1
Aluminum Chloride	A1	A1	A1	A1	D1	A1	B2	A2	C1	A1	C1	A1	D1	A1	A1	A1	A1	A1	A1
Aluminum Fluoride*	A1	N	A1	A1	A1	D1	D2	D2	C1	A1	C1	A1	D1	A1	A1	A1	A1	A1	A1
Aluminum Sulfate	A1	A1	A1	C1	C1	D1	B2	A2	C1	C1	C1	C1	C1	A1	A1	A1	A1	A1	A1
Ammonia (Dry)	N	N	A1	C1	A1	A1	B2	A3	N	A1	N	A1	A1	A1	D1	B1	B1	B1	A1
Ammonium Chloride	C1	D1	A1	A1	A1	A1	A2	A2	A1	A1	A1	A1	A1	A1	A1	A1	A1	A1	A1
Ammonium Cocoampholyte - 30%	A1	N	A1	A1	D1	T	C2	C2	C1	B1	B1	B1	C1	A1	B1	B1	B1	A1	A1
Ammonium Fluoride*	D2	N	A1	C1	C1	D1	D2	D2	C1	C1	C1	C1	C1	A1	A1	A1	A1	A1	A1
Ammonium Hydroxide - 20%	N	N	A1	A1	A1	A1	B2	A2	N	C1	C1	C1	B1	A1	A1	A1	A1	A1	A1
Ammonium Lauryl Sulfate - 30%	C2	T	A1	C1	C1	T	C2	C2	C1	C1	C1	C1	C1	B1	A1	A1	A1	A1	A1
Ammonium Nitrate	C1	A1	A1	A1	A1	A1	A2	A2	C1	A1	A1	A1	A1	D1	A1	A1	A1	A1	A1
Ammonium Persulfate	A1	D1	D1	A1	A1	A1	B2	D2	C1	B1	C1	B1	D1	D1	A1	A1	A1	A1	A1
Ammonium Sulfate	C1	A1	A1	A1	A1	A1	A2	A2	C1	A1	A1	A1	A1	A1	A1	A1	A1	A1	A1
Ammonium Sulfide	D1	N	A1	A1	A1	A1	A2	A2	N	D1	D1	D1	C1	A1	A1	A1	A1	A1	A1
Ammonium Sulfite	D1	N	A1	C1	A1	A1	A2	A2	D1	A1	C1	A1	D1	A1	A1	A1	A1	A1	A1
Ammonium Xylene Sulfonate - 40%	D2	N	A1	C1	C1	T	C2	C2	C1	B1	B1	B1	C1	A1	D1	D1	D1	A1	A1
Amyl Acetate	N	A1	A1	D1	T	N	D2	D2	N	D1	T	D1	T	D1	N	N	N	C1	A1
Amyl Alcohol	N	A1	A1	D1	D1	N	C2	A2	D1	B1	B1	B1	C1	D1	N	N	A1	B1	A1
Aniline	N	A1	A1	D1	N	N	T	N	N	T	T	D1	N	C1	N	N	A1	D1	A1
Aniline Hydrochloride	C2	A1	A1	D1	C1	D1	T	C2	N	B1	D1	D1	C1	C1	N	N	A1	A1	A1
Anodizing-Chromic																			
Anodizing-Sulfuric																			
Antimony Chloride (tri)	A1	A1	A1	D1	C1	A1	B2	A2	C1	A1	A1	A1	C1	A1	A1	A1	A1	A1	A1
Aqua Regia	D2	A1	N	N	N	N	N	N	N	N	N	N	N	N	N	D1	N	D1	B1
Arsenous Acid	A1	A1	A1	C1	T	A1	T	A2	D1	B1	B1	B1	T	A1	A1	A1	A1	A1	A1
Barium Chloride	A1	A1	A1	A1	C1	A1	A2	A2	C1	A1	A1	A1	C1	A1	A1	A1	A1	A1	A1
Barium Hydroxide	N	N	A1	D1	A1	A1	A2	A2	N	C1	D3	C1	A1	A1	A1	A1	A1	A1	A1
Barium Sulfide	N	N	A1	A1	A1	A1	A2	A2	C3	A1	C3	A1	D1	A1	A1	A1	A1	A1	A1
Benzal Chloride	T	A1	A1	T	D1	N	T2	D2	N	T	T	T	D1	C1	N	N	D1	T	A1
Benzaldehyde	N	A1	A1	D2	D1	N	D2	T	N	D3	D3	D3	T	C1	N	N	D1	D1	A1
Benzene (Benzol)	D2	A1	A1	D	D1	N	D2	D2	N	D1	D1	D1	D1	A1	N	N	N	C1	A1
Benzene Sulfonic Acid 50-100%	C1	A1	A1	A1	T	D2	C2	D2	N	A1	D1	C1	T	A1	N	N	D1	A1	A1
Benzene Thiol	N	A1	C2	N	N	N	N	N	N	N	N	N	N	D1	N	N	D1	A1	A1
Benzyl Alcohol	D2	A1	A1	A1	D1	D1	D2	D2	N	D1	T	C1	T	B1	N	N	D1	A1	A1
Benzoic Acid	C1	A1	A1	C1	C1	D1	D2	A2	C1	A1	A1	A1	C1	A1	D1	D1	D1	A1	A1
Benzoyl Chloride	N	A1	A1	D2	D1	N	D2	D2	N	N	N	D2	D1	D1	N	N	N	A1	A1
Benzyl Chloride	N	N	A1	A1	A1	N	T	D2	N	T	N	T	D1	D1	N	N	D1	A1	A1
Black Liquor (Paper)	B1	A1	A1	A1	A1	A1	A2	A2	N	A1	T	A1	C1	N	A1	A1	A1	A1	A1
Boric Acid	D2	A1	A1	D1	D1	D1	B2	A2	C1	A1	B1	A1	C1	A1	A1	A1	A1	A1	A1
Bromine, Wet Gas	N	A1	N	T	N	N	T	N	N	B3	D3	D3	N	N	N	N	N	C1	A1
Bromine, Dry Gas	N	A1	N	T	N	N	T	N	N	B3	D3	B3	N	N	N	N	N	C1	A1
Bromine Water - 5%	T	A1	N	D1	N	D1	T	N	N	D1	D1	D1	N	N	D1	D1	N	A1	A1
Butanol	D2	A1	A1	D1	C1	N	D2	A2	T	D1	D1	D1	C1	A1	D1	D1	D1	A1	A1
Butyl Acetate	N	A1	A1	D1	T	N	T	D2	N	D1	D1	D1	T	D1	N	N	N	D1	A1

KEY TO CHEMICAL RESISTANCE CHART

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CEILCOTE

Corrosive Environment Tables

	LININGS				COATINGS					FLOOR TOPPINGS						
	Flakeline 100 Series	Lining Series	Ceilcrete Series	Coroline Series	Flakeline 200 Series	Flakeline 222HT	Flakeline 300	Flakeline 600	Flaketar	Ceilcrete Series	Coroline Series	681, 685 Floors	682, 683 Floors	687 Floors	Corocrete SR	Sealants
Butyl Acrylate	T	T	T	N	T	T	N	N	N	D2	D2	N	T	T	N	N
Butyl Amine	T	T	T	D3	D3	D3	N	N	N	D2	N	N	N	T	T	N
Butyl Carbitol	D1	D1	D1	D1	D1	D1	T	N	T	D2	A2	D2	D2	D2	N	D2
Butyl Carbitol Acetate	D1	D1	D1	D1	D1	D1	T	N	N	D2	D2	T	T	D2	N	N
Butyl Cellosolve	C1	C1	C1	D1	D1	D1	D2	N	N	D2	D2	T	D2	D2	N	N
Butyl Cellosolve Acetate	D1	D1	D1	D1	D1	D1	D2	T	N	D2	D2	T	D2	D2	N	N
Butyl Ether	D1	D1	D1	T	D1	D1	D2	T	N	D2	D2	T	D2	D2	N	N
Butyl Levuline Acid	D1	D1	D1	D1	D1	D1	T	T	N	D2	D2	T	D2	D2	D2	T
Butyric Acid 100%	D1	D1	D1	N	D1	D1	T	N	N	D2	T	N	N	D2	N	N
Cadmium Plating - Cyanide	C1	C1	C1	A1	D1	D1	T	C2	C2	A2	A2	C2	A2	A2	D2	D2
Calcium Bisulfite	A1	A1	A1	C1	D1	C1	C2	D1	D1	A2	A2	A2	D2	B2	D2	A2
Calcium Chloride	C1	A1	A1	A1	D1	C1	C2	D1	D1	A2	A2	A2	A2	A2	C2	A2
Calcium Hydroxide*	N	C1	C1	A1	D1	T	N	C2	D2	A2	A2	C2	A2	A2	C2	A2
Calcium Hypochlorite* - 5%	N	D1	D1	N	D2	T	N	N	N	N	T	N	D2	N	N	N
Calcium Nitrate	A1	A1	A1	C1	D1	C1	D1	D1	D1	A2	A2	A2	A2	A2	C2	A2
Caprylic Acid (Octanoic Acid)	C1	C1	C1	N	D1	D1	C2	N	N	D2	N	N	N	T	N	N
Carbolic Acid (Phenol) - 88%	N	N	N	N	N	N	N	N	N	D2	N	N	N	T	N	N
Carbon Bisulfide (Di)	D3	D3	N	N	D3	D3	N	N	N	D2	D2	N	D2	T	N	N
Carbon Tetrachloride	D1	C1	C1	D1	D1	D1	D2	N	N	A2	A2	D2	C2	C2	D2	D2
Castor Oil	B1	A1	C1	D1	C1	C1	D1	D1	D1	A2	A2	C2	A2	T	T	A2
Cellosolve	D1	D1	D1	D1	D1	D1	T	T	N	D2	D2	T	D2	D2	N	T
Cellosolve Acetate	D1	D1	D1	D1	D1	D1	T	N	N	D2	D2	N	D2	D2	N	N
Chloroacetic Acid 1-50%	D1	D1	D1	N	D1	D1	D3	N	N	D2	N	N	T	T	N	D2
Chloroacetic Acid - 50%	D1	D1	D1	N	D1	D1	D3	N	N	D2	N	N	N	D2	N	N
Chloroacetic Acid - 80%	N	N	N	N	N	N	N	N	N	D2	N	N	N	D2	N	N
Chlorine Dioxide - 15%	D1	C1	C1	N	D1	D1	T	N	N	B2	T	N	N	N	N	N
Chlorine Gas - Dry	C3	C3	C3	N	C3	C3	C3	N	N	N	N	N	N	N	N	N
Chlorine Gas - Wet	C3	C3	C3	N	D3	C3	N	N	N	D2	N	N	N	N	N	N
Chlorine Water - Saturated	C1	A1	C1	N	D1	C1	D3	N	N	B2	N	N	N	N	N	N
Chlorobenzene (Mono)	D1	D1	D1	D1	D1	D1	N	D2	D2	D2	D2	N	D2	D2	N	N
Chlorobutane	D1	D1	D1	D1	D1	D1	D2	T	N	D2	D2	T	T	D2	N	T
Chloroform	N	N	N	N	N	N	N	N	N	D2	T	N	N	N	N	N
Chlorophenol	N	T	T	T	T	T	N	N	N	D2	N	N	N	N	N	N
Chlorosulfonic Acid	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Chlorotoluene	D1	D1	D1	D1	D1	D1	T	D2	D2	D2	D2	N	D2	D2	N	N
Chromic Acid - 10%	C1	A1	C1	N	D1	D1	C2	N	N	C2	N	N	N	D2	N	D2
Chrome Plating 20 - 42 oz/gal	N	C1	N	N	C2	N	C3	N	N	C2	N	N	N	D2	N	N
Chromic Chloride	C1	A1	A1	N	D1	C1	C2	N	N	A2	A2	C2	A2	A2	D2	A2
Citric Acid	B1	A1	A1	D1	D1	C1	D1	D1	D1	A2	A2	C2	A2	A2	D2	D2
Copper Plating - Cyanide	D1	D1	D1	B1	D1	D1	N	D2	D2	A2	A2	C2	B2	A2	D2	D2
Copper Plating - Acid	B1	A1	A1	C1	D1	D1	C2	D2	D2	A2	B2	D2	D2	B2	D2	D2
Corn Oil	A1	A1	A1	D1	D1	C1	D1	D1	D1	A2	C2	D2	D2	B2	D2	D2
Cottonseed Oil	A1	A1	A1	D1	D1	C1	D1	D1	D1	A2	C2	D2	D2	B2	D2	D2
Cresol	N	T	D2	N	T	T	N	N	N	D2	N	N	N	T	N	N
Cresylic Acid	N	T	T	N	T	T	N	N	N	D2	N	N	N	T	N	N
Cumene	D1	D1	D1	D1	D1	D1	D2	N	N	D2	D2	T	T	D2	T	T
Cyclohexane	C1	C1	C1	C1	D1	D1	D2	N	N	C2	C2	D2	D2	D2	D2	D2
Cyclohexanone	D1	D1	D1	D1	D1	D1	D2	N	N	D2	D2	T	D2	D2	N	T
Cymene	D1	D1	D1	D1	D1	D1	D2	N	N	D2	D2	T	D2	D2	D2	T
Dextrose	A1	A1	A1	A1	D1	C1	D1	D1	D1	A2	A2	A2	A2	A2	C2	A2
Dibromopropane Phosphate	D1	D1	D1	D1	D1	D1	D2	D2	D2	D2	D2	D2	D2	D2	D2	D2
Dibutyl Phthalate	B1	C1	C1	B1	D1	C1	C2	D2	D2	C2	B2	D2	A2	B2	D2	A2
Dichloro Acetic Acid - 20%	D1	D1	D1	N	D1	D1	D3	N	N	D2	N	N	N	T	N	D2
Diethylamine - 100%	T	T	T	N	T	T	N	N	N	T	N	N	N	T	N	N
Diethylene Chloroformate	T	T	T	T	N	T	N	N	N	D2	D2	N	T	T	N	T
Diethylketone - 100%	D1	D1	D1	T	D1	D1	N	N	N	D2	T	N	D2	D2	N	N
Dimethyaminopropylamine	N	N	N	N	D3	T	N	N	N	D2	T	N	N	T	N	N
Dimethyl Aniline	D1	D1	D1	T	D1	T	T	N	N	D2	T	T	T	T	T	N

* Duracor requires synthetic veil for fluorides, caustics and hypochlorites. Other products may require carbon filler

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CEILCOTE

Corrosive Environment Tables

	MORTARS MEMBRANES						GROUTS		DURACOR® FRP LAMINATES						DURACOR THERMOPLASTIC LAMINATES				
	Bric Bond (Reg.) & Carbon	Compobond	Corobond	Polyester	Epoxy	Ceilcote 8303, 8305, HM 195	640 Grout	Epoxy Grouts	Isophthalic Polyester	Bisphenol Polyester	Chlorinated Polyester	Vinyl Ester	Epoxy	Furan	Polyvinyl Chloride (PVC)	Polyvinyl Dichloride (CPVC)	Polypropylene (PP)	Kynar (PVDF)	Armalon (Teflon)
Butyl Acrylate	N	A1	A1	D2	D2	N	T	T	N	N	N	T	N	C1	N	N	N	A1	A1
Butyl Amine	N	N	A1	N	N	N	T	N	N	N	N	D3	N	C1	N	N	D1	D1	A1
Butyl Carbitol	N	A1	A1	D1	D1	N	D2	D2	N	D1	D1	D1	D1	A1	N	N	D1	B1	A1
Butyl Carbitol Acetate	N	A1	A1	D1	D1	N	D2	D2	T	D1	D1	D1	D1	A1	N	N	D1	D1	A1
Butyl Cellosolve	N	A1	A1	D2	D2	N	D1	D1	T	D1	D1	D1	D1	A1	N	N	D1	D1	A1
Butyl Cellosolve Acetate	N	A1	A1	D1	D1	N	D2	D2	T	D1	D1	D1	D1	A1	N	N	D1	D1	A1
Butyl Ether	N	A1	A1	D2	D2	N	D2	D2	D1	D1	D1	D1	T	A1	N	N	D1	C1	A1
Butyl Levuline Acid	N	A1	A1	D1	D1	N	D2	D2	T	D1	T	D1	D1	A1	T	T	D1	C1	A1
Butyric Acid 100%	D2	A1	A1	D1	N	N	D2	N	N	D1	D1	D1	N	A1	D1	D1	D1	A1	A1
Cadmium Plating - Cyanide	N	N	A1	C1	A1	A1	A2	A2	T	C1	C3	C1	A1	A1	A1	A1	A1	A1	A1
Calcium Bisulfite	C2	A1	A1	B1	C1	A1	B2	A2	D1	A1	B1	A1	D1	A1	A1	A1	A1	A1	A1
Calcium Chloride	A1	A2	A1	A1	A1	A1	A2	A2	A1	A1	A1	A1	A1	A1	A1	A1	A1	A1	A1
Calcium Hydroxide*	N	N	A1	D1	A1	A1	A2	A2	N	C1	N	N	A1	A1	A1	A1	A1	A1	A1
Calcium Hypochlorite* - 5%	N	N	N	D1	N	N	N	N	N	D3	N	D1	N	N	A1	A1	D1	A1	A1
Calcium Nitrate	A1	A2	A1	A1	A1	A1	A2	A2	B1	A1	A1	A1	B1	D1	A1	A1	A1	A1	A1
Caprylic Acid (Octanoic Acid)	N	A1	A1	C1	N	N	T	N	N	C1	C1	A1	N	A1	A1	A1	B1	A1	A1
Carbolic Acid (Phenol) - 88%	N	A1	A1	N	N	N	T	N	N	N	N	N	N	A1	N	A1	D1	B1	A1
Carbon Bisulfide (Di)	N	A1	A1	D2	D2	N	T	D2	N	D3	D3	D3	D3	A1	N	N	N	D1	A1
Carbon Tetrachloride	D2	A1	A1	C1	C1	N	C2	A2	C3	D1	N	D1	C1	A1	N	N	N	A1	A1
Castor Oil	N	A1	A1	A1	C1	N	T	C2	C1	C1	C1	C1	D1	A1	D1	D1	A1	A1	A1
Cellosolve	N	A1	A1	D1	D1	N	D2	D2	T	D1	D1	D1	D1	A1	N	N	D1	C1	A1
Cellosolve Acetate	N	A1	A1	D1	D1	N	D2	D2	T	D1	D1	D1	D1	A1	N	N	D1	C1	A1
Chloroacetic Acid 1 - 50%	N	A1	A1	D2	N	D1	T	D2	N	C1	N	D1	N	N	D1	D1	N	A1	A1
Chloroacetic Acid - 50%	N	A1	A1	D1	N	T	D2	N	N	D1	D1	D1	N	D1	D1	D1	N	B1	A1
Chloroacetic Acid - 80%	N	A1	A1	N	N	T	D2	N	N	D3	D3	D3	N	D1	D1	D1	N	B1	A1
Chlorine Dioxide - 15%	N	A1	N	C1	N	D1	N	N	N	C1	D1	B1	N	N	D1	D1	N	A1	A1
Chlorine Gas - Dry	D3	A1	N	C3	N	N	N	N	B3	B3	B3	A3	N	N	D1	D1	N	A1	A1
Chlorine Gas - Wet	N	A1	N	C3	N	N	N	N	D3	B3	B3	A3	N	N	N	N	N	A1	A1
Chlorine Water - Saturated	N	A1	N	C1	N	D1	N	N	D1	B1	B1	A1	N	N	D1	D1	N	A1	A1
Chlorobenzene (Mono)	N	A1	A1	D1	D1	N	D2	D2	N	D1	N	D1	D1	A1	N	N	N	B1	B1
Chlorobutane	N	A1	A1	D1	D1	N	D2	D2	D1	D1	D1	D1	D1	D1	N	N	N	D1	A1
Chloroform	D2	A1	A1	N	N	N	N	N	N	N	N	N	N	D1	N	N	N	D1	C1
Chlorophenol	N	A1	A1	N	N	N	N	N	N	N	N	T	N	B1	N	N	N	A1	A1
Chlorosulfonic Acid	N	A1	N	N	N	N	N	N	N	N	N	N	N	N	D1	D1	N	N	A1
Chlorotoluene	N	A1	A1	D1	D1	N	D2	D2	N	D1	N	C1	D1	B1	N	N	N	B1	A1
Chromic Acid - 10%	N	A1	D2	D1	N	D1	D2	T	N	N	C1	D1	N	N	A1	A1	D1	A1	A1
Chrome Plating 20 - 42 oz/gal	N	C1	N	N	N	N	D2	N	N	N	C1	C1	N	N	A1	A1	N	A1	A1
Chromic Chloride	C2	A1	A2	A1	C2	A1	A2	A2	C1	B1	A1	A1	N	A1	A1	A1	D1	A1	A1
Citric Acid	D1	A1	A1	A1	N	A1	A2	A2	C1	A1	A1	A1	C1	A1	A1	A1	A1	A1	A1
Copper Plating - Cyanide	N	N	A1	D1	B1	A1	A2	A2	N	N	C3	B1	A1	A1	A1	A1	A1	A1	A1
Copper Plating - Acid	C2	A2	A1	A1	C1	A1	B2	C2	C1	A1	A1	A1	D1	A1	A1	A1	A1	A1	A1
Corn Oil	N	A1	A1	A1	D1	N	B2	D2	B1	A1	A1	A1	D1	A1	A1	A1	A1	A1	A1
Cottonseed Oil	N	A1	A1	A1	D1	N	B2	D2	B1	A1	A1	A1	D1	A1	A1	A1	A1	A1	A1
Cresol	N	A1	A1	N	A1	N	T	N	N	N	N	N	N	D1	N	N	N	C1	A1
Cresylic Acid	N	A1	A1	N	N	N	T	N	N	N	N	C3	N	D1	N	N	N	C1	A1
Cumene	N	A1	A1	D1	D1	N	D2	D2	D1	D1	D1	D1	D1	A1	N	N	D1	B1	A1
Cyclohexane	D2	A1	A1	C1	C1	N	D2	D2	C1	C1	C1	C1	C1	A1	N	N	D1	A1	A1
Cyclohexanone	N	A1	A1	D1	D1	N	D2	D2	D1	D1	D1	D1	D1	A1	N	N	D1	A1	A1
Cymene	N	A1	A1	D1	D1	N	D2	D2	D1	D1	D1	D1	D1	A1	N	N	D2	D1	A1
Dextrose	B1	A1	A1	A1	A1	A1	A2	A2	B1	A1	B1	A1	C1	A1	A1	A1	A1	A1	A1
Dibromopropane Phosphate	D2	A1	A1	D1	D1	T	D2	D2	D1	D1	D1	D1	D1	A1	T	T	T	T	T
Dibutyl Phthalate	N	A1	A1	A1	B1	N	B2	A2	B1	A1	B1	A1	C1	A1	N	N	D1	A1	A1
Dichloro Acetic Acid - 20%	N	A1	A1	D1	N	D1	T	D2	N	D1	D1	D1	N	D1	D1	D1	D1	B1	A1
Diethylamine - 100%	N	T	T	N	N	N	T	N	N	N	N	N	N	B1	D1	D1	N	A1	A1
Diethylene Chloroformate	T	A1	A1	D2	D2	N	D2	T	T	T	N	T	T	D1	N	N	N	D1	A1
Diethylketone - 100%	N	A1	A1	D1	N	N	D2	D2	N	T	N	D1	T	D1	N	N	N	B1	D1
Dimethyaminopropylamine	N	A1	A1	N	N	N	T	N	N	N	D3	D3	N	D1	N	N	D1	D1	A1
Dimethyl Aniline	N	A1	A1	D1	D2	N	T	T	T	D1	D1	T	N	C1	N	N	D1	D1	A1

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	Flakeline 100 Series	Lining Series	Ceilcrete Series	Coroline Series	Flakeline 200 Series	Flakeline 222HT	Flakeline 300	Flakeline 600	Flaketar	Ceilcrete Series	Coroline Series	681, 685 Floors	682, 683 Floors	687 Floors	Corocrete SR	Sealants
Dimethyl Carbamoyl Chloride	D1	D1	D1	D1	D1	T	T	N	N	D2	D2	T	D2	D2	T	T
Dimethyl Carbonyl Chloride	T	T	T	D1	T	T	N	N	N	T	D2	T	T	T	N	N
Dimethyl Formamide	T	T	T	T	T	T	N	N	N	T	T	N	T	D2	N	N
Dimethyl Sulfoxide	T	T	T	T	T	T	N	N	N	D2	T	N	T	T	N	N
Dinitro Benzene	T	T	T	T	T	T	T	N	N	D2	D2	T	T	D2	T	N
Dinitro Butyl Phenol	C1	C1	C1	T	D1	D1	T	T	N	D2	D2	T	T	D2	T	T
Dinitro Toluene	T	T	T	T	T	T	T	N	N	D2	D2	T	D2	D2	T	N
Dodecyl Alcohol (Lauryl)	A1	A1	A1	D1	D1	C1	D2	T	T	A2	A2	D2	D2	D2	D2	T
Ethoxy Ethanol	D1	D1	D1	D1	D1	D1	T	T	N	D2	D2	D2	D2	D2	D2	T
Ethoxylated Nonyl Phenol	D1	D1	D1	C1	D1	T	T	T	N	D2	C2	T	T	D2	T	T
Ethyl Acetate	T	T	T	T	T	T	N	N	N	T	T	T	D2	D2	N	N
Ethyl Acrylate	T	T	T	D1	T	T	N	N	N	T	D2	N	T	T	N	N
Ethyl Alcohol	C1	C1	C1	C1	D1	D1	C2	D2	D2	C1	C1	D2	A2	C2	D2	A2
Ethylamine	T	T	T	N	T	T	N	N	N	T	N	N	N	T	N	N
Ethyl Bromide	T	T	T	T	T	T	T	N	N	T	T	N	T	T	N	N
Ethyl Chloride	D1	D1	D1	T	D1	D1	T	N	N	D2	T	N	T	T	N	N
Ethyl Chloroformate	T	T	T	T	T	T	T	N	N	D2	T	N	D2	D2	D2	D2
Ethyl Ether	N	N	N	T	N	N	N	N	N	N	T	N	D2	D2	D2	T
Ethyl Hexyl Acrylate	T	T	T	T	T	T	N	N	N	D2	D2	N	T	T	N	N
Ethylene Dichloride	T	T	N	D1	D2	D2	N	N	N	N	D1	N	N	N	N	N
Ethylene Glycol	A1	A1	A1	A1	C1	B1	D1	D1	D1	A2	A2	A2	A2	B2	C2	A2
Ethylene Oxide	T	T	T	N	T	T	N	N	N	T	N	N	D2	T	N	N
Ethyl Sulfate	D1	D1	D1	D1	D1	D1	T	N	N	D2	D2	N	D2	T	N	N
Ferric Chloride	A1	A1	A1	A1	D1	C1	D1	D1	D1	A2	A2	D2	A2	B2	D2	A2
Ferric Sulfate	A1	A1	A1	A1	D1	C1	D1	D1	D1	A2	A1	C2	A2	B2	D2	A2
Fluosilicic Acid* - 25%	N	C1	C1	T	D2	D2	T	T	T	D2	D2	D2	D2	D2	D2	D2
Formaldehyde	D1	D1	D1	D1	D1	D1	D1	D2	D2	A2	A2	D2	A2	C2	D2	A2
Formic Acid	D1	D1	D1	N	D1	C1	D3	N	N	D2	N	N	N	D2	N	N
Furfural	D1	D1	D1	T	D1	C1	D3	N	N	D2	T	N	T	T	N	T
Furfuryl Alcohol	D1	D1	D1	D1	D1	D1	D2	N	N	D2	C2	D2	D2	D2	D2	D2
Gasoline	A1	A1	A1	A1	D1	C1	D1	D1	D1	A2	A2	D2	A2	C2	D2	D1
Glucose	A1	A1	A1	A1	D1	C1	D1	D1	D1	A2	A2	A2	A2	A2	C2	A1
Glycerine	A1	A1	A1	A1	D1	C1	D1	D1	D1	A2	A2	A2	A2	A2	C2	A1
Glycolic Acid	D1	D1	D1	T	D1	D1	D2	N	N	D2	D2	D2	T	C2	D2	N
Gold Plating (Cyanide)	D1	D1	C1	A1	D1	C1	N	C2	D2	C2	A2	D2	A2	A2	C2	D2
Grape Juice	A1	A1	A1	A1	D1	C1	D1	D1	D1	A2	A2	A2	A2	A2	C2	A2
Green Liquor (Paper Ind)	B1	B1	C1	A1	D1	C1	D2	D2	D2	C2	A2	C2	A2	A2	C2	A2
Heptane	C1	C1	C1	C1	D1	D1	D1	D2	N	C2	A2	C2	A2	C2	D2	D2
Hexane	C1	C1	C1	C1	D1	D1	D1	D2	N	C2	A2	D2	A2	C2	D2	D2
Hydrazine - 35%	T	T	T	D1	T	T	T	N	N	T	D2	T	D2	D2	T	D2
Hydrazine Hydrate	T	T	T	D1	T	T	N	N	N	T	D2	N	T	D2	N	T
Hydriodic Acid - 20%	C1	C1	C1	T	D1	C1	D2	N	N	C2	T	N	T	D2	N	T
Hydrobromic Acid - 20%	B1	B1	B1	T	D1	C1	D2	N	N	C2	T	N	T	D2	N	T
Hydrobromic Acid - 48%	C1	C1	C1	N	D1	D1	T	N	N	D2	N	N	N	T	N	T
Hydrochloric Acid 1-15%	A1	A1	A1	D1	D1	C1	D1	D1	D1	C2	C2	D2	C2	B2	N	D2
Hydrochloric Acid 16-25%	C1	C1	C1	N	D1	D1	D2	N	N	C2	D2	D2	D2	B2	N	N
Hydrochloric Acid 26-34%	D1	D1	D1	N	D2	D2	D3	N	N	D2	N	N	D2	C2	N	N
Hydrochloric Acid Conc	N	D1	N	N	D2	D2	D3	N	N	D2	D2	N	D2	D2	N	N
Hydrofluoric Acid* 1-10%	N	D1	D1	D1	T	T	D2	D3	D3	D2	D2	D2	D2	D2	N	D2
Hydrofluoric Acid* 11-20%	N	N	D1	N	N	N	N	N	N	D2	T	N	N	N	N	N
Hydrofluoric Acid* 21-48%	N	N	D1	N	N	N	N	N	N	D2	T	N	N	N	N	N
Hydrofluosilicic Acid - 25%	N	C1	C1	T	D2	D2	T	T	T	D2	D2	D2	D2	D2	D2	D2
Hydrogen Peroxide - 30%	C1	C1	C1	T	D1	C1	D2	T	T	D2	D2	D2	D2	D2	N	T
Hydrogen Sulfide Gas	A3	A3	A3	D3	D3	C3	C3	D3	D2	T	T	T	T	T	T	D3
Hypo (Photographic Solution)	A1	A1	A1	A1	D1	C1	C2	T	T	A2	A2	A2	A2	A2	D2	A2
Hypochlorous Acid	N	T	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Iodine, Crystals	C1	C1	C1	T	D1	D1	D3	T	T	C2	T	T	T	T	D2	D2
Isooctylthioglycolate	D1	D1	D1	T	D1	D1	T	T	T	D2	T	T	T	T	T	T

* Duracor requires synthetic veil for fluorides, caustics and hypochlorites. Other products may require carbon filler.

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CEILCOTE

Corrosive Environment Tables

	MORTARS MEMBRANES						GROUTS		DURACOR® FRP LAMINATES						THERMOPLASTIC LAMINATES				
	Bric Bond (Reg.) & Carbon	Compobond	Corobond	Polyester	Epoxy	Ceilcote 8303, 8305, HM 195	640 Grout	Epoxy Grouts	Isophthalic Polyester	Bisphenol Polyester	Chlorinated Polyester	Vinyl Ester	Epoxy	Furan	Polyvinyl Chloride (PVC)	Polyvinyl Dichloride (CPVC)	Polypropylene (PP)	Kynar (PVDF)	Armalon (Teflon)
Dimethyl Carbamoyl Chloride	T	A1	A1	D1	D1	T	D2	D2	N	D1	N	T	D1	B1	N	N	T	T	A1
Dimethyl Carbonyl Chloride	N	A1	A1	T	D1	N	D2	D2	N	N	N	T	D1	D1	N	N	T	T	A1
Dimethyl Formamide	N	A1	A1	N	N	N	D2	D2	N	D1	N	T	N	D1	N	N	D1	N	N
Dimethyl Sulfoxide	N	A1	A1	N	T	N	T	T	N	T	N	T	T	B1	N	N	D1	D1	A1
Dinitro Benzene	N	A1	B1	D2	T	N	T	T	N	T	N	T	T	B1	N	N	D1	D1	A1
Dinitro Butyl Phenol	T	A1	A1	C1	T	N	C2	D2	T	C1	T	C1	T	B1	N	N	D1	A1	A1
Dinitro Toluene	N	A1	T	T	D1	N	D2	D2	N	D3	N	D3	T	B1	N	N	T	A1	A1
Dodecyl Alcohol (Lauryl)	D2	A1	A1	C1	D1	T	D2	D2	D1	D1	D1	B1	D1	A1	D1	D1	D1	A1	A1
Ethoxy Ethanol	D2	A1	A1	D1	D1	T	D2	D2	T	D1	T	D1	D1	D1	N	N	T	T	A1
Ethoxylated Nonyl Phenol	T	A1	A1	D1	C1	N	D2	D2	T	D1	D1	T	D1	A1	N	N	T	T	A1
Ethyl Acetate	N	A1	A1	N	D2	N	D2	D2	N	N	N	T	T	D1	N	N	N	N	N
Ethyl Acrylate	N	A1	B1	N	D1	N	T	T	N	T	T	T	D1	B1	N	N	T	T	A1
Ethyl Alcohol	C1	A1	A1	C1	C1	D1	C2	A2	D1	D1	D1	D1	C1	A1	D1	D1	D1	A1	A1
Ethylamine	N	T	T	N	N	N	T	N	N	T	N	T	N	A1	D2	D2	D2	N	A1
Ethyl Bromide	N	A1	N	T	T	N	T	T	N	T	N	N	N	N	N	N	N	D1	A1
Ethyl Chloride	N	A1	D1	T	T	N	T	T	N	T	N	T	T	N	N	N	N	D1	A1
Ethyl Chloroformate	T	A1	A1	D2	T	N	D2	D2	N	T	T	T	T	D1	N	N	N	D1	A1
Ethyl Ether	N	A1	A1	D2	T	N	D2	D2	N	D3	N	D3	T	D1	N	N	N	D1	A1
Ethyl Hexyl Acrylate	N	A1	B1	N	T	N	T	T	N	T	N	T	T	D1	N	N	N	D1	A1
Ethylene Dichloride	N	A1	A1	N	D1	N	N	D2	N	T	N	D3	T	A1	N	N	N	D1	A1
Ethylene Glycol	N	A1	A1	A1	A1	D1	B2	A2	B1	A1	B1	A1	C1	A1	A1	A1	A1	A1	A1
Ethylene Oxide	T	A1	A1	T	N	N	T	N	N	T	N	N	N	D1	N	N	N	D1	A1
Ethyl Sulfate	T	A1	A1	D1	D1	N	T	D2	N	D1	D1	D1	D1	D1	N	N	N	N	A1
Ferric Chloride	C1	A2	A1	A1	A1	A1	B2	A2	A1	A1	A1	A1	C1	A1	A1	A1	A1	A1	A1
Ferric Sulfate	C1	A2	A1	A1	A1	A1	B2	A2	A1	A1	A1	A1	C1	A1	A1	A1	A1	A1	A1
Fluosilicic Acid* - 25%	A1	N	A1	C1	T	D1	D2	D2	D1	B1	B1	B1	T	A1	A1	A1	A1	A1	A1
Formaldehyde	C1	A1	A1	D1	D1	A1	C2	A2	C1	D1	C1	C1	C1	A1	D1	D1	A1	A1	A1
Formic Acid	D2	A1	A1	D1	N	N	D2	N	T	D1	D1	D1	N	N	D1	D1	C1	A1	A1
Furfural	N	A1	A1	D1	T	N	T	T	N	D1	D1	N	T	N	N	N	N	N	A1
Furfuryl Alcohol	N	A1	A1	D1	D1	N	D2	D2	N	D1	D1	D1	D1	D1	N	N	N	D1	A1
Gasoline	D2	A1	A1	A1	B1	N	A2	A2	A1	A1	A1	A1	C1	A1	N	N	D1	A1	A1
Glucose	B1	A1	A1	A1	A1	A1	A2	A2	A1	A1	A1	A1	C1	A1	A1	A1	A1	A1	A1
Glycerine	B1	A1	A1	A1	A1	A1	A2	A2	A1	A1	A1	A1	C1	A1	A1	A1	A1	A1	A1
Glycolic Acid	T	A1	A1	D1	N	D1	C2	N	D1	C1	C1	C1	N	A1	D1	D1	D1	D1	A1
Gold Plating (Cyanide)	D2	N	A1	C1	A1	A1	A2	A2	D3	C1	D3	C1	A1	A1	A1	A1	A1	A1	A1
Grape Juice	D1	A1	A1	A1	A1	A1	A2	A2	A1	A1	A1	A1	A1	A1	A1	A1	A1	A1	A1
Green Liquor (Paper Ind)	D3	N	A1	C1	A1	A1	A2	A2	N	C1	N	C1	A1	D2	A1	A1	D1	A1	A1
Heptane	N	A1	A1	C1	A1	N	C2	A2	A1	A1	D1	A1	C1	A1	N	N	N	A1	A1
Hexane	N	A1	A1	C1	A1	N	C2	A2	D1	C1	D1	C1	C1	A1	N	N	D1	A1	A1
Hydrazine - 35%	T	A1	T	T	D1	T	D2	D2	N	T	T	T	D1	N	N	N	N	A1	A1
Hydrazine Hydrate	N	N	N	T	D1	N	D2	D2	N	N	N	N	D1	D1	D1	D1	T	A1	A1
Hydriodic Acid - 20%	D2	A1	N	D1	T	D2	D2	T	D3	D1	B3	C1	N	A1	A1	A1	D1	A1	A1
Hydrobromic Acid - 20%	C1	A1	D1	D1	T	D2	D2	T	C1	B1	B1	B1	N	D1	A1	A1	A1	A1	A1
Hydrobromic Acid - 48%	C1	A1	D1	C1	N	T	T	N	D3	D1	D1	C1	N	D1	D1	D1	D1	A1	A1
Hydrochloric Acid 1-15%	A1	A1	A1	A1	D1	D1	B2	D2	C1	A1	A1	A1	D1	A1	A1	A1	A1	A1	A1
Hydrochloric Acid 16-25%	A1	A1	A1	C1	N	D1	B2	D2	D1	B1	B1	B1	N	D1	C1	C1	D1	A1	A1
Hydrochloric Acid 26-34%	D1	A1	A1	D1	N	N	C2	D2	D1	B1	B1	B1	N	D1	D1	D1	D1	A1	A1
Hydrochloric Acid Conc.	D1	A1	D1	D1	N	N	D2	D2	D1	D1	C1	C1	N	N	D1	D1	D1	A1	A1
Hydrofluoric Acid* 1-10%	A1	N	A1	D1	D2	D1	D2	D2	D1	D1	D1	C1	T	D1	C1	C1	A1	A1	A1
Hydrofluoric Acid* 11-20%	D1	N	A1	D1	N	N	N	N	D1	D1	D1	D1	N	N	D1	D1	A1	A1	A1
Hydrofluoric Acid* 21-48%	C1	N	A1	D1	N	N	N	N	N	D1	D1	C1	N	N	D1	D1	D1	B1	A1
Hydrofluosilicic Acid - 25%	A1	N	A1	D1	T	D1	D2	D2	D1	B1	B1	B1	T	A1	A1	A1	A1	A1	A1
Hydrogen Peroxide - 30%	D2	A1	N	C1	T	T	D2	D2	T	D1	C1	C1	T	N	D1	D1	D1	D1	A1
Hydrogen Sulfide Gas	A3	A1	A1	A1	B3	A3	T	T	D3	A3	A3	A3	D3	D3	D3	D3	B3	D3	A3
Hypo (Photographic Solution)	A1	A1	A1	A1	A1	A1	A2	A2	D1	A1	A1	A1	A1	A1	A1	A1	A1	A1	A1
Hypochlorous Acid	N	A1	N	N	N	N	N	N	N	N	N	T	N	N	D1	D1	N	B1	A1
Iodine, Crystals	D2	A1	N	C1	T	D2	D2	D2	D1	C1	C1	C1	N	N	N	N	D1	A1	A1
Isooctylthioglycolate	T	A1	A1	D1	T	N	T	T	D1	D1	D1	D1	T	D1	T	T	T	A1	A1

KEY TO CHEMICAL RESISTANCE CHART

Rating	Meaning
A	Good to Maximum Temperature of Product
B	Good to 160°F (71°C) Maximum
C	Good to 140°F (60°C)
D	Good to 100°F (37°C) Ambient

Rating	Meaning
1	Immersion or Constant Flow
2	Intermittent or Spillage Only
3	Fumes Only
N	Not Recommended

Rating	Meaning
T	Varies With Conditions May Require Test Consult Ceilcote for Recommendation

CEILCOTE

Corrosive Environment Tables

	LININGS				COATINGS					FLOOR TOPPINGS						
	Flakeline 100 Series	Lining Series	Ceilcrete Series	Coroline Series	Flakeline 200 Series	Flakeline 222HT	Flakeline 300	Flakeline 600	Flaketar	Ceilcrete Series	Coroline Series	681, 685 Floors	682, 683 Floors	687 Floors	Corocrete SR	Sealants
Isophorone	D1	D1	D1	D1	D1	D1	T	T	T	D2	D2	D2	D2	D2	N	T
Isopropyl Acetate	T	T	T	T	T	T	T	N	N	D2	D2	N	D2	D2	N	N
Isopropyl Alcohol	C1	C1	C1	C1	D1	D1	D2	D2	D2	A2	A2	C2	A2	D2	D2	D2
Isopropyl Ether	D1	D1	D1	D1	D1	D1	T	N	N	D2	D2	D2	D2	D2	D2	D2
Jet Fuel	A1	A1	C1	A1	D1	D1	D1	D1	N	A2	A2	C2	A2	C2	D2	B2
Kerosene	A1	A1	A1	A1	B1	B1	D1	D1	N	A2	A2	C2	A2	C2	C2	B2
Ketchup	A1	A1	A1	A1	D1	C1	C2	C2	D2	A2	A2	A2	A2	B2	C2	A2
Lactic Acid 1-20%	B1	B1	C1	T	D1	C1	C2	N	N	D2	D2	N	D2	C2	N	D2
Lactic Acid Concentrated	D1	D1	D1	N	D1	C1	D1	N	N	D2	T	N	N	D2	N	T
Lard	A1	A1	A1	T	D1	D1	C2	N	N	A2	C2	D2	D2	B2	D2	D2
Lauric Acid	C1	C1	C1	T	D1	C1	C2	N	N	A2	D2	D2	T	D2	N	T
Lead Acetate	A1	A1	A1	A1	C1	C1	C2	D2	D2	A2	A2	A2	A2	A2	C2	A2
Lecithin	D1	D1	D1	D1	D1	D1	D1	D2	D2	D2	D2	D2	D2	D2	D2	D2
Levulinic Acid (Sat'd)	A1	A1	A1	D1	D1	C1	T	N	N	A2	D2	T	D2	D2	D2	D2
Linseed Oil	A1	A1	A1	D1	D1	C1	D1	D2	D2	A2	A2	D2	D2	D2	D2	D2
Lithium Hydroxide* - 10%	N	D1	D1	A1	D2	N	N	D1	D1	D2	B2	D2	B2	C2	B2	C2
Lithium Hydroxide* - 50%	N	D1	D1	A1	D2	N	N	D1	D1	D2	B2	D2	B2	B2	D2	C2
Maleic Acid	B1	B1	C1	N	D1	C1	D2	N	N	A2	N	N	N	B2	N	N
Malic Acid	C1	C1	C1	B1	D1	C1	T	T	N	A2	A2	D2	C2	C2	D2	D2
Mercury and Salts	A1	A1	A1	A1	D1	C1	D1	D1	D1	A2	A2	A2	A2	B2	C2	A2
Methanol	D1	D1	D1	D1	D1	D2	D2	D2	D2	A2	A2	D2	D2	D2	D2	D2
Methyl Acetate	T	T	T	T	T	T	T	N	N	D2	D2	D2	D2	D2	N	N
Methylamyl Alcohol	D1	D1	D1	D1	D1	D1	T	T	T	D2	D2	T	D2	D2	D2	T
Methylene Chloride	T	T	T	N	D2	D2	N	N	N	D2	T	N	N	N	N	N
Methyl Chloride	T	T	T	N	N	T	N	N	N	D2	T	N	N	N	N	N
Methyl Ethyl Ketone	T	T	T	T	T	T	N	N	N	D2	D2	T	D2	D2	N	N
Methyl Oleate	D1	D1	D1	D1	D1	D1	D1	T	N	D2	D2	T	D2	D2	T	T
Methyl Sulfate	T	T	T	T	T	T	N	N	N	D2	T	N	T	D2	N	N
Methyl Isobutyl Ketone	D1	D1	D1	D1	D1	D1	N	N	N	D2	D2	D2	D2	D2	N	N
Milk - Fresh & Sour	A1	A1	A1	A1	D1	C1	D1	D1	D1	A2	A2	A2	A2	B2	C2	A2
Molasses	A1	A1	A1	A1	D1	C1	D1	D1	D1	A2	A2	A2	A2	B2	C2	A2
Naphtha - Aliphatic	C1	C1	C1	C1	D1	C1	C2	D2	D2	A2	A2	D2	D2	D2	D2	D2
Naptha, Aromatic (Coal Tar)	D1	D1	D1	D1	D1	D1	T	N	N	D2	D2	D2	D2	D2	T	T
Naphthalene (In Benzene)	D1	D1	D1	D1	D1	D1	N	N	N	D2	D2	T	D2	D2	T	N
Naphthenic Acid	D1	D1	D1	D1	D1	D1	D2	N	N	D2	D2	D2	T	D2	D2	T
Nickel Plating, Bright	A1	A1	A1	C1	D1	C1	C2	C2	D2	A2	A2	A2	C2	C2	D2	A2
Nitric Acid - 5%	C1	B1	C1	N	D1	C1	D1	N	N	B2	D2	D2	D2	C2	N	N
Nitric Acid - 10%	C1	B1	C1	N	D1	C1	D2	N	N	C2	D2	D2	D2	C2	N	N
Nitric Acid - 25%	D1	D1	D1	N	D2	D2	D2	N	N	D2	N	N	N	C2	N	N
Nitric Acid - 40%	D1	D1	D1	N	D2	D2	N	N	N	D2	N	N	N	C2	N	N
Nitric Acid - 60%	D1	D1	D1	N	D2	D2	N	N	N	D2	N	N	N	D2	N	N
Nitric Acid - 73%	N	N	N	N	N	N	N	N	N	D2	N	N	N	N	N	N
Nitrilotriethanol	D1	D1	D1	D1	D1	D1	D2	T	T	D2	D2	D2	D2	D2	D2	T
Nitrobenzene	D1	D1	D1	T	D1	D1	N	N	N	D2	D2	N	T	D2	D2	N
Nitromethane	D1	D1	D1	T	D1	T	N	N	N	D2	D2	T	T	T	N	T
Octanoic Acid	C1	C1	C1	D1	D1	C1	T	T	T	C2	C2	N	T	C2	N	T
Octanol	D1	D1	D1	N	D1	T	T	T	T	D2	D2	T	D2	D2	T	T
Oils																
Sour Crude Petroleum	A1	A1	A1	A1	D1	C1	D1	D1	D1	A2	A2	C2	A2	A2	C2	A2
Animal	B1	A1	A1	T	C1	C1	D1	D2	D2	A2	D2	N	D2	B2	N	C2
Mineral	A1	A1	A1	A1	D1	C1	D1	D1	D1	A2	A2	A2	A2	A2	C2	A2
Vegetable	A1	A1	A1	T	D1	C1	D1	D2	D2	A2	C2	C2	C2	C2	D2	C2
Oleic Acid	B1	A1	A1	N	D1	C1	D1	N	N	A2	D2	N	T	C2	N	N
Oleum	See Sulfuric Acid															
Oxalic Acid (Sat'd)	A1	A1	C1	T	D1	C1	D1	D2	D2	A2	A2	A2	A2	A2	D2	A2
Para Xylene	C1	C1	C1	C1	C1	C1	T	N	N	C2	C2	T	D2	D2	N	N
Pelargonic Acid	D1	D1	D1	T	D1	D1	T	N	N	D2	D2	T	D2	T	N	D2
Pentachloroethane	D1	D1	D1	N	D1	D1	N	N	N	B2	D2	N	D2	D2	D2	N

CEILCOTE

Corrosive Environment Tables

	MORTARS MEMBRANES						GROUTS		DURACOR FRP LAMINATES						THERMOPLASTIC LAMINATES				
	Bric Bond (Reg.) & Carbon	Compobond	Corobond	Polyester	Epoxy	Ceilcote 8303, 8305, HM 195	640 Grout	Epoxy Grouts	Isophthalic Polyester	Bisphenol Polyester	Chlorinated Polyester	Vinyl Ester	Epoxy	Furan	Polyvinyl Chloride (PVC)	Polyvinyl Dichloride (CPVC)	Polypropylene (PP)	Kynar (PVDF)	Armalon (Teflon)
Isophorone	N	A1	A1	D1	D1	N	D2	D2	D2	D1	D1	D1	D1	A1	N	N	D1	A1	A1
Isopropyl Acetate	N	A1	A1	D2	D2	N	D2	N	N	N	T	T	N	A1	N	N	D1	A1	A1
Isopropyl Alcohol	D2	A1	A1	D1	C1	D1	D2	A2	D1	D1	C1	D1	C1	A1	C1	C1	C1	A1	A1
Isopropyl Ether	T	A1	A1	D1	D1	N	D2	D2	D1	D1	T	D1	D1	D1	N	N	N	D1	A1
Jet Fuel	N	A1	A1	A1	A1	N	C2	B2	A1	A1	A1	A1	A1	A1	D1	D1	D1	A1	A1
Kerosene	N	A1	A1	A1	A1	N	C2	B2	A1	A1	A1	A1	A1	A1	D1	D1	D1	A1	A1
Ketchup	B2	A1	A1	A1	A1	A1	B2	A2	A1	A1	A1	A1	A1	A1	D1	B1	A1	A1	A1
Lactic Acid 1-20%	C1	A1	A1	C1	T	D1	C2	N	C1	A1	A1	A1	N	A1	D1	D1	A1	D1	A1
Lactic Acid Concentrated	D2	A1	A1	D1	N	N	D2	N	C1	A1	A1	A1	N	A1	D1	D1	D1	D1	A1
Lard	N	A1	A1	A1	T	N	B2	D2	A1	A1	A1	A1	T	A1	D1	D1	D1	A1	A1
Lauric Acid	N	A1	A1	C1	N	N	D2	C2	C1	A1	A1	A1	N	A1	D1	D1	D1	A1	A1
Lead Acetate	D1	A1	A1	A1	A1	A1	A2	A2	A1	A1	A1	A1	A1	A1	C1	B1	A1	A1	A1
Lecithin	D2	A1	A1	D1	D1	T	D2	D2	D1	D1	D1	D1	D1	A1	A1	A1	A1	A1	A1
Levulinic Acid (Sat'd)	N	A1	A1	B1	D1	T	D2	D2	D1	D1	D1	D1	D1	A1	D1	D1	D1	A1	A1
Linseed Oil	N	A1	A1	A1	D1	N	D2	D2	A1	A1	A1	A1	D1	A1	C1	B1	A1	A1	A1
Lithium Hydroxide* - 10%	N	N	C1	D1	A1	D1	C2	C2	N	D1	N	D1	B1	B1	D1	D1	D1	A1	A1
Lithium Hydroxide* - 50%	N	N	C1	D1	A1	D1	C2	C2	N	D1	N	D1	B1	B1	D1	D1	D1	A1	A1
Maleic Acid	C1	A1	A1	C1	N	N	C2	N	C1	A1	A1	A1	N	A1	D1	D1	D1	A1	A1
Malic Acid	N	A1	A1	C1	B1	T	C2	C2	D1	C1	D1	C1	D1	A1	C1	C1	A1	A1	A1
Mercury and Salts	A1	A1	A1	A1	A1	A1	B2	A2	A1	A1	A1	A1	A1	A1	A1	A1	A1	A1	A1
Methanol	D1	A1	A1	D1	D1	D1	D2	D2	D1	D1	D1	D3	D1	A1	C1	B1	B1	A1	A1
Methyl Acetate	D2	A1	A1	T	T	N	D2	T	N	N	N	T	T	C1	N	N	D1	C1	A1
Methylamyl Alcohol	C1	A1	A1	D1	D1	T	D2	D2	T	D1	D1	D1	D1	A1	T	T	T	D1	A1
Methylene Chloride	N	A1	D1	N	N	N	N	N	N	N	N	D3	N	D1	N	N	N	D1	A1
Methyl Chloride	N	A1	A1	N	N	N	N	N	N	N	N	N	N	D1	N	N	N	A1	A1
Methyl Ethyl Ketone	N	A1	D1	T	T	N	D2	D2	N	T	N	D3	D3	D1	N	N	N	N	C1
Methyl Oleate	N	A1	A1	D1	D1	N	D2	D2	D1	D1	D1	D1	D1	A1	T	T	T	D1	A1
Methyl Sulfate	T	A1	A1	N	T	N	D2	D2	N	T	T	T	T	D1	N	D1	D1	A1	A1
Methyl Isobutyl Ketone	D2	A1	A1	D	D1	N	D2	D2	N	T	N	D1	D1	D1	N	N	N	A1	A1
Milk - Fresh & Sour	A2	A1	A1	A1	A1	A1	B2	A2	A1	A1	A1	A1	A1	A1	B1	A1	A1	A1	A1
Molasses	A2	A1	A1	A1	A1	A1	B2	A2	A1	A1	A1	A1	A1	A1	B1	A1	A1	A1	A1
Naphtha - Aliphatic	D2	A1	A1	C1	A1	N	B2	D2	C1	A1	A1	A1	A1	A1	D1	D1	D1	A1	A1
Naptha, Aromatic (Coal Tar)	N	A1	A1	D1	D1	N	D2	D2	D1	D1	D1	D1	C1	B1	N	N	D1	A1	A1
Naphthalene (In Benzene)	N	A1	C1	D1	D1	N	D2	D2	N	D1	D1	D1	D1	B1	N	N	N	D1	A1
Naphthenic Acid	N	A1	A1	D1	D1	N	D2	D2	D1	C1	C1	C1	D1	A1	C1	B1	D1	A1	A1
Nickel Plating, Bright	A1	A1	A1	A1	C1	A1	C2	A2	C1	A1	A1	A1	D1	A1	C1	B1	A1	A1	A1
Nitric Acid - 5%	C1	A1	N	C1	N	A1	C2	N	C1	A1	A1	A1	N	N	C1	B1	A1	A1	A1
Nitric Acid - 10%	D1	A1	N	C1	N	D1	C2	N	D1	B1	B1	B1	N	N	C1	B1	A1	A1	A1
Nitric Acid - 25%	D1	A1	N	D1	N	N	C2	N	N	C1	C1	C1	N	N	D1	D1	D1	A1	A1
Nitric Acid - 40%	N	A1	N	D1	N	N	C2	N	N	D1	C1	D1	N	N	D1	D1	D1	B1	A1
Nitric Acid - 60%	N	A1	N	D1	N	N	D2	N	N	D1	D1	D1	N	N	D1	D1	N	D1	B1
Nitric Acid - 73%	N	A1	N	N	N	N	N	N	N	B3	B3	B3	N	N	N	N	N	N	D1
Nitrilotriethanol	T	A1	A1	D1	D1	N	D2	D2	T	D1	D1	D1	D1	D1	N	N	T	D1	A1
Nitrobenzene	N	A1	A1	D1	D1	N	D2	T	N	T	T	D1	T	D1	N	N	N	D1	A1
Nitromethane	N	A1	B1	D1	T	N	T	T	N	D1	N	N	T	A1	N	N	T	D1	A1
Octanoic Acid	N	A1	A1	C1	D1	N	D2	D2	T	C1	C1	A1	D1	A1	D1	D1	D1	A1	A1
Octanol	N	A1	A1	D1	N	T	D2	D2	T	D1	D1	D1	N	B1	D1	D1	D1	A1	A1
Oils																			
Sour Crude Petroleum	N	A1	A1	A1	A1	N	A2	A2	A1	A1	A1	A1	A1	A1	D1	D1	C1	A1	A1
Animal	N	A1	A1	A1	A1	N	B2	C2	A1	A1	A1	A1	T	A1	D1	D1	B1	A1	A1
Mineral	N	A1	A1	A1	A1	N	A2	A2	A1	A1	A1	A1	A1	A1	D1	D1	B1	A1	A1
Vegetable	N	A1	A1	A1	A1	N	C2	T	A1	A1	A1	A1	T	A1	D1	D1	B1	A1	A1
Oleic Acid	D1	A1	A1	A1	N	N	C2	N	A1	A1	A1	A1	N	D1	N	N	D1	A1	A1
Oleum															See Sulfuric Acid				
Oxalic Acid (Sat'd)	A1	A1	A1	C1	T	A1	A2	A2	A1	A1	A1	A1	T	A1	D1	D1	D1	D1	A1
Para Xylene	N	A1	B1	C1	C1	N	D2	D2	N	N	N	C1	D1	A1	N	N	N	B1	A1
Pelargonic Acid	T	A1	A1	D1	T	N	T	D2	D1	D1	D1	D1	T	A1	D1	A1	D1	D1	A1
Pentachloroethane	N	A1	A1	D1	N	N	D2	D2	T	T	T	B1	N	D1	N	N	N	D1	A1

KEY TO CHEMICAL RESISTANCE CHART

Rating Meaning
- A Good to Maximum Temperature of Product
- B Good to 160°F (71°C) Maximum
- C Good to 140°F (60°C)
- D Good to 100°F (37°C) Ambient

Rating Meaning
- 1 Immersion or Constant Flow
- 2 Intermittent or Spillage Only
- 3 Fumes Only
- N Not Recommended

Rating Meaning
- T Varies With Conditions May Require Test Consult Ceilcote for Recommendation

A UNIT OF GENERAL SIGNAL GS

CEILCOTE

Corrosive Environment Tables

	LININGS				COATINGS					FLOOR TOPPINGS						
	Flakeline 100 Series	Lining Series	Ceilcrete Series	Coroline Series	Flakeline 200 Series	Flakeline 222HT	Flakeline 300	Flakeline 600	Flaketar	Ceilcrete Series	Coroline Series	681, 685 Floors	682, 683 Floors	687 Floors	Corocrete SR	Sealants
Perchloric Acid - 30%	D1	D1	D1	N	D1	D1	N	N	N	D2	T	D2	T	T	T	N
Perchloroethylene	D1	D1	D1	D1	D1	D1	T	N	N	B2	C2	N	D2	D2	D2	D2
Phenol - 5%	D1	D1	D1	T	D1	D1	T	N	N	D2	D2	N	N	D2	N	D2
Phenol - 85%	T	T	T	N	T	T	N	N	N	D2	T	N	N	N	N	N
Phenol Sulfonic Acid - 65%	D1	D1	D1	N	D3	D3	T	N	N	D2	T	T	T	T	N	N
Phosphoric Acid - 20%	A1	A1	A1	N	D1	C1	C2	N	N	A2	D2	D2	D2	B2	N	D1
Phosphoric Acid - 85%	A1	A1	A1	N	D1	C1	D1	N	N	A2	N	N	N	C2	N	N
Phosphorous Oxychloride	N	N	N	C1	N	N	T	T	T	T	C2	T	D2	D2	N	T
Phosphorous Trichloride	N	N	N	C1	N	N	T	T	T	T	C2	T	D2	D2	N	N
Picric Acid - 10% in Alcohol	C1	C1	C1	T	D1	C1	N	N	N	C2	T	N	T	T	N	T
Polyacrylic Acid - 50%	D1	D1	D1	D1	D1	D1	T	N	N	D2	D2	T	T	D2	T	T
Potassium Acetate	A1	A1	A1	A1	D1	C1	D1	D2	D2	A2	A2	A2	A2	A2	D2	D2
Potassium Bichromate	A1	A1	A1	T	D1	C1	D1	D2	D2	A2	C2	D2	D2	D2	D2	C2
Potassium Bromide	A1	A1	A1	T	D1	C1	D1	D2	D2	A2	D2	C2	D2	C2	D2	D2
Potassium Carbonate - 25%	D1	D1	D1	A1	D1	C1	N	D1	D1	A2	A2	D2	A2	A2	C2	D2
Potassium Chlorate	B1	B1	C1	B1	D1	C1	C2	D2	D2	A2	A2	D2	A2	D2	D2	D2
Potassium Chloride	A1	A1	A1	A1	D1	C1	D1	D1	D1	A2	A2	A2	A2	A2	C2	A1
Potassium Cyanide	A1	A1	A1	A1	D1	C1	C2	C2	D2	A2	A2	A2	A2	A2	C2	D1
Potassium Fluoride*	T	D1	A1	A1	T	T	D2	D2	D2	A2	A2	D2	A2	D2	D2	D1
Potassium Hydroxide* - 10%	N	D1	D1	A1	N	N	N	D1	D1	A2	A2	D2	A2	A2	C2	D2
Potassium Hydroxide* - 50%	N	D1	D1	A1	T	N	N	D1	D1	D2	A2	D2	A2	A2	D2	B2
Potassium Nitrate	A1	A1	A1	A1	D1	C1	D1	D1	D1	A2	A2	A2	A2	A2	C2	A2
Potassium Permanganate	A1	A1	A1	N	D1	C1	D1	D1	D2	C2	D2	D2	D2	D2	D2	A2
Potassium Persulfate	A1	A1	A1	T	D1	C1	C2	T	T	A2	D2	C2	C2	T	D2	D2
Potassium Sulfate	A1	A1	A1	A1	D1	C1	D1	D1	D1	A2	A2	C2	A2	C2	C2	A2
Propanediol	D1	D1	D1	D1	D1	D1	D2	D2	D2	D2	D2	D2	D2	D2	D2	D2
Propionic Acid - 100%	D1	D1	D1	N	D1	D1	T	N	N	D2	N	N	N	T	N	N
Propylene Glycol	A1	B1	A1	B1	D1	C1	D1	D1	D1	B2	B2	A2	A2	A2	C2	D3
Pyridine	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Rayon Spin Liquor	A1	A1	A1	B1	D1	C1	C2	D2	D2	A2	C2	D2	C2	B2	N	N
Salicylaldehyde	D1	D1	D1	D1	D1	T	N	N	N	D2	D2	D2	D2	D2	T	T
Salicylic Acid (Benzoic Acid)	A1	A1	A1	C1	D1	C1	D2	D2	D2	A2	C2	D2	A2	C2	D2	A2
Salt Brine	A1	A1	A1	A1	D1	C1	D1	D1	D1	A2	A2	A2	A2	A2	C2	A2
Silicon Tetrachloride	D1	D1	D1	T	D3	D3	N	N	N	D2	T	T	T	T	T	T
Sodium Acetate	A1	A1	A1	A1	D1	C1	D1	D2	D2	A2	A2	A2	A2	A2	C2	A2
Sodium Bicarbonate	A1	A1	A1	A1	D1	C1	T	D1	D1	A2	A2	A2	A2	A2	C2	A2
Sodium Bisulfate	A1	A1	A1	A1	D1	C1	D1	D1	D1	A2	A2	D2	A2	A2	C2	A2
Sodium Bisulfite	A1	A1	A1	A1	D1	C1	D1	D1	D1	A2	A2	C2	A2	A2	C2	C2
Sodium Bromate	A1	A1	A1	D1	D1	D1	D1	C2	C2	A2	A2	A2	A2	T	D2	C2
Sodium Carbonate	D1	C1	C1	A1	D1	D1	T	D1	D1	A2	A2	D2	A2	A2	C2	A2
Sodium Chloride	A1	A1	A1	A1	D1	C1	D1	D1	D1	A2	A2	A2	A2	A2	C2	A2
Sodium Chlorite - 50%	C1	C1	C1	N	D1	D1	D2	D2	D2	D2	T	T	T	T	T	T
Sodium Chromate	A1	A1	A1	T	D1	C1	C2	T	T	A2	A2	C2	A2	C2	D2	C2
Sodium Chlorate	B1	B1	B1	B1	D1	C1	C2	D2	D2	A2	A2	A2	A2	A2	D2	A2
Sodium Cyanide	A1	A1	A1	A1	D1	C1	C2	D1	D1	A2	A2	A2	A2	A2	C2	A2
Sodium Dichromate	A1	A1	A1	D1	D1	C1	C2	D2	D2	A2	A2	C2	A2	C2	C2	A2
Sodium Fluoride*	N	D1	A1	A1	T	T	T	D2	D2	A2	A2	D2	A2	D2	D2	D2
Sodium Hydrosulfide - 45%	C1	C1	C1	N	D1	C1	N	N	N	C2	C2	C2	C2	C2	D2	C2
Sodium Hydroxide* - 10%	N	D1	D1	A1	N	N	N	D1	D1	C2	A2	D2	A2	A2	C2	A2
Sodium Hydroxide* - 50%	N	D1	D1	A1	D2	N	N	D1	D1	B2	A2	D2	A2	A2	D2	D2
Sodium Hypochlorite* - 3%	N	C1	D1	N	D2	N	N	N	N	D2	D2	N	D2	D2	N	N
Sodium Hypochlorite* - 17%	N	D1	N	N	D2	N	N	N	N	D2	N	N	N	N	N	N
Sodium Lauryl Sulfate - 20%	C1	C1	C1	C1	D1	D1	D2	D2	D2	C2	C2	D2	C2	C2	D2	C2
Sodium Oxalate	A1	A1	A1	A1	D1	C1	D1	D1	D1	A2	A2	A2	A2	A2	D2	A2
Sodium Peroxide	D1	D1	D1	T	D1	D1	T	T	T	D2	C2	D2	D2	D2	D2	D2
Sodium (Acid) Phosphate	A1	A1	A1	C1	D1	C1	D1	C2	C2	A2	A2	D2	D2	B2	D2	D2
Sodium Phosphate (Tri)	C1	C1	C1	A1	D1	C1	N	D1	D1	A2	A2	C2	A2	A2	C2	D2

* Duracor requires synthetic veil for fluorides, caustics and hypochlorites. Other [illegible]

A UNIT OF GENERAL SIGNAL GS

CEILCOTE

Corrosive Environment Tables

	MORTARS MEMBRANES						GROUTS		DURACOR® FRP LAMINATES						DURACOR THERMOPLASTIC LAMINATES				
	Bric Bond (Reg.) & Carbon	Compobond	Corobond	Polyester	Epoxy	Ceilcote 8303, 8305, HM 195	640 Grout	Epoxy Grouts	Isophthalic Polyester	Bisphenol Polyester	Chlorinated Polyester	Vinyl Ester	Epoxy	Furan	Polyvinyl Chloride (PVC)	Polyvinyl Dichloride (CPVC)	Polypropylene (PP)	Kynar (PVDF)	Armalon (Teflon)
Perchloric Acid - 30%	N	A1	N	T	N	N	T	N	N	D1	N	D1	N	N	C1	B1	D1	B1	A1
Perchloroethylene	N	A1	A1	D1	D1	N	D2	D2	N	D1	D1	D1	D1	D1	N	N	N	B1	A1
Phenol - 5%	N	A1	A1	D1	N	N	D2	D2	N	D1	B1	B1	N	A1	D1	D1	D1	A1	A1
Phenol - 85%	N	A1	A1	T	N	N	N	N	N	N	N	T	N	D1	N	N	D1	D1	A1
Phenol Sulfonic Acid - 65%	T	A1	B1	D1	N	N	T	N	N	T	T	D1	N	B1	D1	D1	D1	A1	A1
Phosphoric Acid - 20%	A1	A1	A1	A1	N	D1	B2	D2	B1	A1	A1	A1	N	A1	D1	D1	B1	A1	A1
Phosphoric Acid - 85%	A1	N	A1	A1	N	N	C2	N	B1	A1	A1	A1	N	A1	D1	D1	B1	B1	A1
Phosphorous Oxychloride	T	A1	A1	N	C1	T	N	D2	N	T	T	A3	C1	D1	D1	D1	N	A1	A1
Phosphorous Trichloride	T	A1	A1	N	C1	T	D2	D2	N	N	N	N	D1	D1	N	N	N	A1	A1
Picric Acid - 10% in Alcohol	N	A1	T	D1	T	N	T	T	T	D1	D1	C1	T	N	D1	D1	D1	A1	A1
Polyacrylic Acid - 50%	N	A1	A1	D1	D1	T	D2	D2	T	D1	T	D1	D1	A1	N	N	N	D1	A1
Potassium Acetate	C1	A1	A1	A1	A1	C1	A2	A2	A1	A1	A1	A1	B1	A1	D1	D1	A1	A1	A1
Potassium Bichromate	T	A1	N	A1	A2	A1	D2	C2	B1	A1	A1	A1	T	N	C1	B1	D1	A1	A1
Potassium Bromide	A1	A1	D2	A1	T	D1	C2	D2	B1	A1	A1	A1	T	N	C1	B1	B1	A1	A1
Potassium Carbonate - 25%	D2	N	A1	D1	A1	D1	A2	A2	N	B1	N	C1	A1	A1	C1	B1	A1	A1	A1
Potassium Chlorate	T	A1	A1	A1	C1	A1	D2	A2	C1	A1	A1	A1	C1	B1	C1	B1	D1	A1	A1
Potassium Chloride	A1	C1	A1	A1	A1	A1	A2	A2	C1	A1	A1	A1	A1	B1	C1	B1	A1	A1	A1
Potassium Cyanide	A2	D2	A1	A1	A1	A1	A2	A2	D1	A1	B1	A1	A1	A1	C1	B1	A1	A1	A1
Potassium Fluoride*	D2	N	A1	D1	A1	D1	D2	A2	D1	B1	C1	B1	D1	A1	C1	B1	A1	A1	A1
Potassium Hydroxide* - 10%	N	N	D1	D1	A1	D1	D2	A2	N	D1	N	D1	A1	A1	C1	B1	B1	A1	A1
Potassium Hydroxide* - 50%	N	N	A1	D1	A1	D1	D2	A2	N	B1	N	D1	A1	A1	C1	B1	D1	B1	A1
Potassium Nitrate	A1	D1	A1	A1	A1	A1	A2	A2	A1	A1	A1	A1	A1	D1	C1	B1	C1	A1	A1
Potassium Permanganate	A1	A1	A1	A1	N	A1	A2	A2	A1	A1	A1	A1	N	T	C1	B1	D1	A1	A1
Potassium Persulfate	T	A1	A1	A1	T	A1	D2	A2	D1	C1	D1	A1	T	A1	C1	B1	D1	A1	A1
Potassium Sulfate	A1	A1	A1	A1	A1	A1	C2	A2	A1	A1	A1	A1	A1	A1	C1	B1	A1	A1	A1
Propanediol	D2	A1	A1	D1	D1	T	D2	D2	D1	D1	D1	D1	D1	A1	D1	D1	B1	A1	A1
Propionic Acid - 100%	N	A1	A1	D1	N	N	T	N	N	D1	N	D1	N	D1	D1	D1	D1	A1	A1
Propylene Glycol	T	A1	A1	D1	D1	T	A2	D2	B1	B1	A1	A1	C1	A1	C1	B1	B1	A1	A1
Pyridine	N	A1	T	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	C1
Rayon Spin Liquor	C2	A1	A1	A1	B1	C1	B2	C2	D1	A1	B1	A1	D1	A1	C1	B1	A1	A1	A1
Salicylaldehyde	N	A1	A1	N	T	N	D2	T	T	D1	D1	D1	D1	B1	N	N	T	D1	A1
Salicylic Acid (Benzoic Acid)	A1	A1	A1	A1	D1	D1	C2	A2	D1	C1	C1	B1	C1	D1	C1	B1	D1	D1	A1
Salt Brine	A1	A2	A1	A1	A1	A1	A2	A2	A1	A1	A1	A1	A1	A1	C1	B1	A1	A1	A1
Silicon Tetrachloride	T	T	D1	D1	T	T	T	T	T	D3	D1	T	T	D1	D1	D1	D1	B1	A1
Sodium Acetate	D1	A1	A1	A1	A1	A1	A2	A2	A1	A1	A1	A1	A1	A1	B1	B1	A1	A1	A1
Sodium Bicarbonate	A1	A1	A1	A1	A1	A1	A2	A2	T	A1	A1	A1	A1	A1	C1	B1	A1	A1	A1
Sodium Bisulfate	A1	A1	A1	A1	A1	A1	A2	A2	A1	A1	A1	A1	A1	A1	C1	B1	A1	A1	A1
Sodium Bisulfite	D1	A1	A1	A1	A1	A1	A2	A2	A1	A1	A1	A1	A1	A1	C1	B1	A1	A1	A1
Sodium Bromate	A1	A1	D1	A1	D1	A1	D2	A2	A1	A1	A1	A1	D1	D1	C1	B1	D1	A1	A1
Sodium Carbonate	D2	N	A1	D1	A1	A1	A2	A2	N	B1	N	B1	A1	A1	C1	B1	A1	A1	A1
Sodium Chloride	A1	A1	A1	A1	A1	A1	A2	A2	A1	A1	A1	A1	A1	A1	C1	B1	A1	A1	A1
Sodium Chlorite - 50%	T	T	T	D1	N	N	T	N	N	D1	D1	D1	N	N	C1	B1	D1	A1	A1
Sodium Chromate	T	A1	C2	A1	T	A1	C2	A2	D1	A1	A1	A1	T	N	C1	B1	D1	A1	A1
Sodium Chlorate	N	N	D1	B1	B1	D1	B2	A2	C1	B1	B1	B1	B1	B1	A1	A1	A1	A1	A1
Sodium Cyanide	T	N	A1	A1	A1	A1	A2	A2	D1	A1	B1	A1	A1	A1	C1	B1	B1	A1	A1
Sodium Dichromate	A1	A1	N	B1	D1	A1	C2	A2	D1	A1	A1	A1	D1	N	C1	B1	D1	A1	A1
Sodium Fluoride*	A1	N	A1	D1	D1	A1	D2	D2	D1	B1	C1	B1	D1	B1	B1	B1	A1	B1	A1
Sodium Hydrosulfide - 45%	N	N	B1	C2	N	T	C2	C2	N	C1	N	B1	N	B1	A1	A1	A1	A1	A1
Sodium Hydroxide* - 10%	N	N	A1	D1	A1	D1	A2	A2	N	C1	N	T	A1	A1	C1	C1	B1	A1	A1
Sodium Hydroxide* - 50%	N	N	A1	D1	A1	N	A2	A2	N	C1	N	T	A1	B1	C1	C1	D1	B1	B1
Sodium Hypochlorite* - 3%	N	N	N	D1	N	T	D2	N	N	D1	N	C1	N	N	C1	B1	D1	A1	A1
Sodium Hypochlorite* - 17%	N	N	N	N	N	N	N	N	N	N	N	D1	N	N	C1	B1	N	A1	A1
Sodium Lauryl Sulfate - 20%	C2	N	B1	C1	C1	T	C2	C2	T	C1	D1	C1	C1	B1	A1	A1	A1	A1	A1
Sodium Oxalate	A1	A1	A1	A1	A1	A1	A2	A2	A1	A1	A1	A1	A1	D1	C1	C1	D1	A1	A1
Sodium Peroxide	N	N	N	D1	T	D1	D2	A2	N	A1	N	A1	T	N	C1	C1	D1	A1	A1
Sodium (Acid) Phosphate	A1	A1	A1	A1	C1	A1	B2	A2	A1	A1	A1	A1	D1	A1	C1	A1	A1	A1	A1
Sodium Phosphate (Tri)	N	N	A1	C1	A1	A1	A2	A2	N	A1	N	A1	A1	A1	C1	A1	A1	A1	A1

KEY TO CHEMICAL RESISTANCE CHART

Rating	Meaning
A	Good to Maximum Temperature of Product
B	Good to 160°F (71°C) Maximum
C	Good to 140°F (60°C)
D	Good to 100°F (37°C) Ambient

Rating	Meaning
1	Immersion or Constant Flow
2	Intermittent or Spillage Only
3	Fumes Only
N	Not Recommended

Rating	Meaning
T	Varies With Conditions May Require Test Consult Ceilcote for Recommendation

CEILCOTE

Corrosive Environment Tables

	LININGS				COATINGS					FLOOR TOPPINGS						
	Flakeline 100 Series	Lining Series	Ceilcrete Series	Coroline Series	Flakeline 200 Series	Flakeline 222HT	Flakeline 300	Flakeline 600	Flaketar	Ceilcrete Series	Coroline Series	681, 685 Floors	682, 683 Floors	687 Floors	Corocrete SR	Sealants
Sodium Polymethacrylate	D1	D1	D1	D1	D1	D1	D1	D2	D2	D2	D2	D2	D2	D2	D2	D2
Sodium Sulfate	A1	A1	A1	A1	D1	C1	D1	D1	D1	A2	A2	A2	A2	A2	C2	A2
Sodium Sulfide	C1	C1	C1	A1	D1	C1	N	D1	D1	A2	A2	C2	A2	A2	C2	D2
Sodium Sulfite	A1	A1	A1	C1	D1	C1	D1	D1	D1	A2	A2	A2	A2	A2	C2	D2
Sodium Tartrate	A1	A1	A1	A1	D1	C1	D1	D1	D1	A2	A2	A2	A2	A2	C2	A2
Sodium Thiosulfate (Hypo)	A1	A1	A1	A1	D1	C1	C2	T	T	A2	A2	A2	A2	A2	C2	A2
Soybean Oil	A1	A1	A1	T	C1	C1	D1	T	T	A2	D2	C2	D2	C2	D2	T
Stearic Acid	B1	B1	B1	N	C1	C1	D1	N	N	A2	D2	D2	D2	D2	D2	T
Styrene	D1	D1	D1	D1	D1	D1	T	N	N	D2	D2	T	D2	D3	T	T
Sugar	A1	A1	A1	A1	D1	C1	D1	D1	D1	A2	A2	A2	A2	A2	C2	A2
Sulfamic Acid - 25%	C1	C1	C1	N	D1	C1	D2	N	N	C2	D2	T	D2	D2	T	T
Sulfite Liquor (Paper)	A1	A1	A1	A1	D1	C1	C2	D2	D2	A2	A2	A2	A2	A2	D2	D2
Sulfur Dioxide (Wet)	A3	A3	A3	C3	D3	C3	C2	D3	D3	not applicable for gases						D3
Sulfur Trioxide (Wet)	A3	A3	A3	N	D3	C3	T	N	N	not applicable for gases						D3
Sulfuric Acid 1 - 20%	A1	A1	A1	D1	D1	C1	D1	N	N	A2	D2	D2	D2	B2	N	D2
Sulfuric Acid 21 - 50%	C1	C1	C1	N	D1	D1	D2	N	N	C2	D2	D2	D2	C2	N	D2
Sulfuric Acid 51 - 85%	D1	D1	D1	N	D2	D2	D3	N	N	D2	N	N	N	D2	N	N
Sulfuric Acid 86 - 98%	T	T	T	N	N	N	N	N	N	D2	N	N	N	N	N	N
Sulfuric Acid - Oleum	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N
Sulfurous Acid (Sat'd)	A1	A1	A1	C1	D1	C1	C2	D2	D2	A2	A2	D2	D2	B2	D2	D2
Tall Oil	A1	A1	A1	B1	D1	C1	C2	N	N	A2	A2	C2	D2	C2	D2	D2
Tartaric Acid	A1	A1	A1	D1	D1	C1	D1	D2	D2	A2	A2	A2	A2	A2	C2	A2
Tetrachloroethane	D1	D1	D1	D1	D1	D1	N	N	N	D2	D2	N	T	T	N	N
Tetrachloroethylene	D1	D1	D1	D1	D1	D1	N	N	N	D2	D2	T	D2	D2	T	N
Tetrahydrofuran	N	N	N	N	N	N	N	N	N	D2	N	N	N	T	N	N
Tetrahydrofurfuryl Alcohol	D1	D1	D1	T	D1	D1	D3	T	T	C2	D2	D2	D2	D2	D2	T
Thionyl Chloride	N	N	N	N	N	N	N	N	N	N	T	N	N	N	N	N
Thionyl Chloride - Water Sol'n	N	N	N	T	N	N	N	N	N	N	T	N	N	N	N	N
Tin Plating (Fluoborate)	See Fluoboric Acid															
Tin Plating (Stannate)	See Sodium Hydroxide															
Titanium Tetrachloride	A1	A1	A1	D1	D1	C1	C2	D2	D2	A2	A2	A2	A2	C2	D2	D2
Toluol (Toluene)	D1	D1	D1	T	D1	D1	T	N	N	C2	D2	D2	D2	D2	N	N
Toluene Sulfonic Acid	A1	A1	A1	T	D1	C1	C2	D2	D2	A2	D2	A2	D2	D2	D2	D2
Toluidine	D1	D1	D1	N	D1	T	T	N	N	D2	T	T	T	T	N	N
Triethylamine	D1	D1	D1	T	D1	D1	T	N	N	D2	T	N	T	T	N	T
Triethylenetetramine	D1	D1	D1	T	D1	D1	T	N	N	D2	T	N	T	T	N	T
Triethyl Phosphite	D1	D1	D1	D1	D1	D1	D2	T	T	D2	D2	T	D2	D2	D2	T
Trichloroacetic Acid - 20%	C1	C1	C1	N	D1	C1	D2	N	N	C2	N	D2	N	D2	N	D2
Trichlorobenzene	D1	D1	D1	D1	D1	D1	T	N	N	D2	D2	T	D2	D2	T	N
Trichloroethane	D1	D1	D1	D1	D1	D1	T	N	N	C2	C2	N	D2	D2	N	N
Trichloroethylene	D1	D1	D1	D1	D1	N	T	N	N	C2	C2	N	D2	D2	N	N
Tricresyl Phosphate	C1	C1	C1	D1	D1	D1	D2	N	N	C2	C2	T	D2	D2	T	T
Trisodium Phosphate	C1	C1	C1	A1	D1	C1	T	D1	D1	A2	A2	C2	A2	A2	C2	A2
Turpentine	D1	D1	D1	D1	D1	C1	T	T	N	C2	A2	D2	D2	C2	C2	D2
Urea Solutions	A1	A1	A1	A1	D1	C1	C2	D1	D1	A2	A2	A2	A2	A2	C2	A2
Vinegar	A1	A1	A1	C1	D1	C1	D1	N	N	A2	A2	C2	D2	B2	D2	A2
Vinyl Acetate (Monomer)	T	T	T	T	T	T	N	N	N	T	D2	T	D2	D2	T	N
Vinyl Chloride	T	T	T	T	T	T	T	N	N	D2	D2	N	D2	D2	T	N
Water, Distilled & Demineralized	B1	B1	C1	B1	D1	C1	D1	D1	D1	A2	A2	A2	A2	A2	C2	A2
White Liquor (Paper)	C1	C1	C1	A1	D1	C1	C2	C2	D2	A2	A2	A2	A2	A2	C2	D2
Wine	A1	A1	A1	A1	D1	C1	D1	D1	D1	A2	A2	A2	A2	A2	C2	A2
Xylol (Xylene)	D1	D1	D1	D1	D1	D1	N	N	N	D2	D2	D2	D2	D2	N	N
Zinc Plating - Acid Fluoborate	See Fluoboric Acid															
Zinc Plating - Cyanide	See Sodium Hydroxide 10%															
Zinc Plating - Acid Sulfate	A1	A1	A1	C1	D1	C1	C2	C2	D2	A2	A2	A2	C2	C2	D2	D2

* Duracor requires synthetic veil for fluorides, caustics and hypochlorites. Other products may require carbon filler

A UNIT OF GENERAL SIGNAL

CEILCOTE

Corrosive Environment Tables

	MORTARS MEMBRANES						GROUTS		DURACOR® FRP LAMINATES						THERMOPLASTIC LAMINATES				
	Bric Bond (Reg.) & Carbon	Compobond	Corobond	Polyester	Epoxy	Ceilcote 8303, 8305, HM 195	640 Grout	Epoxy Grouts	Isophthalic Polyester	Bisphenol Polyester	Chlorinated Polyester	Vinyl Ester	Epoxy	Furan	Polyvinyl Chloride (PVC)	Polyvinyl Dichloride (CPVC)	Polypropylene (PP)	Kynar (PVDF)	Armalon (Teflon)
Sodium Polymethacrylate	D2	T	A1	D1	D1	T	D2	D2	D1	D1	D1	D1	D1	B1	T	T	T	A1	A1
Sodium Sulfate	A1	A1	A1	A1	A1	A1	A2	A2	A1	A1	A1	A1	A1	A1	C1	A1	A1	A1	A1
Sodium Sulfide	N	N	A1	C1	A1	A1	A2	A2	N	A1	C1	A1	A1	A1	C1	A1	A1	A1	A1
Sodium Sulfite	N	A1	A1	A1	A1	A1	A2	A2	A1	A1	A1	A1	A1	A1	C1	A1	A1	A1	A1
Sodium Tartrate	A1	A1	A1	A1	A1	A1	A2	A2	A1	A1	A1	A1	A1	A1	C1	A1	A1	A1	A1
Sodium Thiosulfate (Hypo)	A1	A1	A1	A1	A1	A1	A2	A2	D1	A1	A1	A1	A1	A1	C1	A1	A1	A1	A1
Soybean Oil	T	A1	A1	A1	T	N	C2	D2	A1	A1	A1	A1	T	A1	D1	D1	D1	A1	A1
Stearic Acid	D1	A1	A1	B1	N	N	D2	D2	A1	B1	B1	A1	N	A1	D1	D1	D1	A1	A1
Styrene	N	A1	A1	D1	D1	N	D2	D2	T	D1	N	D1	D1	A1	N	N	N	D1	A1
Sugar	A1	A1	A1	A1	A1	A1	A2	A2	A1	A1	A1	A1	A1	A1	C1	A1	A1	A1	A1
Sulfamic Acid - 25%	T	A1	A1	C1	N	D1	D2	D2	C1	C1	C1	C1	N	A1	A1	A1	A1	A1	A1
Sulfite Liquor (Paper)	A1	A1	A1	A1	A1	T	A2	A2	C1	A1	C1	A1	A1	D1	C1	B1	D1	A1	A1
Sulfur Dioxide (Wet)	A1	A1	A1	A3	C3	C1	A2	D3	C3	C3	A3	A3	D3	D1	N	N	D1	B1	A1
Sulfur Trioxide (Wet)	A1	A1	B1	B1	N	D3	C2	D3	C3	A3	A3	A3	N	N	D1	D1	N	N	A1
Sulfuric Acid 1 - 20%	C1	A1	A1	A1	D1	A1	B2	D2	C1	A1	A1	A1	D1	A1	C1	D1	B1	A1	A1
Sulfuric Acid 21 - 50%	C1	A1	A1	A1	N	D1	C2	D2	C1	A1	A1	A1	N	A1	C1	B1	B1	A1	A1
Sulfuric Acid 51 - 85%	D1	C1	D1	D1	N	T	D2	N	N	D1	D1	D1	N	D1	C1	B1	D1	A1	A1
Sulfuric Acid 86 - 98%	C2	D1	N	N	N	T	N	N	N	N	N	D3	N	N	D1	D1	N	D1	B1
Sulfuric Acid - Oleum	N	D1	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	D1
Sulfurous Acid (Sat'd)	A1	A1	A1	A1	C1	A1	B2	A2	A1	A1	A1	A1	C1	D1	N	N	C1	A1	A1
Tall Oil	N	A1	A1	A1	B1	N	C2	A2	D1	A1	A1	A1	B1	A1	C1	C1	D1	A1	A1
Tartaric Acid	D1	A1	A1	A1	D1	D1	A2	A2	A1	A1	A1	A1	C1	A1	C1	A1	A1	A1	A1
Tetrachloroethane	N	A1	D1	N	D1	N	T	T	N	T	D1	D1	D1	B1	N	N	N	D1	D1
Tetrachloroethylene	N	A1	B1	D1	D1	N	D2	D2	N	D1	N	D1	D1	A1	N	N	N	A1	A1
Tetrahydrofuran	N	A1	D1	N	N	N	T	N	N	N	N	N	N	D1	N	N	N	N	B1
Tetrahydrofurfuryl Alcohol	N	A1	A1	D	T	N	D2	D2	N	D1	D1	D1	T	D1	N	N	N	B1	A1
Thionyl Chloride	T	T	T	N	N	N	N	N	N	N	N	N	N	N	N	N	N	N	B1
Thionyl Chloride - Water Sol'n	T	T	T	N	T	N	N	N	N	N	N	N	N	B1	N	N	N	B1	A1
Tin Plating (Fluoborate)	See Fluoboric Acid																		
Tin Plating (Stannate)	See Sodium Hydroxide																		
Titanium Tetrachloride	A1	A1	A1	A1	D1	A1	C2	D2	D1	A1	A1	A1	D1	A1	N	N	D1	A1	A1
Toluol (Toluene)	N	A1	A1	D1	T	N	D2	D2	N	D1	D1	D1	T	B1	N	N	N	C1	A1
Toluene Sulfonic Acid	D1	A1	A1	A1	T	D1	D2	D2	D1	A1	A1	A1	T	B1	D1	D1	C1	A1	A1
Toluidine	N	A1	B1	D1	N	N	T	T	T	T	D1	D1	N	B1	T	T	D1	A1	A1
Triethylamine	N	N	B1	D1	T	N	T	T	T	D1	D1	D1	N	B1	D1	D1	D3	D1	A1
Triethylenetetramine	N	N	B1	D1	T	N	T	T	T	D1	D1	D1	N	B1	D1	D1	D1	B1	A1
Triethyl Phosphite	T	A1	B1	D1	D1	T	D2	D2	T	D1	D1	D1	D1	B1	N	N	D1	A1	A1
Trichloroacetic Acid - 20%	N	A1	A1	C1	N	T	D2	D2	D1	A1	A1	A1	N	D1	C1	C1	D1	A1	A1
Trichlorobenzene	N	A1	B1	D1	D1	N	D2	D2	N	D1	D1	D1	D1	A1	N	N	N	D1	B1
Trichloroethane	N	A1	A1	D1	D1	N	D2	D2	N	D1	D3	D1	D1	B1	N	N	N	D1	A1
Trichloroethylene	N	A1	A1	D1	D1	N	D2	D2	N	D1	D3	N	D1	B1	N	N	N	B1	A1
Tricresyl Phosphate	T	A1	B1	C1	D1	N	D2	D2	T	C1	C1	C1	D1	B1	D1	D1	B1	A1	A1
Trisodium Phosphate	N	N	A1	C1	A1	A1	A2	A2	N	A1	D1	A1	A1	A1	C1	B1	A1	A1	A1
Turpentine	N	A1	A1	D1	D1	N	C2	D2	D1	A1	D1	A1	D1	A1	D1	D1	N	A1	A1
Urea Solutions	A1	A1	A1	D1	A1	D1	A2	A2	D1	B1	B1	C1	C1	A1	C1	B1	A1	A1	A1
Vinegar	D2	A1	A1	A1	D1	D1	B2	A2	A1	A1	A1	A1	D1	A1	C1	B1	A1	A1	A1
Vinyl Acetate (Monomer)	D1	D1	D1	N	T	N	D2	T	N	N	N	T	T	D1	N	N	N	D1	A1
Vinyl Chloride	N	A1	A1	N	T	N	D2	D2	N	T	N	T	T	D1	N	N	N	D1	D1
Water, Distilled & Demineralized	A1	N	A1	A1	A1	B1	A2	A2	B1	B1	B1	B1	B1	A1	C1	B1	A1	A1	A1
White Liquor (Paper)	D2	N	A1	B1	A1	D2	A2	A2	N	C1	N	C1	A1	D1	C1	B1	D1	A1	A1
Wine	A2	A2	A1	A1	A1	A1	A2	A2	A1	A1	A1	A1	A1	A1	D1	D1	A1	A1	A1
Xylol (Xylene)	N	A1	A1	D1	D1	N	D2	D2	T	D1	D1	D1	D1	B1	N	N	N	A1	A1
Zinc Plating - Acid Fluoborate	See Fluoboric Acid																		
Zinc Plating - Cyanide	See Sodium Hydroxide 10%																		
Zinc Plating - Acid Sulfate	A1	A2	A1	A1	A1	A1	C2	A2	A1	A1	A1	A1	C1	A1	C1	B1	A1	A1	A1

KEY TO CHEMICAL RESISTANCE CHART

Rating	Meaning
A	Good to Maximum Temperature of Product
B	Good to 150°F (71°C) Maximum
C	Good to 140°F (60°C)
D	Good to 100°F (37°C) Ambient

Rating	Meaning
1	Immersion or Constant Flow
2	Intermittent or Spillage Only
3	Fumes Only
N	Not Recommended

Rating	Meaning
T	Varies With Conditions. May Require Test Consult Ceilcote for Recommendation

APPENDIX L.1

MONITORING WELL CONSTRUCTION SKETCHES

Observation Well Installation Report

Observation Well No. W-4-88

Project Dynecol, Inc. Location See Site Map

Type of Rig N/A Installed By WTD/ELC Date 5/20/88 Time

Method of Installation Hand Auger

Log of Boring and Observation Well

Boring

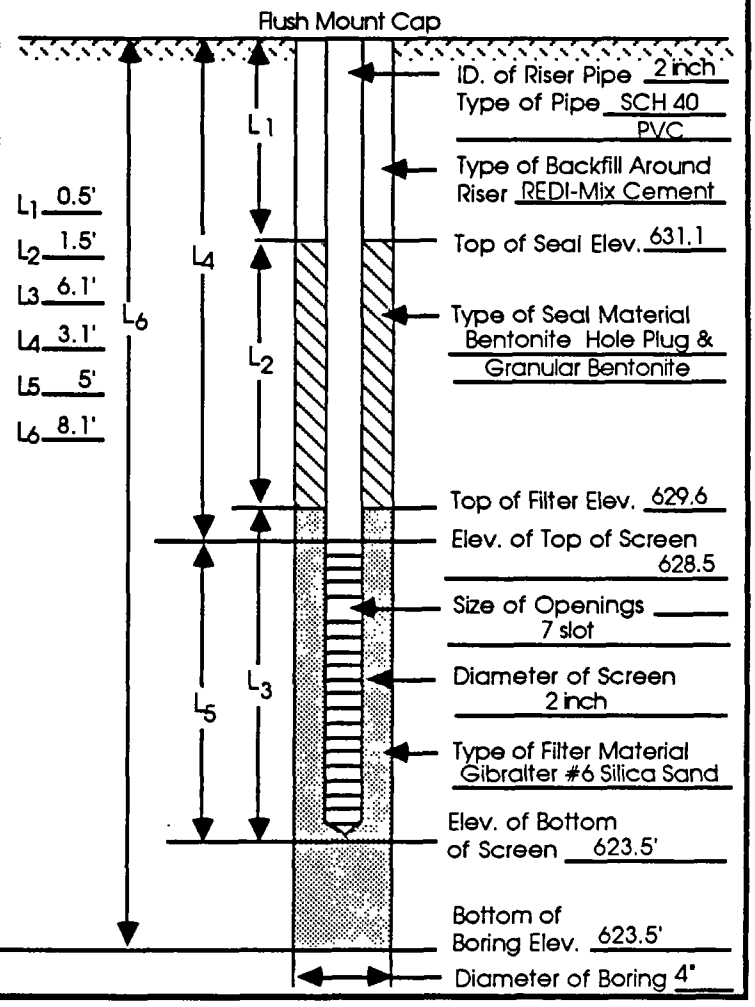
Depth in ft.	Cored Interval	Description
		Concrete
		Gravel/Slag
2		Rubble (concrete & brick slag) in silt and clay matrix
4		Sand - fine, gray-brown, silty with trace organic debris, wet
6		Clay- mottled brown-gray, slightly silty, firm
8		E.O.B. = 8.1'

Observation Well

Type of Monitoring Well 2-inch PVC Casing with stainless steel screen; Perched groundwater within fill

Ground Elev. 631.66 Top of Casing Elev 631.41

L_1 0.5'
L_2 1.5'
L_3 6.1'
L_4 3.1'
L_5 5'
L_6 8.1'



ID. of Riser Pipe 2 inch
Type of Pipe SCH 40 PVC
Type of Backfill Around Riser REDI-Mix Cement
Top of Seal Elev. 631.1
Type of Seal Material Bentonite Hole Plug & Granular Bentonite
Top of Filter Elev. 629.6
Elev. of Top of Screen 628.5
Size of Openings 7 slot
Diameter of Screen 2 inch
Type of Filter Material Gibralter #6 Silica Sand
Elev. of Bottom of Screen 623.5'
Bottom of Boring Elev. 623.5'
Diameter of Boring 4"

Remarks Fitted with internally locking flush mount cap. Slight bend in casing/screen connection necessitates utilizing a 1-1 1/2 inch diameter bailer for sampling. Water sample obtained.

Observation Well Installation Report

Observation Well No. W-5-88

Project Dynecol, Inc *Location* See Site Map

Type of Rig N/A *Installed By* WTD/ELC *Date* 5/20/88 *Time*

Method of Installation Hand Auger

Log of Boring and Observation Well

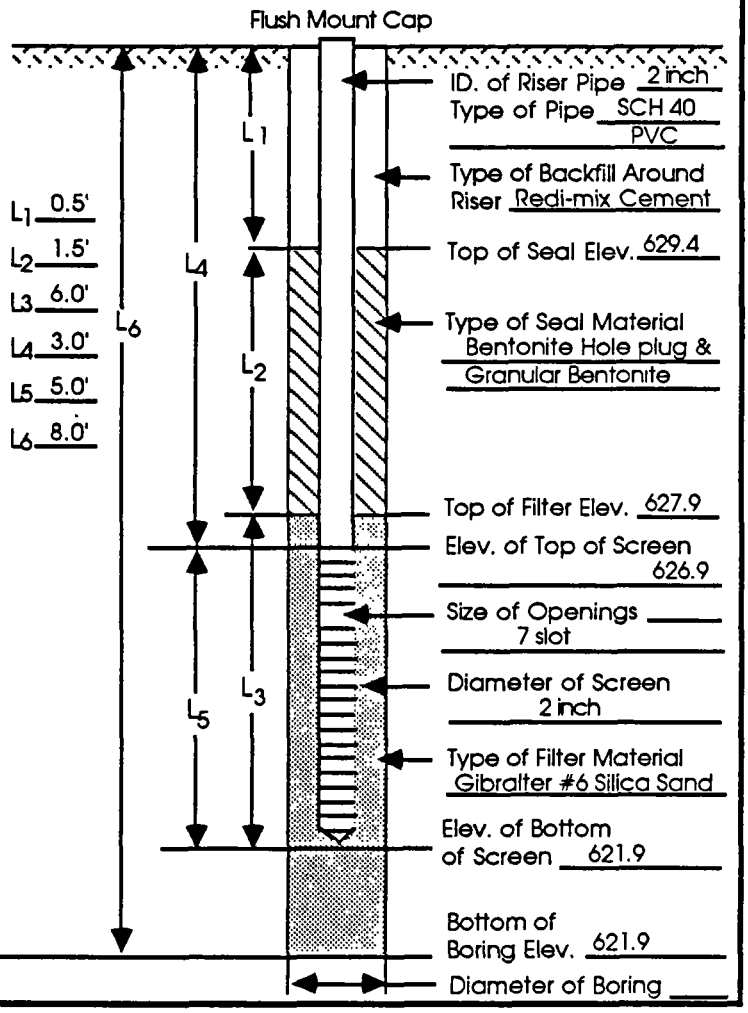
Boring

Depth in ft.	Cored Interval	*Description*
		Concrete
2		Clay, brown, black, sandy
4		Clay, mottled gray to brown, sandy
6		Clay, brown, sandy, silty
8		E.O.B - 8'

Observation Well

Type of Monitoring Well 2-inch PVC casing with stainless steel screen; perched groundwater within fill

Ground Elev. 629.92 Top of Casing Elev 629.66



Remarks Fitted with internally locking flush mount cap. Slight bend in casing/screen connection necessitates utilizing a 1-1 1/2 inch diameter bailer for sampling. No water yielded into well following installation due to low permeability of andy clay soils.

soil and materials
ngineers, inc.

CLIENT WASTE ACID SERVICES
DETROIT, MICHIGAN

PROJECT MONITORING WELL
INSTALLATION

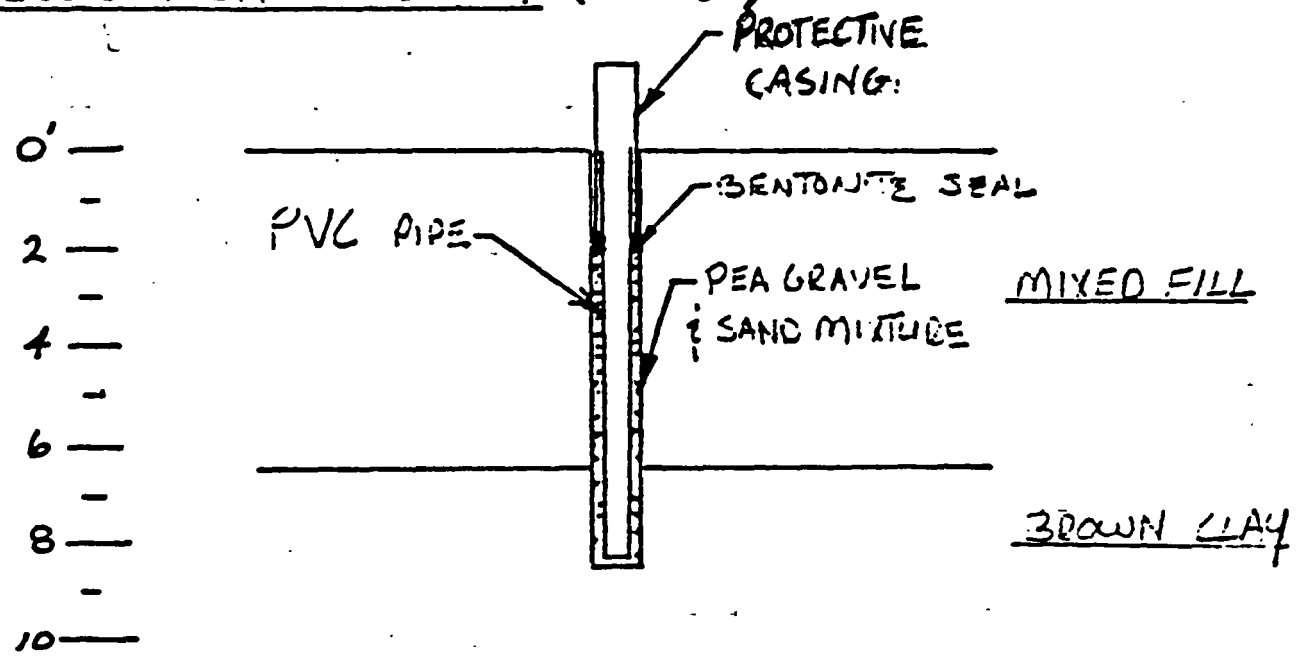
FILE NUMBER 6936

DATE 6-7-83

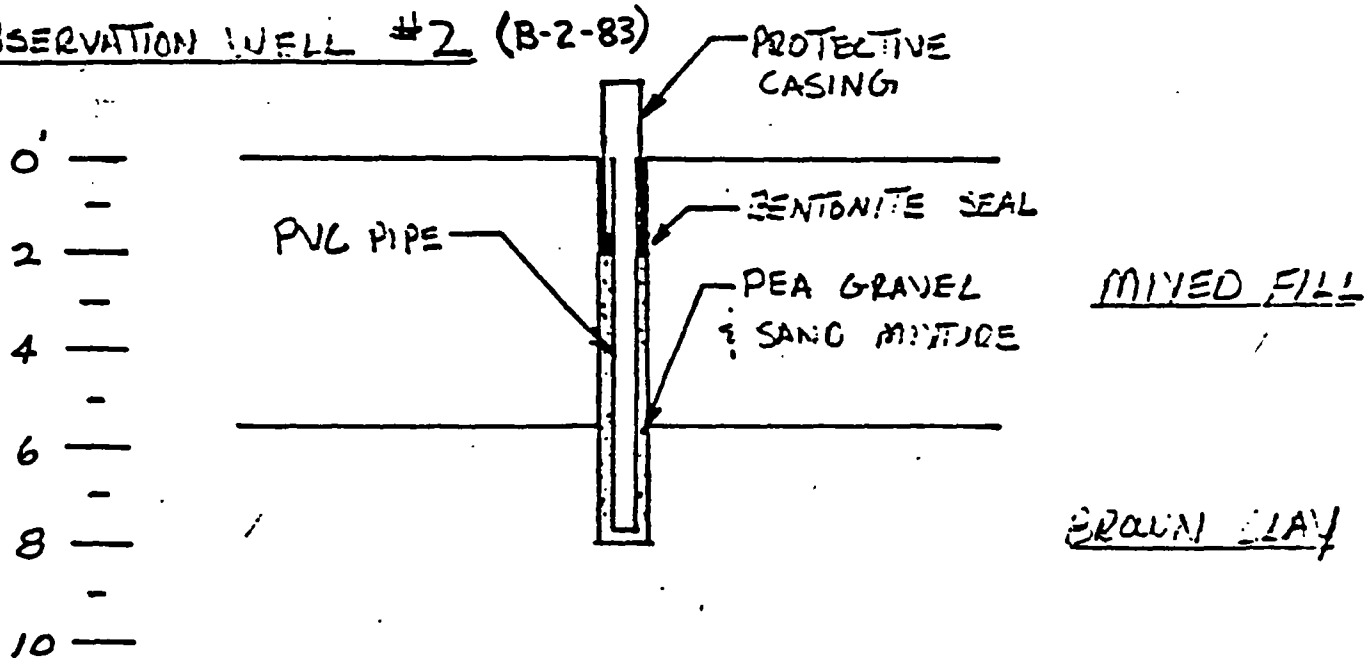
COMPUTED BY TB

CHECKED BY

OBSERVATION WELL #1 (B-1-83)



OBSERVATION WELL #2 (B-2-83)



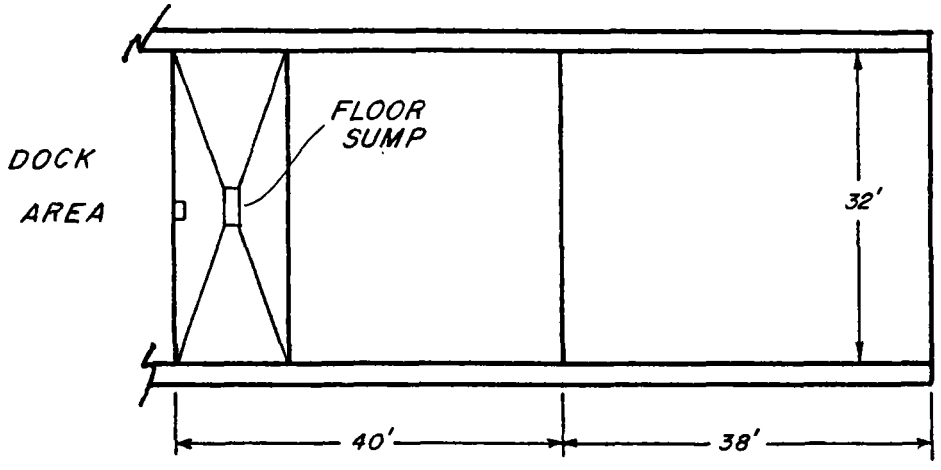
APPENDIX D.1d

CONTAINER STORAGE AREA
SECONDARY CONTAINER CALCULATIONS

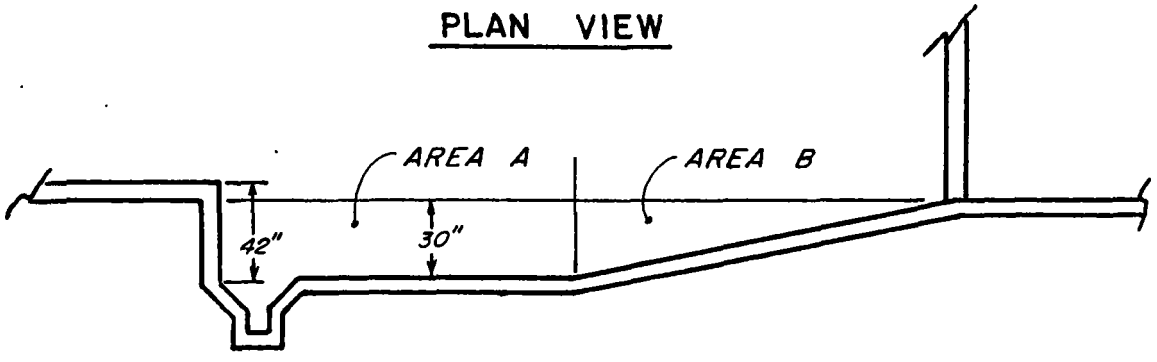
SECONDARY CONTAINMENT CALCULATION

LOADING DOCK AREA

CONTAINER STORAGE FACILITY



PLAN VIEW



SECTION

Secondary Containment Volume = Area A + Area B

Area A = 40′ x 32′ x 30"/12" x 7.48 gal./cu.ft. = 23,936 gal.

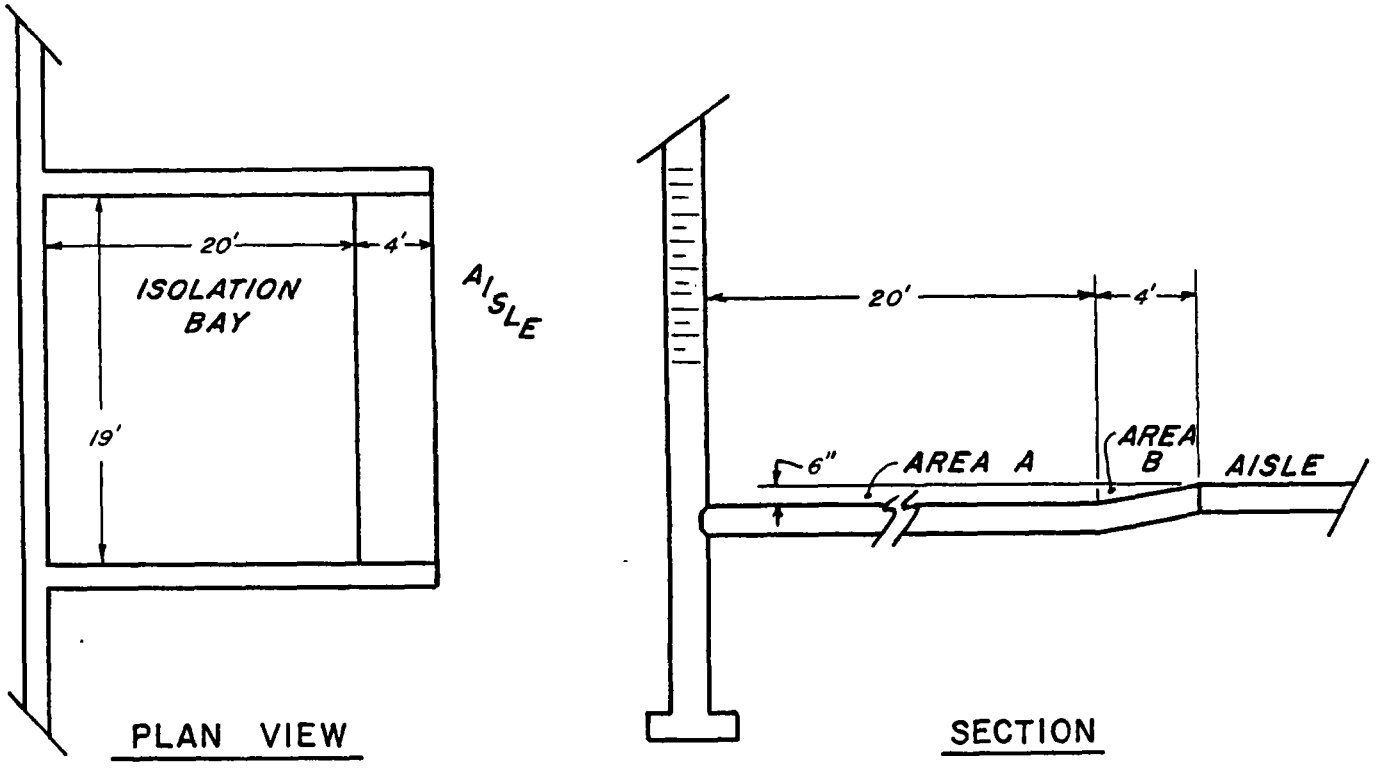
Area B = 38′ x 32′ x 1/2 x 30"/12" x 7.48 gal./cu.ft. = 11,370 gal.

Total Containment Vol = 35,306 gal.

SECONDARY CONTAINMENT CALCULATION

CONTAINER STORAGE - ISOLATION BAY

CONTAINER STORAGE FACILITY



Secondary Containment Volume = Area A + Area B - Pallet & Drum Volume

Area A = (20′ x 19′ x 6"/12")(7.48 gal./cu.ft.) = 1,420 gal.

Area B = (1/2 x 4′ x 19′ x 6"/12")(7.48 gal./cu.ft.) = 142 gal.

Pallet Vol= 15 [3 (2"/12" x 4"/12" x 4′) + (0.75"/12" x 4′ x4′)] 7.48 gal./cu.ft. = -187 gal.

Drum Vol = 60 [2"/12" (11.25/12")^2 x π] 7.48 gal./cu.ft. = - 209 gal.

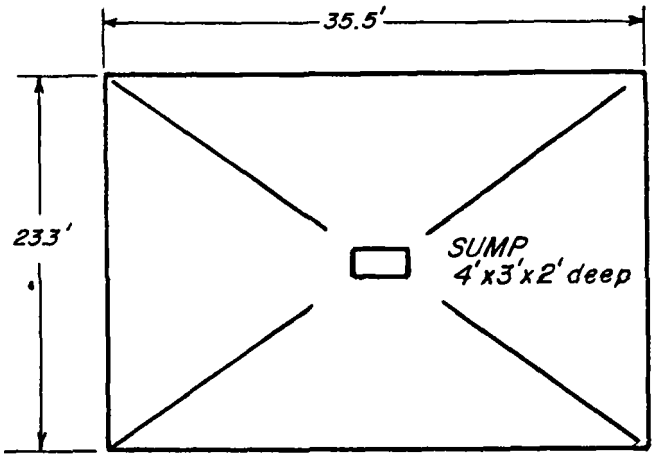
Total Containment Vol = 1,166 gal.

This represents 18% of the maximum storage volume in each bay $\left(\frac{1166}{6600} \times 100\right)$

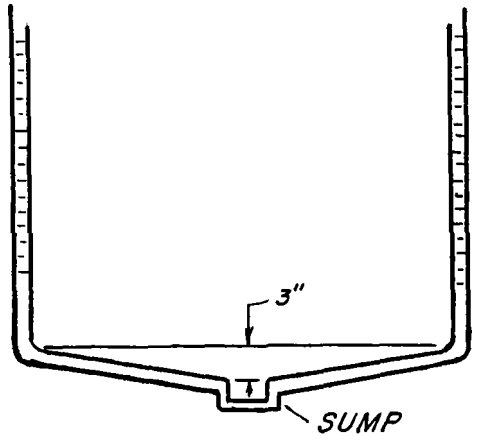
SECONDARY CONTAINMENT CALCULATION

WASTE BULKING/TRANSFER AREA

CONTAINER STORAGE FACILITY



PLAN VIEW



BUILDING SECTION

Secondary Containment Volume = Sump Vol. + Sloped Floor Vol.

Sump Vol = 4′ x 3′ x 2′ x 7.48 gal./cu.ft. = 180 gal.

Sloped Floor Vol = $h\,(a + A + \sqrt{aA})\ 1/3 \times 7.48$ gal./cu.ft.

Where:

a = 12 ft.^{2} (4′ x 3′)

A = 828 ft.^{2} (23.3′ x 35.5′)

h = 3"/12" (0.25′)

Vol = $(0.25)\,(12 + 828 + \sqrt{(12)\,(828)})\ 1/3\ (7.48)$ = 586 gal.

= (0.25) (940) 1/3 (7.48)

Total Containment Vol = 766 gal.

APPENDIX D.2

EXISTING REGULATED (TREATMENT AND STORAGE) TANKS

APPENDIX D.2a

BASIS OF DESIGN AND DESIGN CAPACITY FOR REGULATED TANKS

APPENDIX D.2b

FACILITY DRAWINGS FOR REGULATED TANKS

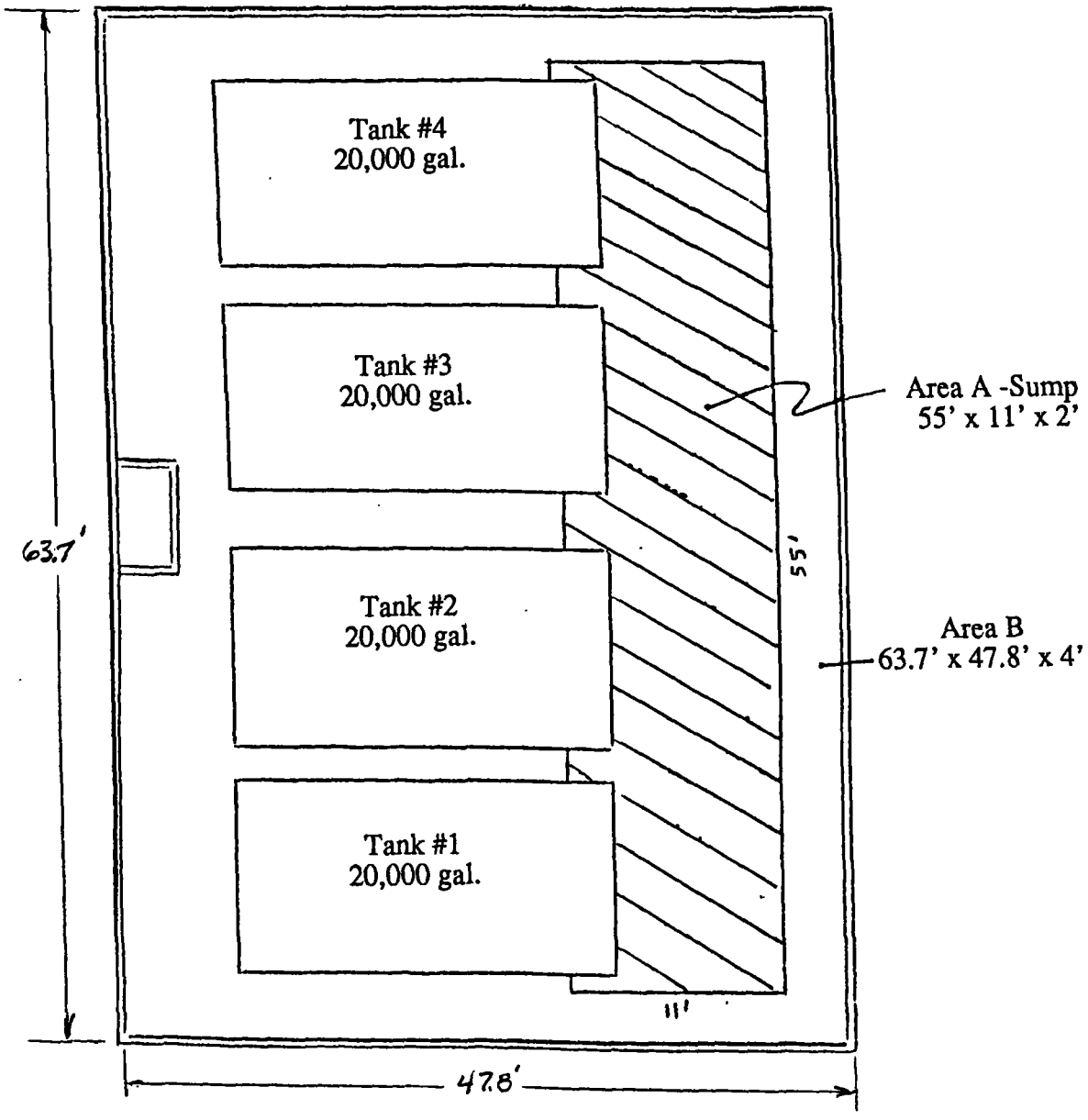
APPENDIX D.2c

EQUIPMENT SPECIFICATIONS FOR REGULATED TANKS

APPENDIX D.2d

SECONDARY CONTAINMENT CALCULATIONS FOR REGULATED TANKS

SECONDARY CONTAINMENT CALCULATION
PRIMARY TREATMENT AREA



Secondary holding capacity = Area A + Area B

Vol A = (55' x 11' x 2') 7.48 gal./cu.ft. =	9,051 gal.
Vol B = (63.7' x 47.8' x 4') 7.48 gal./cu.ft. =	91,108 gal.
Total Containment Val =	100,159 gal.

This exceeds 150% of the largest tank (1.5 x 20,000 = 30,000 gal.)

SECONDARY CONTAINMENT CALCULATION

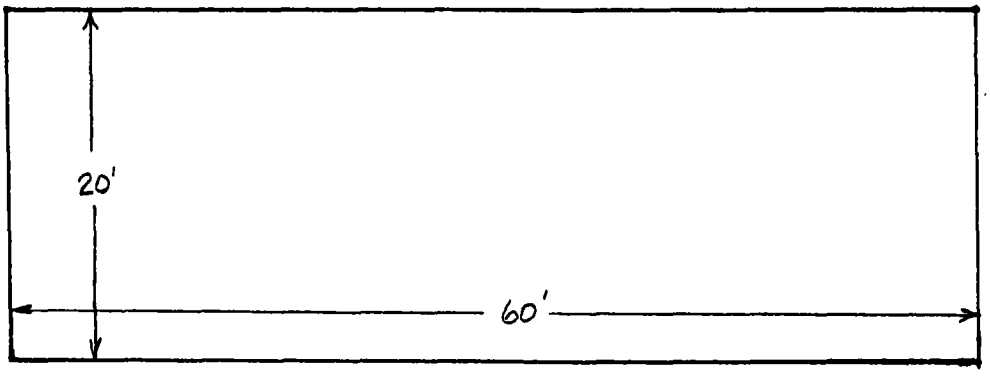
BUILDING 'A' TANKAGE

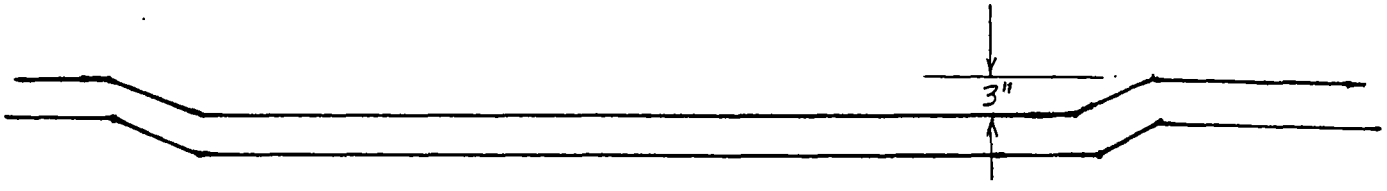
Tank #	Diameter	Total Volume	Volume Deducted*
7	10'	10,000	2,350 gal.
8	8' x32' cyl.	12,000	4,150 gal.
9	14'	27,600	4,606 gal.
10	12'	12,000	3,384 gal.
12	11'	25,800	2,843 gal.
13	11'	25,800	2,843 gal.
15	14'	27,600	4,606 gal.
16	11'	25,800	2,843 gal.
17	11'	25,800	2,843 gal.
14	14'	14,000	0 (on legs)
23	8'	6,000	0 (on legs)
24	8'	6,000	0 (on legs)
			30,468 gal.

*Based on 4 feet of depth in each tank

SECONDARY CONTAINMENT CALCULATION

TANKER UNLOADING PAD





Secondary Holding Capacity

(60' x 20' x 3"/12") 7.48 gal./cu.ft. = 2,244 gal.

This is approximately 37% of the largest tanker

$$\left(\frac{2{,}244}{6{,}000} \times 100 = 37.4\%\right)$$

APPENDIX D.2e

TANK FACILITY CERTIFICATION

CHEMTEC RESEARCH ASSOCIATES, INC.
16241 Westmoreland Detroit, Michigan 48219
Telephone: (313) 534-4298
Raymond J. Barker, P.E.

June 27, 1986

Mr. Gordon E. Guyer
Director
State of Michigan
Department of Natural Resources
P.O. Box 30028
Lansing, Michigan 48909

Re: Hazardous Waste Management Facility
Certification of Capability for
Waste Acid Services, Inc.
6520 Georgia Street
Detroit, Michigan 48211

Dear Mr.

I am familiar with the equipment, the processes, the management, and the personnel at the above referenced facility.

I certify that this facility is capable of storage, treatment, and disposal of hazardous waste in accordance with applicable provisions of Michigan Act 64 and with Federal RCRA regulations.

Raymond J. Barker, P.E.
Michigan #24201

RJBeh

CHEMTEC RESEARCH ASSOCIATES, INC.
32401 West Eight Mile Road Livonia, MI 48152
Telephone: (313) 476-9898
Raymond J. Barker, P.E.

April 28, 1987

Mr. Wayne D. Laraway
Dynecol, Inc.
6520 Georgia
Detroit, Mi 48211

Dear Mr. Laraway,

I am familiar with your facility located at the address referenced above, including the processes, operations, procedures, equipment and personnel utilized there.

The waste treatment procedures carried out at the facility are typical of the conventional treatment processes normally used to treat acid, alkaline and heavy metal wastes. The system used in this waste treatment process is commonly described in the technical literature for similar applications and has been observed by me to be in successful operation in a number of plating and metal finishing plants in the Detroit area and elsewhere.

Based upon my experience at your facility, and at others, the design and construction of the waste treatment system was completed using only high quality workmanship and materials. I have also observed that operation and maintenance of the facility and its equipment is carried out by personnel who are well trained and dedicated to quality performance of their duties.

It is my opinion that this facility will continue to meet or exceed federal, state, county and city environmental control regulations.

Sincerely,

Raymond J Barker, P.E.
Chemtec Research Associates

RJB/da

APPENDIX E.1

SOIL BORING AND MONITORING WELL LOG SHEETS

EDI Engineering & Science

Page: 1 of 1
Well/Boring No.: SB-1-88
Client: Dynecol
Project No.: 20878

Well/Boring Log Sheet

County	Township	Fraction	Section	T	R
Wayne		NE1/4 SE 1/4 SW 1/4	21	1S	12E

Contractor Stearns Drilling
Address: Dutton, MI

Equipment: Acker
Mike H. Tim, Rich
Supervisor: WTD/DJJ-EDI

Screen
Manufacturer:
Material:
Model: N/A
Slot/Gauze: Dia.:
Length:
Depth Set: To:

Date
Started: 3/14/88 Finished: 3/14/88

Elevation
Casing:
Ground: 631.88'
Ref. Pt.: USGS

Drilling Method(s) **Depth**

concrete corer	0-0.7'
Auger (HSA)	0.7-20'

Casing

Dia.	Type	Depth Set
	N/A	To
		To

Water Level N/A Ft. Below
Measure On:

Grouting/Seal

Depth	To	Material/Meth
0.0	18'	Natural Soil w/ Hole plug
18'	20'	Hole plug

Location See location Map

Remarks (include here, other data available)
Split Spoon Samples not scanned with HNU photoionizer -batteries low
Soil pH conducted on composite of split spoon samples utilizing method 9045 for noncalcareous soils.

Development N/A

Thick-ness	Depth to Base	LITHOLOGIC DESCRIPTION	Sampled from/to	Blow Counts 1st 6"	2nd 6"	3rd 6"	Remarks Soil pH
0.7	0.7	CONCRETE	1'-2.5	7	8	7	7.8
0.5	1.2	CLAY - brown, sandy, (fill)	3.5-5	4	5	5	7.4
0.4	1.6	CINDERS - peat, with traces of clay and occasional fine gravel (fill)	6-7.5	6	10	15	7.7
0.5	2.1	CINDERS - small pieces of slag (fill)	8.5-10	9	16	21	8.0
1.1	3.2	SAND - brown to light brown, fine to medium with seams of fine black sand (fill)	11-12.5	10	16	21	8.1
1.0'	4.2	SAND, black, fine to medium	13.5-15	8	12	14	8.3
1.3'	5.5	SAND - brownish green, fine with traces of clay (fill)	16-17.5	8	10	13	8.2
3.5	9.0	CLAY - brown, with seams of brown and gray silt (firm) [CL]	18.5-20	6	8	12	8.4
1.2'	10.2	CLAY - brown to gray, with occasional fine gravel (firm) [CL]					
1.8	12	CLAY - gray with seams of brown sandy clay, occasional fine gravel (firm) [CL]					
8.0	20	CLAY - gray, with occasional fine gravel, (firm) [CL]					

EDI Engineering & Science

Page: 1 of 1
Well/Boring No.: SB-2-88
Client: Dynecol
Project No.: 20878

Well/Boring Log Sheet

County	Township	Fraction	Section	T	R
Wayne		NE 1/4 SE 1/4 SW1/4	21	1S	12E

Contractor Stearns Drilling
Address: Dutton, MI

Equipment: Acker
Mike H. Tim, Rich
Supervisor: WTD/DJJ-EDI

Drilling Method(s) **Depth**
Auger (HSA) 0-20'

Grouting/Seal

Depth	To	Material/Method
0.0	20'	Natural Soil & Hole plug

Development N/A

Screen
Manufacturer:
Material:
Model: N/A
Slot/Gauze: Dia.:
Length:
Depth Set: To:

Casing

Dia.	Type	Depth Set
	N/A	To
		To

Date
Started: 3/15/88 Finished: 3/15/88

Elevation
Casing:
Ground: 629.7'
Ref. Pt.: USGS

Water Level N/A Ft. Below
Measure On:

Location See location Map

Remarks (include here, other data available)
Split Spoon Samples scanned with HNU photoionizer - no detectable levels
Soil pH conducted on composite of split spoon samples utilizing method 9045 for noncalcareous soils.

Thick-ness	Depth to Base	LITHOLOGIC DESCRIPTION	Blow Counts / Remarks: Sampled from/to	1st 6"	2nd 6"	3rd 6"	Soil pH
0.6	0.6	GRAVEL - fine to coarse; sand, brown, medium to fine (fill)	1'-2.5	8	13	13	0.4
1.2	1.8	SAND - black, fine to medium, (fill)	3.5-5	4	8	10	8.2
1.2	3.0	SAND - brownish; green, fine to medium, (fill)	6-7.5	18	22	33	2.2
5	8.0	CLAY - light brown, sandy w/ occasional fine gravel & seams of brown & gray silt [CL]	8.5-10	10	15	17	8.6
12	20	CLAY - gray, with occasional coarse sand and seams of gray silt (firm) [CL]	11-12.5	9	13	13	8.7
			13.5-15	8	10	14	8.6
			16-17.5	7	11	13	8.9
			18.5-20	6	8	12	9.0

EDI Engineering & Science

Page: 1 of 1
Well/Boring No.: SB-3-88
Client: Dynecol
Project No.: 20878

Well/Boring Log Sheet

County	Township	Fraction	Section	T	R
Wayne		NE 1/4 SE 1/4 SW1/4	21	1S	12E

Contractor Stearns Drilling
Address: Dutton, MI

Equipment: Acker
Mike H. Tim, Rich
Supervisor: WTD/DJJ-EDI

Drilling Method(s) **Depth**
Auger (HSA) 0-20'

Grouting/Seal

Depth	To	Material/Method
0.0	20'	Natural Soil & Hole plug

Development N/A

Screen
Manufacturer:
Material:
Model: N/A
Slot/Gauze: Dia.:
Length:
Depth Set: To:

Casing

Dia.	Type	Depth Set
	N/A	To
		To

Date
Started: 3/15/88 Finished: 3/15/88

Elevation
Casing:
Ground: 629.7'
Ref. Pt.: USGS

Water Level N/A Ft. Below
Measure On:

Location See location Map

Remarks (include here, other data available)
Split Spoon Samples scanned with HNU photoionizer -no detectable levels
Soil pH conducted on composite of split spoon samples utilizing method 9045 for noncalcareous soils.

Thick-ness	Depth to Base	LITHOLOGIC DESCRIPTION	Blow Counts / Remarks: Sampled	from/to	1st 6"	2nd 6"	3rd 6"	Soil pH
0.8	0.8	GRAVEL - fine to coarse (fill)		1'-2.5	7	7	7	8.7
4	4.8	SAND - brown to light brown, medium to fine (fill)		3.5-5	4	3	3	8.8
0.7	5.5	CLAY - gray, sandy, with occasional fine gravel [CL]		6-7.5	7	11	18	8.8
3.5	9.0	CLAY - gray, firm with occasional fine gravel [CL]		8.5-10	20	24	14	8.5
10	19	CLAY - gray, firm with occasional fine to medium gravel [CL]		11-12.5	12	15	17	8.6
1'	20	CLAY - gray, sandy (fine sands), with occasional fine gravel (firm) [CL]		13.5-15	15	17	17	8.6
				16-17.5	7	11	13	9.1
				18.5-20	5	7	12	8.9

EDI Engineering & Science

Well/Boring No.: SB-4-88
Client: Dynecol
Project No.: 20878

Well/Boring Log Sheet

County	Township	Fraction	Section	T	R
Wayne		NE 1/4 SE 1/4 SW1/4	21	1S	12E

Contractor Stearns Drilling
Address: Dutton, MI

Equipment: Acker
Mike H. Tim, Rich
Supervisor: WTD/DJJ-EDI

Drilling Method(s) **Depth**
Auger (HSA) 0-60'

Grouting/Seal

Depth	To	Material/Method
0.0	60'	Cement Grout

(18 bags type I cmt and 90 gallons of water)

Development N/A

Screen
Manufacturer:
Material:
Model: N/A
Slot/Gauze: Dia.:
Length:
Depth Set: To:

Casing

Dia.	Type	Depth Set
	N/A	To
		To

Date
Started: 3/15/88 Finished: 3/16/88

Elevation
Casing:
Ground: 630.2'
Ref. Pt.: USGS

Water Level N/A Ft. Below
Measure On:

Location See location Map

Remarks (include here, other data available)
Split Spoon Samples scanned with HNU photoionizer -no detectable levels
Soil pH conducted on composite of split spoon samples utilizing method 9045 for noncalcareous soils.

Thick-ness	Depth to Base	LITHOLOGIC DESCRIPTION	Sampled from/to	Blow Counts 1st 6"	2nd 6"	3rd 6"	Remarks Soil pH
2	2	SAND - brown to gray, medium with traces of clay and fine gravel (fill)	1'-2.5	6	7	10	9.5
1.2	3.2	CLAY - gray, sandy with fine gravel [CL]	3.5-5	4	4	6	8.8
2.8	6	CLAY - greenish gray, sandy (fine sands), soft [CL]	6-7.5	8	14	22	8.0
2	8	CLAY - greenish gray, firm with occasional fine gravel [CL]	8.5-10	14	22	27	8.3
2.3	10.3	CLAY - greenish gray to brown, sandy, firm with occasional fine gravel [CL]	11-12.5	7	10	15	8.3
15.2'	25.5	CLAY - gray, sandy firm with occasional, fine gravel, [CL]	13.5-15	8	13	16	8.5
4.5	30	SAND - gray, fine with silt and clay and occasional medium sand and fine gravel [SM]	16-17.5	8	11	16	8.6
6	36	CLAY - gray with fine to medium gravel [CL]	18.5-20	7	8	14	8.8
1.5	37.5	SAND - gray, fine, intermittently layered with silty clay [ML]	21-22.5	6	10	12	8.8
4.5	42	CLAY - gray, with occasional fine gravel [CL]	23.5-25	6	10	14	8.5
0.2	42.2	SAND - gray, medium to fine with traces of gray silt [SM]	26-27.5	5	6	15	8.5
17.8'	60	CLAY - gray, with occasional fine gravel [CL]	28.5-30	7	9	10	8.9
			31-32.5	6	10	14	9.0
			33.5-35	7	6	14	9.0
			36-37.5	12	9	13	8.8
			38.5-40	7	7	10	8.8
			41-42.5	6	10	14	9.0
			43.5-45	5	7	11	9.0

EDI Engineering & Science

Well/Boring No.: SB-4-88
Client: Dynecol
Project No.: 20878

Well/Boring Log Sheet

County	Township	Fraction	Section	T	R
Wayne		NE 1/4 SE 1/4 SW1/4	21	1S	12E

Contractor Stearns Drilling
Address: Dutton, MI

Equipment: Acker
Mike H. Tim, Rich
Supervisor: WTD/DJJ-EDI

Drilling Method(s) **Depth**
Auger (HSA) 0-60'

Grouting/Seal

Depth	To	Material/Method
0.0	60'	Cement Grout

(18 bags type I cmt and 90 gallons of water)

Development N/A

Screen
Manufacturer:
Material:
Model: N/A
Slot/Gauze: Dia.:
Length:
Depth Set: To:

Casing

Dia.	Type	Depth Set
	N/A	To
		To

Date
Started: 3/15/88 Finished: 3/16/88

Elevation
Casing:
Ground: 630.2'
Ref. Pt.: USGS

Water Level N/A Ft. Below
Measure On:

Location See location Map

Remarks (include here, other data available)
Blow counts and pH readings continued from pg 1.

Thick-ness	Depth to Base	LITHOLOGIC DESCRIPTION	Blow Counts / Remarks: Sampled from/to	1st 6"	2nd 6"	3rd 6"	Soil pH
			46-47.5	5	6	7	8.6
			48.5-50	6	7	8	8.5
			51-52.5	5	7	7	8.6
			53.5-55	5	7	9	8.6
			56-58.5	4	6	9	8.6
			58.5-60	4	6	10	8.6

EDI Engineering & Science

Page: 1 of 1
Well/Boring No.: SB-5-88
Client: Dynecol
Project No.: 20878

Well/Boring Log Sheet

County	Township	Fraction	Section	T	R
Wayne		NE1/4 SE 1/4 SW 1/4	21	1S	12E

Contractor Stearns Drilling
Address: Dutton, MI

Equipment: Acker
Mike H. Tim, Rich
Supervisor: WTD/DJJ-EDI

Drilling Method(s) **Depth**

Concrete Curer	0-0.8'
Auger (HSA)	0.8-60'

Grouting/Seal

Depth	To	Material/Meth
0.0	60'	Cement Grout

(15 bags type I cmt, 1 bag redimix and 78 gallons of water)

Development N/A

Screen
Manufacturer:
Material:
Model: N/A
Slot/Gauze: Dia.:
Length:
Depth Set: To:

Casing

Dia.	Type	Depth Set
	N/A	To
		To

Date
Started: 3/16/88 Finished: 3/17/88

Elevation
Casing:
Ground: 631.93'
Ref. Pt.: USGS

Water Level N/A Ft. Below
Measure On:

Location See location Map

Remarks (include here, other data available) Gamma log available.
Split Spoon Samples scanned with HNU photoionizer -no detectable levels
Soil pH conducted on composite of split spoon samples utilizing method 9045 for noncalcareous soils.
Augered to 40' on 3/16/88; 30' of water (pH 7.12)in auger at 8:00am 3/17/88
Accumulated water bailed from auger prior to drilling on 3/17/88.

Thick-ness	Depth to Base	LITHOLOGIC DESCRIPTION	Blow Counts / Remarks: Sampled from/to	1st 6"	2nd 6"	3rd 6"	Soil pH
0.7	0.7	CONCRETE					
0.5	1.2	CLAY - brown, sandy, (fill)	8.5-10	7	14	10	8.0
0.4	1.6	CINDERS - peat, with traces of clay and occasional fine gravel (fill)	13.5-15	10	14	21	8.3
0.5	2.1	CINDERS - small pieces of slag (fill)	21-22.5	7	9	18	8.8
1.1	3.2	SAND - brown to light brown, fine to medium with seams of fine black sand (fill)	23.5-25	5	8	11	8.8
1.0'	4.2	SAND - brownish green, fine with traces of clay (fill)	26-27.5	6	8	13	8.8
1.3'	5.5	CLAY - brown, with seams of brown and gray silt (firm) [CL]	28.5-30	5	7	12	9.0
3.5	9.0	CLAY - brown to gray, with occasional fine gravel (firm) [CL]	31-32.5	5	6	9	9.0
1.2'	10.2	CLAY - gray with seams of brown sandy clay, occasional fine gravel (firm) [CL]	33.5-35	5	8	10	9.0
1.8	12	CLAY - gray, with occasional fine gravel, (firm) [CL]	36-37.5	5	6	9	9.0
17.8	29.8	CLAY - gray, sandy, firm with occasional fine gravel, [CL]	38.5-40	5	5	8	9.1
1	30.8	SAND - gray, fine, silt, gray interbedded with gray sandy clay [SM]	41-42.5	4	5	7	9.1
5.7	36.5	CLAY - gray, sandy, soft with occasional fine gravel [CL]	43.5-45	4	5	7	9.1
0.8	37.3	CLAY - gray, with seams of silt and rare fine gravel [CL]	46-47.5	7	7	12	8.9
11.4	48.7	CLAY - gray, sandy with occasional fine gravel, soft [CL]	48.5-50	9	15	12	8.9
2.8	51.5	SILT - gray, very fine gray sands [SM]	51-52.5	8	7	6	9.1
0.2	51.7	SAND - gray, fine to medium with traces of silt & occasional fine gravel [SM]	53.5-55	5	12	12	8.8
0.3	52	SILT - gray, very fine gray sands [SM]	56-57.5	5	7	7	9.2
8.0	60	CLAY - gray and sandy soft with occasional fine gravel [CL]	58.5-60	4	6	14	8.9

EDI Engineering & Science

Well/Boring No.: SB-6-88
Client: Dynecol
Project No.: 20878

Well/Boring Log Sheet

County	Township	Fraction	Section	T	R
Wayne		NE 1/4 SE 1/4 SW1/4	21	1S	12E

Contractor Stearns Drilling
Address: Dutton, MI

Equipment: Acker
Mike H. Tim, Rich
Supervisor: WTD/DJJ-EDI

Drilling Method(s) **Depth**
Auger (HSA) 0-60'

Grouting/Seal

Depth	To	Material/Method
0.0	60'	Cement Grout

(16 bags type I cement and 85 gallons of water)

Development N/A

Screen
Manufacturer:
Material:
Model: N/A
Slot/Gauze: Dia.:
Length:
Depth Set: To:

Casing

Dia.	Type	Depth Set
	N/A	To
		To

Date
Started: 3/17/88 Finished: 3/18/88

Elevation
Casing:
Ground: 629.3'
Ref. Pt.: USGS

Water Level N/A Ft. Below
Measure On:

Location See location Map

Remarks (include here, other data available) Gamma log available
Split Spoon Samples scanned with HNU photoionizer -no detectable levels
Soil pH conducted on composite of split spoon samples utilizing method 9045 for noncalcareous soils. Augered to 30' on 3/17/88; 8.5' of water (pH 8.13) in auger at 8:00am 3/18/88 Accumulated water bailed from auger prior to drilling on 3/18/88. -Saturated zone encountered 38.5-43; bailed water sample (pH 8.37)

from: Thick-ness	12' Depth to Base	LITHOLOGIC DESCRIPTION	Sampled from/to	Blow Counts 1st 6"	2nd 6"	3rd 6"	Remarks Soil pH
1.2	1.2	GRAVEL FILL	8.5-10	5	7	6	8.0
.8	2.0	CLAY - (fill)	13.5-15	7	12	18	8.3
.5	2.5	SAND - fine to medium, brown to black with occasional fine gravel (fill)	21-22.5	11	17	22	8.8
5.5	8.0	CLAY - mottled, brown, with seams of gray silt and occasional fine gravel (firm) [CL]	23.5-25	14	29	27	8.3
2.5	10.5	CLAY - brownish green, sandy with occasional fine gravel (firm) [CL]	26-27.5	11	14	17	8.7
2.7	13.2	CLAY - gray, firm with veins of brown silt and occasional fine gravel [CL]	28.5-30	9	13	18	8.6
5.2	18.4	CLAY - gray, firm, with traces of gray silt and occasional fine gravel [CL]	31-32.5	8	11	13	8.6
0.2	18.6	SAND - gray, fine to medium with traces of gray silt [SM]	33.5-35	5	8	12	8.6
8.4	27	CLAY - gray, soft, with traces of silt and occasional fine gravel [CL]	36-37.5	5	8	10	8.8
1	28	SILT - gray, with occasional fine gray sand and clay (Dry) [ML]	38.5-40	5	9	13	9.0
0.5	28.5	CLAY - gray, soft, with occasional fine gravel [CL]	41-42.5	5	14	19	9.0
1.5	32	SILT - gray, very fine gray sands [ML]	43.5-45	7	14	11	9.1
2	34	CLAY - gray with occasional fine gravel [CL]	46-47.5	5	11	13	9.1
0.5	34.5	SILT - gray, very fine (Dry) [ML]	48.5-50	6	10	17	9.1
2.5	37	CLAY - gray, with occasional fine gravel [CL]	51-52.5	13	22	24	9.1
1.5	38.5	SILT - gray, fine with occasional fine gray sands [SM]	53.5-55	12	20	15	9.0
4.5	43	SAND - gray, fine to medium with occasional fine gravel and seams of silt [SM-SP]	56-57.5	10	14	14	9.0
4	47	CLAY - gray, with occasional fine to medium gravel [CL]	58.5-60	6	8	10	9.1

EDI Engineering & Science

Page: 1 of 2
Well/Boring No.: SB-6-88
Client: Dynecol
Project No.: 20878

Well/Boring Log Sheet

County	Township	Fraction	Section	T	R
Wayne		NE 1/4 SE 1/4 SW1/4	21	1S	12E

Contractor Stearns Drilling
Address: Dutton, MI

Equipment: Acker
Mike H. Tim, Rich
Supervisor: WTD/DJJ-EDI

Drilling Method(s) **Depth**
Auger (HSA) 0-60'

Grouting/Seal

Depth	To	Material/Method
0.0	60'	Cement Grout

(16 bags type I cement and 85 gallons of water)

Development N/A

Screen
Manufacturer:
Material:
Model: N/A
Slot/Gauze: Dia.:
Length:
Depth Set: To:

Casing

Dia.	Type	Depth Set
	N/A	To
		To

Date
Started: 3/17/88 Finished: 3/18/88

Elevation
Casing:
Ground: 629.3'
Ref. Pt.: USGS

Water Level N/A Ft. Below
Measure On:

Location See location Map

Remarks (include here, other data available) Gamma log available
Split Spoon Samples scanned with HNU photoionizer -no detectable levels
Soil pH conducted on composite of split spoon samples utilizing method 9045 for noncalcareous soils. Augered to 30' on 3/17/88; 8.5' of water (pH 8.13) in auger at 8:00am 3/18/88 Accumulated water bailed from auger prior to drilling on 3/18/88. -Saturated zone encountered 38.5-43; bailed water sample (pH 8.37)

Thickness	Depth to Base	LITHOLOGIC DESCRIPTION	Sampled from/to	Blow Counts 1st 6"	2nd 6"	3rd 6"	Remarks Soil pH
1.2	1.2	GRAVEL FILL	8.5-10	5	7	6	8.0
.8	2.0	CLAY - (fill)	13.5-15	7	12	18	8.3
.5	2.5	SAND - fine to medium, brown to black with occasional fine gravel (fill)	21-22.5	11	17	22	8.8
5.5	8.0	CLAY - mottled, brown, with seams of gray silt and occasional fine gravel (firm) [CL]	23.5-25	14	29	27	8.3
2.5	10.5	CLAY - brownish green, sandy with occasional fine gravel (firm) [CL]	26-27.5	11	14	17	8.7
2.7	13.2	CLAY - gray, firm with veins of brown silt and occasional fine gravel [CL]	28.5-30	9	13	18	8.6
5.2	18.4	CLAY - gray, firm, with traces of gray silt and occasional fine gravel [CL]	31-32.5	8	11	13	8.6
0.2	18.6	SAND - gray, fine to medium with traces of gray silt [SM]	33.5-35	5	8	12	8.6
8.4	27	CLAY - gray, soft, with traces of silt and occasional fine gravel [CL]	36-37.5	5	8	10	8.8
1	28	SILT - gray, with occasional fine gray sand and clay (Dry) [ML]	38.5-40	5	9	13	9.0
0.5	28.5	CLAY - gray, soft, with occasional fine gravel [CL]	41-42.5	5	14	19	9.0
1.5	32	SILT - gray, very fine gray sands [ML]	43.5-45	7	14	11	9.1
2	34	CLAY - gray with occasional fine gravel [CL]	46-47.5	5	11	13	9.1
0.5	34.5	SILT - gray, very fine (Dry) [ML]	48.5-50	6	10	17	9.1
2.5	37	CLAY - gray, with occasional fine gravel [CL]	51-52.5	13	22	24	9.1
1.5	38.5	SILT - gray, fine with occasional fine gray sands [SM]	53.5-55	12	20	15	9.0
4.5	43	SAND - gray, fine to medium with occasional fine gravel and seams of silt [SM-SP]	56-57.5	10	14	14	9.0
4	47	CLAY - gray, with occasional fine to medium gravel [CL]	58.5-60	6	8	10	9.1

EDI Engineering & Science

Page: 1 of 1
Well/Boring No.: SB-7-88
Client: Dynecol
Project No.: 20878

Well/Boring Log Sheet

County	Township	Fraction	Section	T	R
Wayne		NE 1/4 SE 1/4 SW1/4	21	1S	12E

Contractor Stearns Drilling
Address: Dutton, MI

Equipment: Acker
Mike H. Tim, Rich
Supervisor: WTD/DJJ-EDI

Drilling Method(s) **Depth**
Auger (HSA) 0-43.5'

Grouting/Seal

Depth	To	Material/Method
0.0	43.5'	Cement Grout

(26 bags cement 1 bag bentonite hole plug and 150 gallons of water)

Development N/A

Screen
Manufacturer:
Material:
Model: N/A
Slot/Gauze: Dia.:
Length:
Depth Set: To:

Casing

Dia.	Type	Depth Set
	N/A	To
		To

Date
Started: 3/21/88 Finished: 3/21/88

Elevation
Casing:
Ground:
Ref. Pt.:

Water Level N/A Ft. Below
Measure On:

Location 6' SE of SB-6-88

Remarks (include here, other data available)
Boring SB-7-88 was intended for monitor well construction within saturated zone encountered in SB-6-88 from 38.5-43', but interval was silty clay in this boring

Thick-ness	Depth to Base	LITHOLOGIC DESCRIPTION	Blow Counts / Remarks: Sampled Depth from	to	1st 6"	2nd 6"	3rd 6"
1.0	1.0	GRAVEL FILL					
1.0	2.0	CLAY - (fill)					
.5	2.5	SAND - fine to medium, brown (fill)					
15.5	18	CLAY - brown, firm [CL]					
.5	18.5	SILT - gray, sandy [ML]					
20	38.5	CLAY - with occasional silty intervals (no samples-auger cuttings unreliable at this depth) [CL-ML]	38.5	40	6	10	10
5.0	43.5	CLAY - brown, very silty, firm with occasional fine gravel [CL]	41.5	43	8	11	13

BORING LOG NO. B-1-81

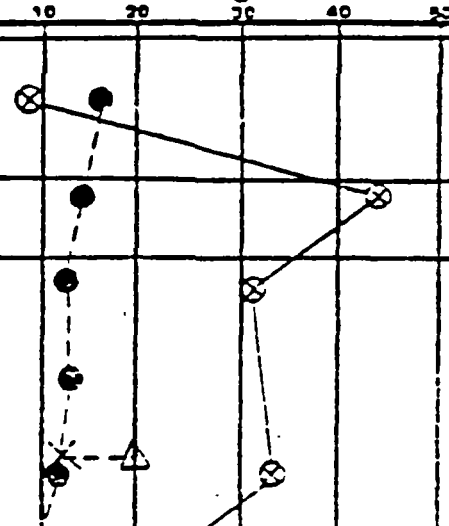
DYNECOL, INC.	ARCHITECT/ENGINEER
6520 Georgia Detroit, Michigan	PROJECT NAME Hydrogeologic Study

FT	ELEVATION	SAMPLE NO.	TYPE SAMPLE	SAMPLE DIST.	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT³
					SURFACE ELEVATION 108.6	
					See Note A Below	
		1	SS		Mixed Sand & Clay fill	
10		2	SS		Sandy clay - tr. silt & gravel -brown- hard (CL)	
		3	SS		Silty Clay - tr. to some gravel - tr sand - gray -hard (CL)	
20		4	SS			
		5	SS			
		6	SS		Silty clay - Some sand- tr. gravel - gray - stiff (CL)	
30		7	SS		Silty Sand-tr-clay-gray-dense (SM)	
					End of Boring	

UNCONFINED COMPRESSIVE STRENGTH TONS/FT²: 1 2 3 4 5

PLASTIC LIMIT % — WATER CONTENT % — LIQUID LIMIT %

STANDARD "N" PENETRATION (BLOWS/FT): 10 20 30 40 50



Notes

A. Driller reports crushed stone fill

B. Driller reports very small amount of water in fill and small amount @ 34

DRILLING & SAMPLING METHOD SUMMARY	HOLE PLUGGING RECORD
CASING: ____ TO ____ FT WASH WATER: ____ TO ____ FT FLIGHT AUGERS: 0 TO 36 FT HOLLOW STEM AUGERS: ____ TO ____ FT	NATURAL MATERIALS: 0 TO 30 FT : ____ TO ____ FT

NOTE: The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

WATER LEVELS		
TIME:	____ FT TIME ____	
	____ FT TIME ____	
	33.5 FT TIME AB	
	20 FT TIME 8 hr AB	

BORING START	7-20-81
BORING COMPLETE	7-20-81
RIG: Corbin	FOREMAN: JC
DRAWN: CG	APPROVED: CG
JOB: 81 HM-16C	SHT: 1 of 1

HMA Consultants Inc.
400 Renaissance Center
Suite - 900
Detroit, MI 48243

BORING LOG NO. B-1A-81

DYNECOL, INC.	ARCHITECT/ENGINEER
6520 Georgia Detroit, Michigan	PROJECT NAME Hydrogeologic Study

DEPTH FT	ELEVATION	SAMPLE NO.	TYPE SAMPLE	SAMPLE DIST.	RECOVERY	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT³	UNCONFINED COMPRESSIVE STRENGTH TONS/FT² (1 2 3 4 5)	PLASTIC LIMIT % / WATER CONTENT % / LIQUID LIMIT %	STANDARD "N" PENETRATION (BLOWS/FT) (10 20 30 40 50)
						SURFACE ELEVATION 105.6'				
						See Note A below Driller reports				
						Driller reports hard brn. Silty clay - tr. sand & gr.				
						End of Boring				

Notes
A. Driller reports 9" crushed stone fill
B. Boring without sampling to check perched water level

DRILLING & SAMPLING METHOD SUMMARY		HOLE PLUGGING RECORD
CASING: ____ TO ____ FT WASH WATER: ____ TO ____ FT	FLIGHT AUGERS: 0 TO 10 FT HOLLOW STEM AUGERS: ____ TO ____ FT	NATURAL MATERIALS: 0 TO 10 FT : ____ TO ____ FT

NOTE: The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

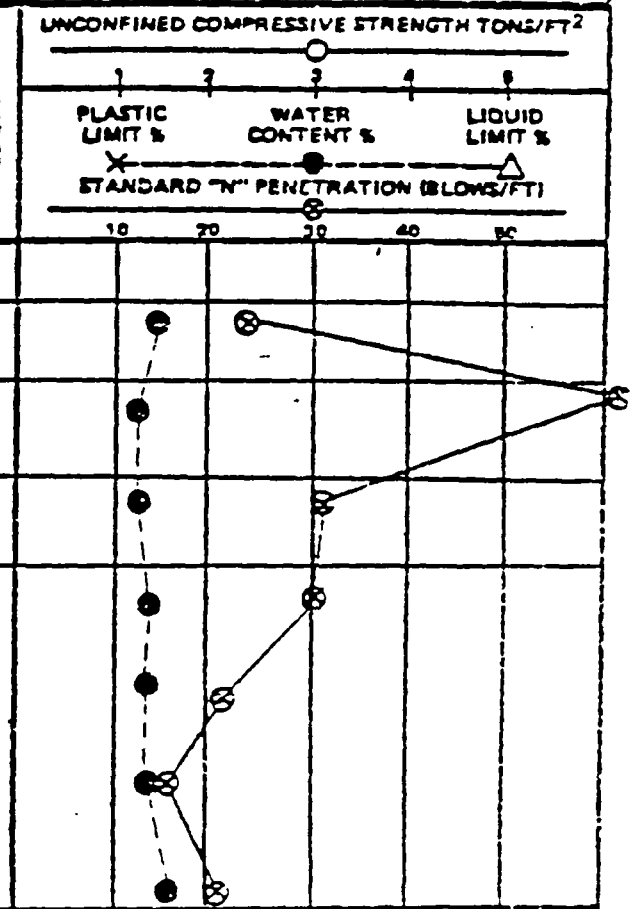
WATER LEVELS			BORING START	7-20-81
			BORING COMPLETE	7-20-81
AFS:	6.6	FT TIME ____	RIG: Corbin	FOREMAN: JC
	____	FT TIME ____	DRAWN: CG	APPROVED: CG
	6.6	FT TIME AB	JOB: 81 HM -16C	SHT: 1 of 1
	____	FT TIME ____		

HMA Consultants Inc.
400 Renaissance Center
Suite - 800
Detroit MI 48243

BORING LOG NO. B-2-81

DYNECOL, INC.	ARCHITECT/ENGINEER
6520 Georgia Detroit, MI	PROJECT NAME Hydrogeological Study

DEPTH FT	ELEVATION	SAMPLE NO.	TYPE SAMPLE	SAMPLE DIST.	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT³
					SURFACE ELEVATION 107.2'	
					Driller reports mixed clay fill with brick & some sand	
		1	SS		Sandy clay - tr. gravel and silt -mottled brown & gray - hard (CL)	
[illegible]		2	SS		Silty clay - tr to some sand tr. gravel - brn - hard (CL)	
		3	SS		Silty clay - tr. sand & gravel- occ. seems of sand-gray-hard (CL)	
[illegible]		4	SS		Silty Clay - tr. sand & gravel -gray- v. Stiff to Stiff (CL) occ. sand partings below 30'	
		5	SS			
		6	SS			
[illegible]		7	SS			



Note
A. Driller report 2" of moist sand @ 29'

DRILLING & SAMPLING METHOD SUMMARY		HOLE PLUGGING RECORD
CASING: ____ TO ____ FT WASH WATER: ____ TO ____ FT	FLIGHT AUGERS: 0 TO 36 FT HOLLOW STEM AUGERS: ____ TO ____ FT	NATURAL MATERIALS: 0 TO 36 FT : ____ TO ____ FT

NOTE: The indicated stratification lines are approximate. In situ, the transition between materials may be gradual.

WATER LEVELS		
none FT TIME ____	BORING START	7-20-81
none FT TIME ____	BORING COMPLETE	7-20-81
none FT TIME AE	RIG: Corbin	FOREMAN: JC
____ FT TIME ____	DRWN: CG	APPROVED: CG
	JOB: 81 HM-16C	SHT: 1 of 1

HMA Consultants Inc.
400 Renaissance Center
Suite - 500
Detroit, MI 48243

App. 2.1 B-4

BORING LOG NO. B-3-81

DYNECOL, INC.	ARCHITECT/ENGINEER
6520 Georgia Detroit, MI	PROJECT NAME Hydrogeologic Study

DEPTH FT	ELEVATION	SAMPLE NO.	TYPE SAMPLE	SAMPLE DIST.	DESCRIPTION OF MATERIAL	UNIT DRY WT. LBS/FT³	UNCONFINED COMPRESSIVE STRENGTH TONS/FT² (1 2 3 4 5) / PLASTIC LIMIT % / WATER CONTENT % / LIQUID LIMIT % / STANDARD "N" PENETRATION (BLOWS/FT) (10 20 30 40 50)
					SURFACE ELEVATION 109.92 (top of casing)		
					~~See Note A Below~~		
					See Note B Below		
		1	ss		Silty clay - fr. sand & gravel gravel-gray-stiff (CL)		
10.0		2	ss				
		3	ss				
					See note D Below		
					See note E below		
					End of Boring		

Notes

A. Driller report 8" of crushed stone fill
B. Driller report brown silty sand - small pieces of wood, wire, brick etc. - fill
C. Fine to med. sand - fr to some silt - brown w/ black discolorations - med dense (SM)
D. Driller reports sandy clay/clayey sand - gray-wet
E. Driller reports hard gray silty clay
F. Water sample @ 17' 4"
G. Piezometer installed screened length interval 16'-19'

DRILLING & SAMPLING METHOD SUMMARY		HOLE PLUGGING RECORD
CASING: ____ TO ____ FT	FLIGHT AUGERS: 0 TO 36 FT	NATURAL MATERIALS: ____ TO ____ FT
WASH WATER: ____ TO ____ FT	HOLLOW STEM AUGERS: ____ TO ____ FT	: ____ TO ____ FT

NOTE: The indicated classification lines are approximate. In situ, the transition between materials may be gradual.

WATER LEVELS		
16.6 FT TIME ____	BORING START	7-20-81
____ FT TIME ____	BORING COMPLETE	7-20-81
17.3 FT TIME 2hr 15	RIG: Corbin	FOREMAN: JC
____ FT TIME ____	DRWN: CG	APPROVED: CG
	JOB: 81 HM-16C	SHT: 1 of 1

HMA Consultants Inc.
400 Renaissance Center
Suite - 500
Detroit, MI 48243

Piezometer installed (See Note above)

soil and materials engineers, inc.

CLIENT WASTE ACID SERVICES
DETROIT, MICHIGAN

PROJECT MONITORING WELL INSTALLATION

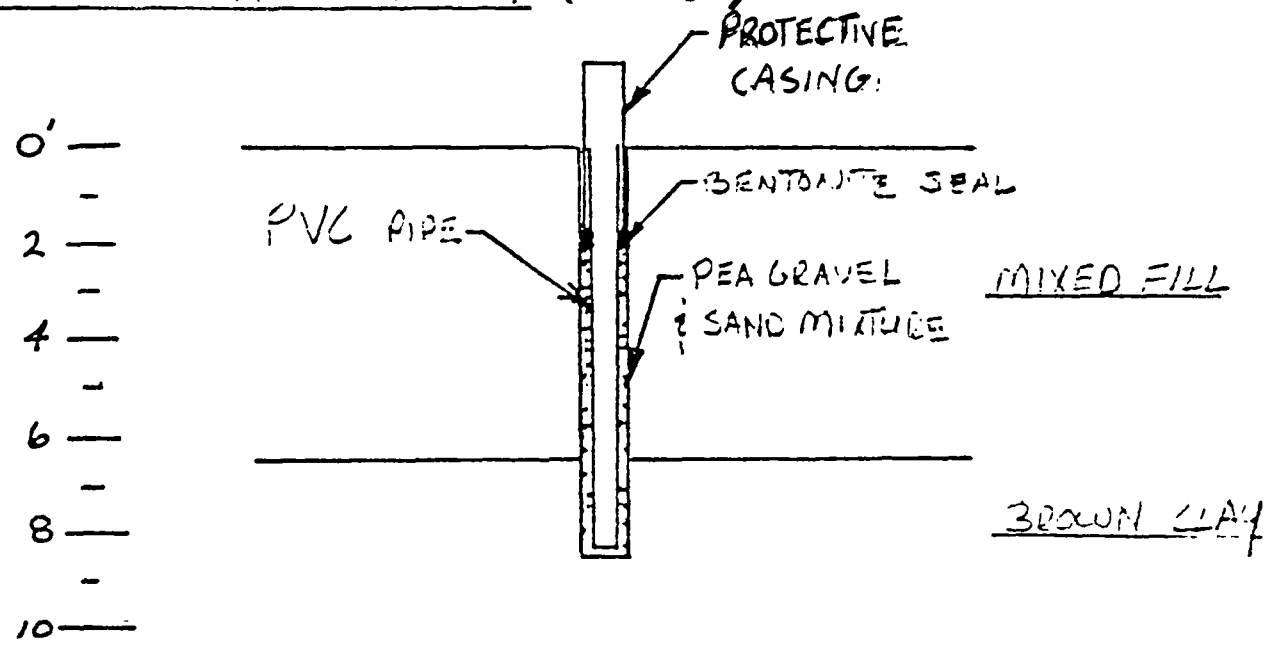
FILE NUMBER 6936

DATE 6-7-83

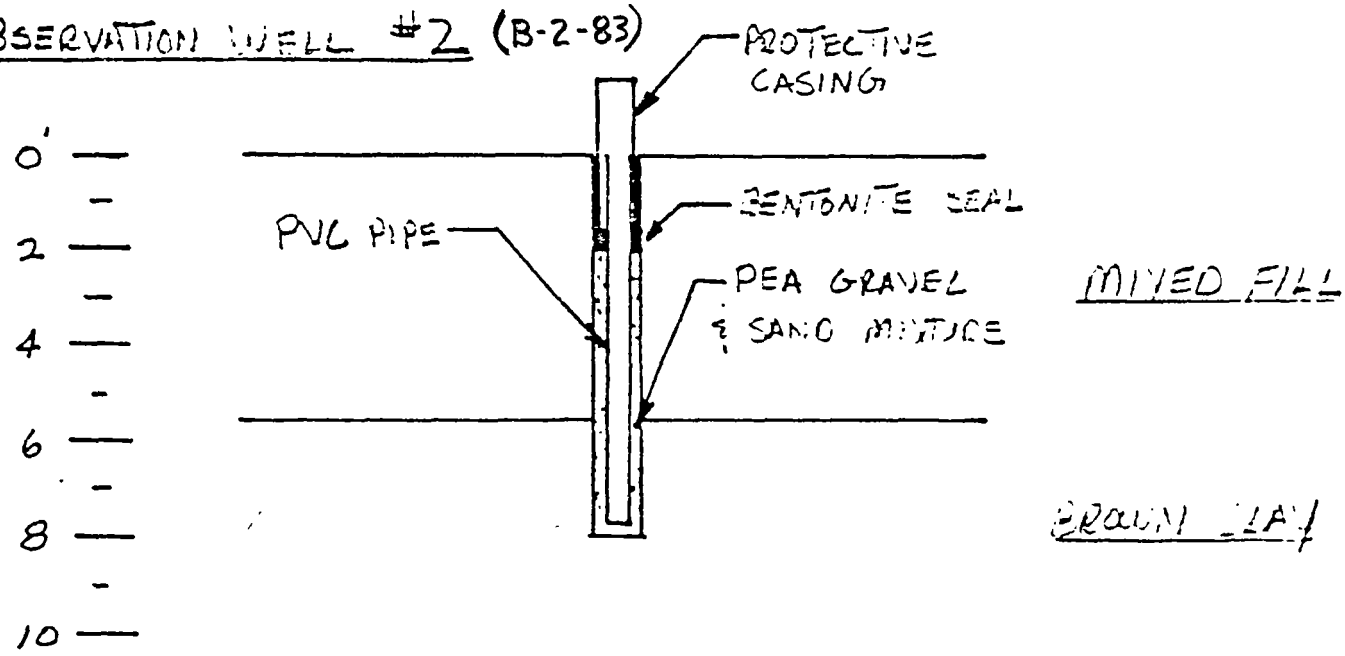
COMPUTED BY TB

CHECKED BY

OBSERVATION WELL #1 (B-1-83)



OBSERVATION WELL #2 (B-2-83)



APPENDIX E.2

GEOPHYSICAL LOGS

Well/Boring No.: SB-6-88
Client: Dynecol
Project No.: 20878
Date: 3-18-88

Gamma Log

Location: State Mich County Wayne Township _____

NE 1/4 SE 1/4 SW 1/4 Section 21 T 2S R 12E

Contractor Stearns Drilling

Type of Hole: From 0 ft. to 60 ft: Dia 8.5": Material HSA
From ___ ft. to ___ ft: Dia ___: Material _____

Type of Fluid in Hole: Depth to Fluid NA Type NA

Log Datum: G.L. 629.30 (USGS)

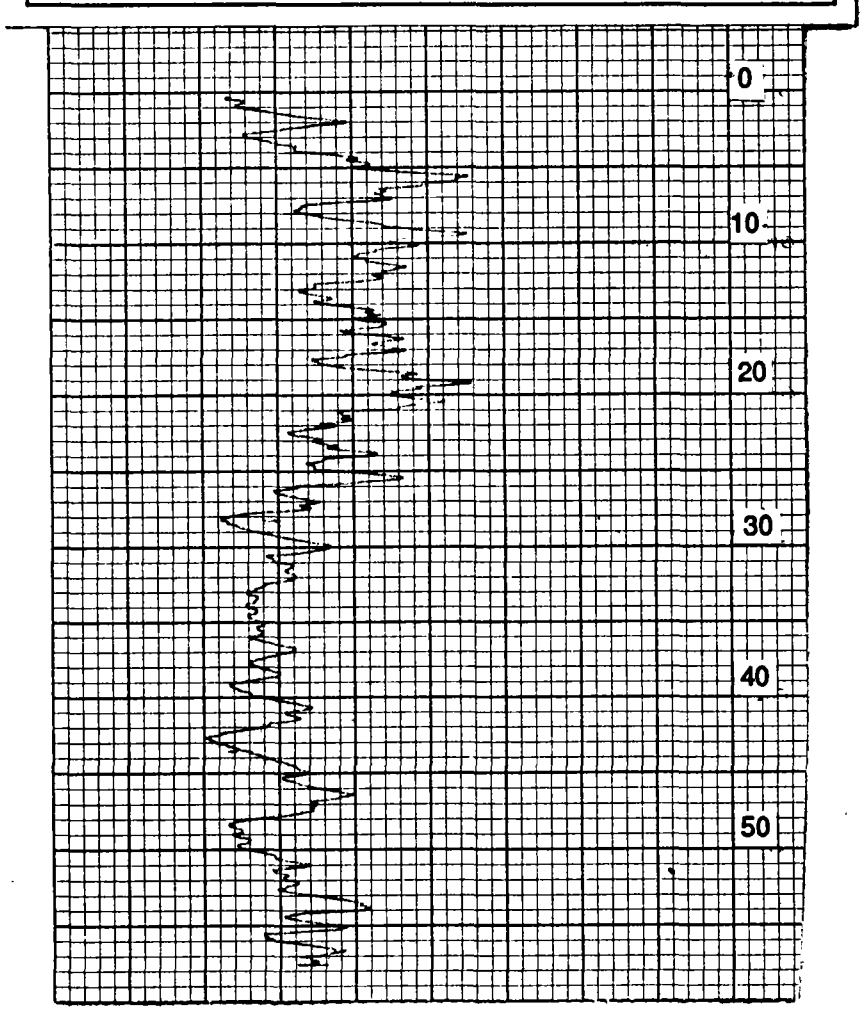
Interval Logged: From 0 ft. to 58 ft.

Instrument: Johnson Keck, Model SR-3000

Instrument Setting:
Recorder Sensitivity 0.2
Module Sensitivity 100
Time Constant 10 Sec

Probe: _____

Scale
Counts per Minute
400 500 600



Well/Boring No.: SB-5-88
Client: Dynecol
Project No.: 20878
Date: 3-17-88

Gamma Log

Location: State Mich County Wayne Township _____

NE 1/4 SE 1/4 SW 1/4 Section 21 T 2S R 12E

Contractor Stearns Drilling

Type of Hole: From 0 ft. to 60 ft: Dia 8.5": Material HSA
From ___ ft. to ___ ft: Dia ___: Material _____

Type of Fluid in Hole: Depth to Fluid NA Type NA

Log Datum: G.L. 631.93 (USGS)

Interval Logged: From 0 ft. to 50.5 ft.

Instrument: Johnson Keck, Model SR-3000

Instrument Setting:
Recorder Sensitivity 0.2
Module Sensitivity 100
Time Constant 5 Sec

Probe: _____

Scale
Counts per Minute
400 500 600

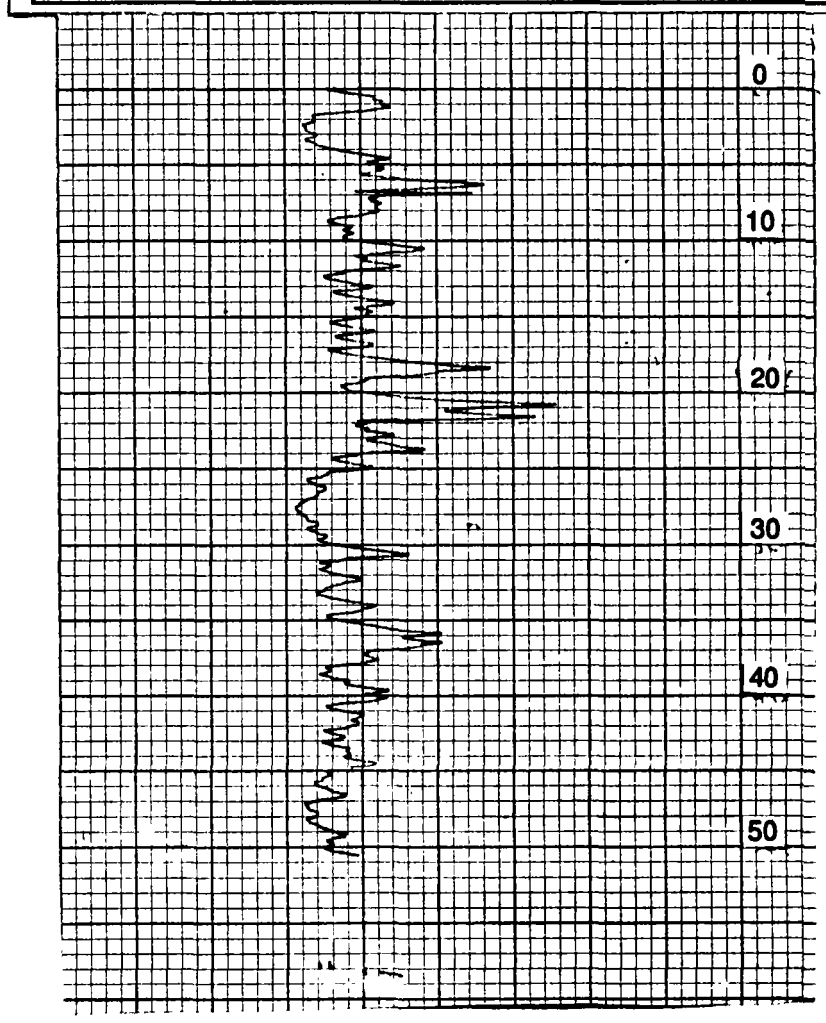


Figure E - 2

Geophysical Logs

Dynecol, Inc.
Detroit, Michigan

April, 1988

20878

APPENDIX E.3

STANDARD OPERATING PROCEDURES FOR FIELD pH AND CONDUCTANCE

METHOD 9045

SOIL pH

1.0 SCOPE AND APPLICATION

1.1 Method 9045 is an electrometric procedure which has been approved for measuring pH in calcareous and noncalcareous soils.

2.0 SUMMARY OF METHOD

2.1 The soil sample is mixed either with Type II water or with a calcium chloride solution (see Section 5.0), depending on whether the soil is considered calcareous or noncalcareous. The pH of the solution is then measured with a pH meter.

3.0 INTERFERENCES

3.1 Samples with very low or very high pH may give incorrect readings on the meter. For samples with a true pH of >10, the measured pH may be incorrectly low. This error can be minimized by using a low-sodium-error electrode. Strong acid solutions, with a true pH of <1, may give incorrectly high pH measurements.

3.2 Temperature fluctuations will cause measurement errors.

3.3 Errors will occur when the electrodes become coated. If an electrode becomes coated with an oily material that will not rinse free, the electrode can either (1) be cleaned with an ultrasonic bath, or (2) be washed with detergent, rinsed several times with water, placed in 1:10 HCl so that the lower third of the electrode is submerged, and then thoroughly rinsed with water.

4.0 APPARATUS AND MATERIALS

4.1 pH Meter with means for temperature compensation.

4.2 Electrodes:

4.2.1 Calomel electrode.

4.2.2 Glass electrode.

4.2.3 A combination electrode can be employed instead of calomel or glass.

4.5 Beaker: 50-mL.

4.6 Volumetric flask: 2-Liter.

4.7 Volumetric flask: 1-Liter.

5.0 REAGENTS

5.1 ASTM Type II water (ASTM D1193): Water should be monitored for impurities.

5.2 Primary standard buffer salts are available from the National Bureau of Standards (NBS) and should be used in situations where extreme accuracy is necessary. Preparation of reference solutions from these salts requires some special precautions and handling, such as low-conductivity dilution water, drying ovens, and carbon-dioxide-free purge gas. These solutions should be replaced at least once each month.

5.3 Secondary standard buffers may be prepared from NBS salts or purchased as solutions from commercial vendors. These commercially available solutions, which have been validated by comparison with NBS standards, are recommended for routine use.

5.4 Stock calcium chloride solution ($CaCl_2$), 3.6 M: Dissolve 1059 g of $CaCl_2 \cdot 2H_2O$ in Type II water in a 2-liter volumetric flask. Cool the solution, dilute it to volume with Type II water, and mix it well. Dilute 20 mL of this solution to 1 liter with Type II water in a volumetric flask and standardize it by titrating a 25-mL aliquot of the diluted solution with standard 0.1 N $AgNO_3$, using 1 mL of 5% K_2CrO_4 as the indicator.

5.5 Calcium chloride ($CaCl_2$), 0.01 M: Dilute 50 mL of stock 3.6 M $CaCl_2$ to 18 liters with Type II water. If the pH of this solution is not between 5 and 6.5, adjust the pH by adding a little $Ca(OH)_2$ or HCl. As a check on the preparation of this solution, measure its electrical conductivity. The specific conductivity should be 2.32 $\pm$ 0.08 mmho per cm at 25°C.

6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

6.1 All samples must be collected using a sampling plan that addresses the considerations discussed in Chapter Nine of this manual.

6.2 Samples should be analyzed as soon as possible.

7.0 PROCEDURE

7.1 Calibration:

7.1.1 Because of the wide variety of pH meters and accessories, detailed operating procedures cannot be incorporated into this method. Each analyst must be acquainted with the operation of each system and familiar with all instrument functions. Special attention to care of the electrodes is recommended.

7.1.2 Each instrument/electrode system must be calibrated at a minimum of two points that bracket the expected pH of the samples and are approximately three pH units or more apart. Repeat adjustments on successive portions of the two buffer solutions until readings are within 0.05 pH units of the buffer solution value.

7.2 Sample preparation and pH measurement of noncalcareous soils:

7.2.1 To 20 g of soil in a 50-mL beaker, add 20 mL of Type II water and stir the suspension several times during the next 30 min.

7.2.2 Let the soil suspension stand for about 1 hr to allow most of the suspended clay to settle out from the suspension.

7.2.3 Adjust the electrodes in the clamps of the electrode holder so that, upon lowering the electrodes into the beaker, the glass electrode will be immersed just deep enough into the clear supernatant solution to establish a good electrical contact through the ground-glass joint or the fiber-capillary hole. Insert the electrodes into the sample solution in this manner. For combination electrodes, immerse just below the suspension.

7.2.4 If the sample temperature differs by more than 2°C from the buffer solution, the measured pH values must be corrected.

7.2.5 Report the results as "soil pH measured in water."

7.3 Sample preparation and pH measurement of calcareous soils:

7.3.1 To 10 g of soil in a 50-mL beaker, add 20 mL of 0.01 M $CaCl_2$ (Step 5.5) solution and stir the suspension several times during the next 30 min.

7.3.2 Let the soil suspension stand for about 30 min to allow most of the suspended clay to settle out from the suspension.

7.3.3 Adjust the electrodes in the clamps of the electrode holder so that, upon lowering the electrodes into the beaker, the glass electrode will be immersed well into the partly settled suspension and the calomel electrode will be immersed just deep enough into the clear supernatant solution to establish a good electrical contact through the ground-glass joint or the fiber-capillary hole. Insert the electrode into the sample solution in this manner.

7.3.4 If the sample temperature differs by more than 2°C from the buffer solution, the measured pH values must be corrected.

7.3.5 Report the results as "soil pH measured in 0.01 M $CaCl_2$".

8.0 QUALITY CONTROL

8.1 Duplicate samples and check standards should be analyzed routinely.

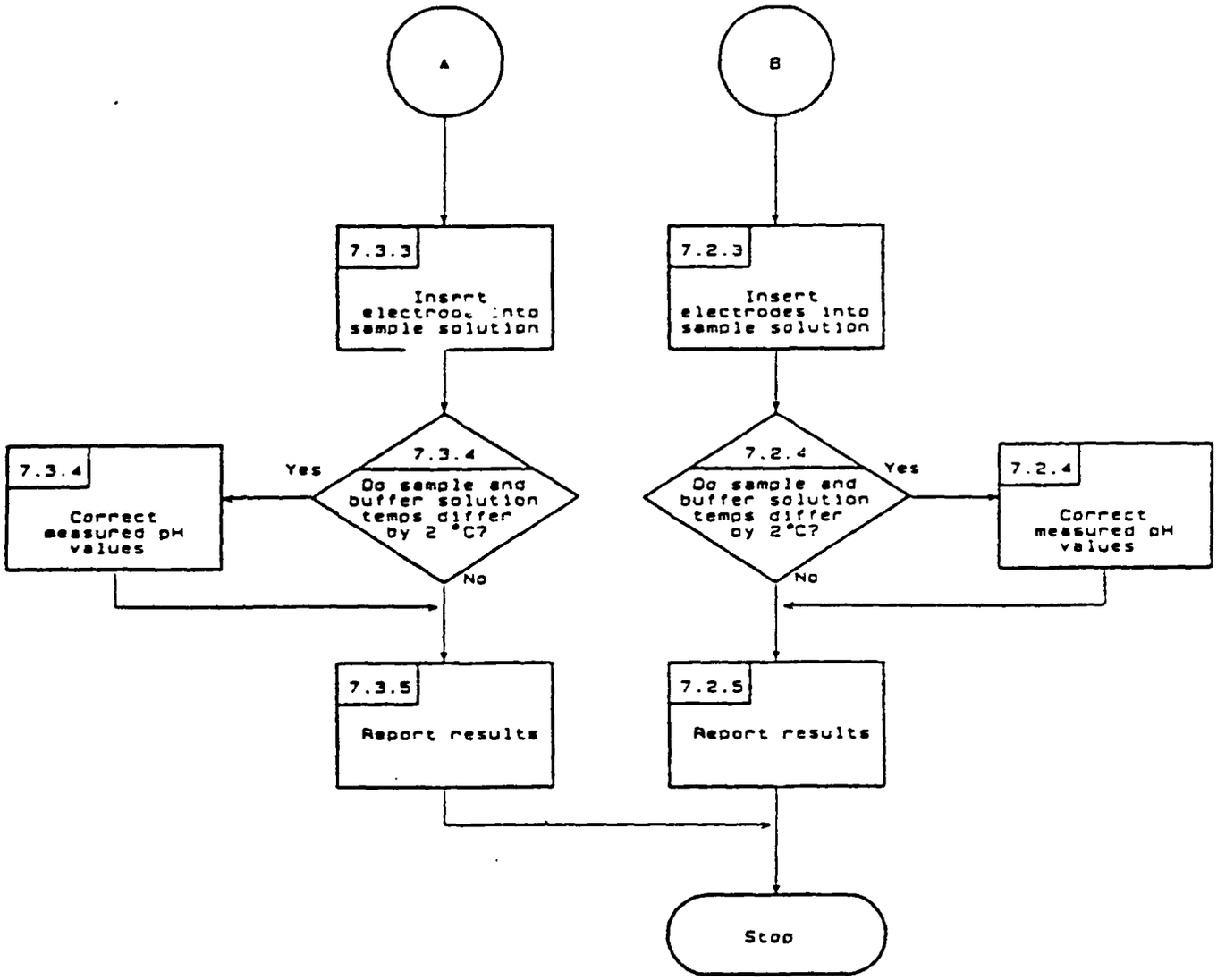
8.2 Electrodes must be thoroughly rinsed between samples.

9.0 METHOD PERFORMANCE

9.1 No data provided.

10.0 REFERENCES

10.1 None required.


A
B
7.3.3
Insert electrodes into sample solution
7.2.3
Insert electrodes into sample solution
7.3.4
Do sample and buffer solution temps differ by 2 °C?
Yes
No
7.3.4
Correct measured pH values
7.2.4
Do sample and buffer solution temps differ by 2°C?
Yes
No
7.2.4
Correct measured pH values
7.3.5
Report results
7.2.5
Report results
Stop

STANDARD OPERATING PROCEDURE FOR FIELD DETERMINATION OF pH, METHOD 423

Soil Sediment, Groundwater, Surface Water, Leachate Analysis

1.0 METHOD SUMMARY

1.1 This is a determination of the activity of the hydrogen ions by potentiometric measurement.

2.0 INTERFERENCES

2.1 Temperature is an important factor. The temperature compensator attached to the instrument automatically corrects the pH value displayed by the meter.

3.0 INSTRUMENTATION

Altex pH meter
pH probe
Temperature compensator

4.0 MATERIALS AND REAGENTS

Sample cups
Prepared pH 4, 7, 10 standards for calibration

5.0 CALIBRATION

During initial setup and calibration, two standards are run.

5.1 Clear the meter by pushing the clear button.

5.2 The prepared pH 7.00 standard is agitated with the pH probe and the standard number 1 button is pushed.

5.3 After the "eye" symbols come on indicating this portion of the calibration procedure is complete, the probe is rinsed with distilled water.

5.4 The second standard pH 10.00 or pH 4.00 is then agitated with the pH probe while pushing the calibration button. When the "eye" symbol reappears, calibration is complete.

5.5 Verify meter calibration by analyzing the third standard as described in Section 6.0. A +0.05 pH acceptance limit should be used in determining calibration acceptability. If unacceptable, recalibrate as described in 5.1.

6.0 PROCEDURE

6.1 Prepare and analyze samples without delay.

6.2 Place about 50 mls of sample into a plastic cup and stir with the pH probe.

6.3 Allow the pH reading to stabilize. Record the pH value on the well sampling record form. Rinse the probe with distilled water and verify calibration by submersing in a prepared pH standard as described in 5.5.

6.4 Proceed to the next sample or location; verify calibration before each measurement.

7.0 Quality Control

7.1 Document all calibrations and verification readings, including time and meter readings.

7.2 Run duplicate measurements on each batch or every 10th sample.

METHOD 9050

SPECIFIC CONDUCTANCE

1.0 SCOPE AND APPLICATION

1.1 Method 9050 is used to measure the specific conductance of drinking, ground, surface, and saline waters and domestic and industrial aqueous wastes. Method 9050 is not applicable to solid samples.

2.0 SUMMARY OF METHOD

2.1 The specific conductance of a sample is measured using a self-contained conductivity meter (Wheatstone bridge-type or equivalent).

2.2 Whenever possible, samples are analyzed at 25°C. If samples are analyzed at different temperatures, temperature corrections must be made and results reported at 25°C.

3.0 INTERFERENCES

3.1 Platinum electrodes can degrade and cause erratic results. When this happens, as evidenced by erratic results or flaking off of the platinum ol the electrode should be replatinized.

3.2 The specific conductance cell can become coated with oil and other materials. It is essential that the cell be thoroughly rinsed and, if necessary, cleaned between samples.

.0 APPARATUS AND MATERIALS

4.1 Self-contained conductivity instruments: an instrument consisting f a source of alternating current, a Wheatstone bridge, null indicator, and a onductivity cell or other instrument measuring the ratio of alternating urrent through the cell to voltage across it. The latter has the advantage f a linear reading of conductivity. Choose an instrument capable of easuring conductivity with an error not exceeding 1% or 1 umho/cm, whichever s greater.

4.2 Platinum-electrode or non-platinum-electrode specific conductance ell.

4.3 Water bath.

4.4 Thermometer: capable of being read to the nearest 0.1°C and overing the range 23° to 27°C. An electrical thermometer having a small ne tor sensing element is convenient because of its rapid response.

5.0 REAGENTS

5.1 Conductivity water: Pass distilled water through a mixed-bed deionizer and discard first 1,000 mL. Conductivity should be less than 1 umho/cm.

5.2 Standard potassium chloride (0.0100 M): Dissolve 0.7456 g anhydrous KCl in conductivity water and make up to 1,000 mL at 25°C. This solution will have a specific conductance of 1,413 umho/cm at 25°C.

6.0 SAMPLE COLLECTION, PRESERVATION, AND HANDLING

6.1 All samples must be collected using a sampling plan that addresses the considerations discussed in Chapter Nine of this manual.

6.2 All sample containers must be prewashed and thoroughly rinsed. Both plastic and glass containers are suitable.

6.3 Aqueous samples should be stored at 4°C and analyzed within 24 hr.

7.0 PROCEDURE

7.1 Determination of cell constant: Rinse conductivity cell with at least three portions of 0.01 N KCl solution. Adjust temperature of a fourth portion to 25.0 ± 0.1°C. Measure resistance of this portion and note temperature. Compute cell constant, C:

$$C = (0.001413)(R_{KCl})\ 1 + 0.0191\ (t - 25)$$

where:

R_{KCl} = measured resistance, ohms; and

t = observed temperature, °C.

7.2 Conductivity measurement: Rinse cell with one or more portions of sample. Adjust temperature of a final portion to 25.0 ± 0.1°C. Measure sample resistance or conductivity and note temperature.

7.3 Calculation: The temperature coefficient of most waters is only approximately the same as that of standard KCl solution; the more the temperature of measurement deviates from 25.0°C, the greater the uncertainty in applying the temperature correction. Report all conductivities at 25.0°C.

7.3.1 When sample resistance is measured, conductivity at 25°C is:

$$K = \frac{(1,000,000)(C)}{R_m \quad 1 + 0.0191\ (t - 25)}$$

where:

K = conductivity, umho/cm;
C = cell constant, cm-L;
R_m = measured resistance of sample, ohms; and
t = temperature of measurement.

7.3.2 When sample conductivity is measured, conductivity at 25°C is:

$$K = \frac{(K_m)(1,000,000)(C)}{1 + 0.0191\ (t - 25)}$$

where:

K_m = measured conductivity, umho at t°C, and other units are defined as above.

NOTE: If conductivity readout is in umho/cm, delete the factor 1,000,000 in the numerator.

.0 QUALITY CONTROL

8.1 All quality control data should be maintained and available for easy reference or inspection.

8.2 Analyze check standards after approximately every 15 samples.

8.3 Run 1 duplicate sample for every 10 samples.

9.0 METHOD PERFORMANCE

9.1 Three synthetic samples were tested with the following results:

Conductivity umhos/cm	No. of Results	Relative Standard Deviation %	Relative Error %
147.0	117	8.6	9.4
303.0	120	7.8	1.9
228.0	120	8.4	3.0

STANDARD OPERATING PROCEDURE FOR FIELD DETERMINATION OF CONDUCTIVITY, METHOD 205

Groundwater, Surface Water, and Wastewater

1.0 METHOD SUMMARY

1.1 Conductivity is a numerical expression on aqueous solution's ability to carry an electric current. This is dependent on the presence of ions, their concentrations, mobility, valence, and on the temperature of the solution.

1.2 The conductivity probe is immersed in a sample and the conductivity is read directly off of the meter scale.

2.0 INTERFERENCES

2.1 Temperature greatly influences the electrolytic conductivity of a sample. Therefore, it is extremely important accurate temperature measurements are made.

3.0 INSTRUMENTATION

3.1 Conductance meter YSI Model 32.

4.0 MATERIALS AND REAGENTS

Conductivity cell
Thermometer
Specimen containers

5.0 STANDARD

5.1 Primary Working Standard:

Potassium chloride standard 0.01N: Dissolved 0.7456 g anhydrous KCl in deionized water and dilute to 1 liter at 25°C. Conductivity = 1,413 umhos/cm.

6.0 CALIBRATION

6.1 Check the conductivity of the standard prior to actual sample evaluation. Record the temperature of each standard.

6.2 Calculate the conductivity at 25°C. making adjustments for the temperature, see 8.1 for equation.

7.0 PROCEDURE

7.1 Rinse the cell with deionized water.

7.2 Measure the conductivity of each sample by swirling the cell in a portion of the sample. Record the conductivity reading and the temperature.

7.3 Calculate the conductivity at 25°C as outlined in Section 8.1.

8.0 CALCULATIONS

8.1 Conductivity at 25°C = $\frac{K}{1 + 0.0191\ (t-25)}$

K = measured conductivity
t = temperature of sample, °C

9.0 QUALITY CONTROL

9.1 Document all calibrations and verification of readings including time and meter readings.

9.2 A blank of deionized water is run and should have a conductivity of less than 5 umhos/cm.

9.3 The initial standard is checked after every 10th sample.

APPENDIX E-4

DRILLERS LOGS OF BEDROCK-PENETRATING WELLS

19-15-E (R)

Detroit Twp., (Wayne Co.)

TD 395 in Detroit River

The Federal Carbonic Co. 5" Well

Location: S½ NW, section 19, T 1S, R 12E., Greenwood Ave. & G. T. R. R., Detroit

Elevation: 617 feet above sea level

Record by: E. S. Beal, Lansing, Mich. Drilled Dec. 1914. Record from cores.

Drilling Contractor: E. S. Beal, Lansing, Mich.

	Thickness (Feet)	Depth (Feet)
PLEISTOCENE:		
Fill, yellow sand	12	12
Clay, blue with small pebbles, very firm	30	42
Clay, blue, smooth with occasional sand pockets	60	102
Clay, blue, very gritty with limestone cobbles & boulders	40	142
Gravel, 35' coarse, 11' very fine; dry all the way	46	188
DEVONIAN:		
Traverse:		
Limestone	4	192
Shale, black, very fossiliferous with shining grains, pyrites of iron	9	201
Soft gray slate or shale, slacks on exposure to air	14	215
Slate, gray, hard: cores run 8" to 3' long	24	239
Dundee:	(51)	
Limestone, blue	7	246
Limestone, white, very fossiliferous, numerous calcite seams; small flow at 239' - 3 gallons per minute	45	291
Limestone, sandy, very soft	21	312
Limestone, blue; trace of oil & iron pyrites	12	324
Limestone, cherty	4	328
Limestone, coral formation, very fossiliferous	9	337
Detroit River:	(98)	
Dolomite, gray, sharp grit; very hard	23	360
Dolomite, whitish, sharp grit, very hard (small flows water at 376', water 30' from surface -6½ gallons per minute)	30	390
Dolomite, yellow, sandy, soft	5	395
	(58)	
TOTAL DEPTH		395

Drilled December 1914

DNR GEOLOGICAL SURVEY DIVISION - BOX 30028 - LANSING, MI 48909

Wayne Co T1S R12E

WAYNE Co.
DETROIT
SEC 15
NW NW NE
T1S R12E

WELL LOG

DUNBAR DRILLING INC.

SWANTON, OHIO

Customer Greenfield construction Co.

Address Livonia, Michigan

Job Name North East Sewage Pumping Station

Location 1 Block East of Conners on State Fair, South Side of Shaft. Well No. 3

Strainer: Overall Length 1[illegible] Dia. [illegible] Ft. of Slot [illegible]

Slot Size No. _____ Fittings _____

Mfd. By Johnson Material Galv.

Pipe: No. Ft. 1[illegible] Size [illegible]" Wt. _____ lb. Type T & C

No. Ft. _____ Size _____" Wt. _____ lb. Type _____

No. Ft. _____ Size _____" Wt. _____ lb. Type _____

Drive Shoe: Size _____" Size _____" Size _____"

Static Water Level _____ Ft. Completed depth of well 145 ft.

Surging and Developing: Total Time 5 Hrs.

GPM	PUMPING LEVEL	LENGTH OF TEST	TEMPERATURE
[illegible]	_____ Ft.	_____ Hrs.	_____ °F.
_____	_____ Ft.	_____ Hrs.	_____ °F.
_____	_____ Ft.	_____ Hrs.	_____ °F.
_____	_____ Ft.	_____ Hrs.	_____ °F.

REMARKS: 16 x [illegible] Gravel Pack

Date Started [illegible] Date Completed 9-1[illegible]-0 99

DRILLER	HELPER	HELPER
John Fowler	Bill Brown	Ken Walters
	John Morrow	

WELL LOG

From	To	Formation
0	35	Hard Brown Clay
35	140	Soft Blue Clay, Layers of Sand
140	151	Hard Pan
151	156	Hard Gray Limestone

REMARKS:

APPENDIX E-5

ANALYTICAL DATA SHEETS

ANALYTICAL SERVICES
EDI LABORATORY REPORT

CLIENT: DYNECOL
PROJECT NO.: 26116
LOCATION:
SAMPLED BY: WTD/ELC
DESCRIPTION: ACT 64 PERMIT APPLICATION

DATE SAMPLED: 05/20/88 TIME: 11:21 AM
DATE RECEIVED: 05/23/88 TIME:
DATE COMPLETED: 06/17/88
SCHEDULED COMPLETION: 06/14/88
ANALYST: CS,SH,GW,TJC,BH
QUALITY CONTROL REVIEW BY: KLM,DEK
WORKSHEET NO: 2

	W-4-88	DETECTION LIMIT	UNITS
EDI SAMPLE NO:	90175		
ARSENIC,TOTAL	6.0	2.0	ug/l
CHROMIUM,TOTAL	<0.05	0.05	mg/l
LEAD,TOTAL	<0.05	0.05	mg/l
MERCURY,TOTAL	<0.50	0.50	ug/l
NICKEL,TOTAL	0.01	0.01	mg/l
ZINC,TOTAL	0.22	0.02	mg/l
DNR SCAN 1&2	ENCLOSED		
pH (FIELD)	7.58	---	std. units
CONDUCTIVITY (FIELD)	4,900	5	umhos/cm

ANALYTICAL SERVICES
EDI LABORATORY REPORT

CLIENT: DYNECOL
PROJECT NO.: 26116
LOCATION:
SAMPLED BY: WTD/ELC
DESCRIPTION: ACT 64 PERMIT APPLICATION

DATE SAMPLED: 05/20/88 TIME: 11:21 AM
DATE RECEIVED: 05/23/88 TIME:
DATE COMPLETED: 06/17/88
SCHEDULED COMPLETION: 06/14/88
ANALYST: CS,SH,GW,TJC,BH
QUALITY CONTROL REVIEW BY: KLM,DEK
WORKSHEET NO: 1

	W-4-88	DETECTION LIMIT	UNITS
EDI SAMPLE NO:	90175		
POTASSIUM, TOTAL	47	0.50	mg/l
SODIUM, TOTAL	340	0.50	mg/l
CALCIUM, TOTAL	430	0.50	mg/l
MAGNESIUM, TOTAL	65	0.50	mg/l
BICARBONATE	383	2.0	mg/l
CHLORIDE	1,140	1.0	mg/l
SULFATE	180	5.0	mg/l
CARBONATE	<2.0	2.0	mg/l

ANALYTICAL SERVICES
PRIORITY POLLUTANT ANALYSIS

VOLATILE FRACTION

CLIENT: DYNECOL
PROJECT NO.: 26116
SAMPLE: W-4-88

DATE SAMPLED: 05-20-1988 TIME: 11:20 AM
DATE RECEIVED: 05-23-1988 TIME: 01:00 PM
TEST DATE: 05-26-1988
SAMPLE NO. 90175

COMPOUND	RESULT (mg/L)
Benzene	< 0.001
Bromodichloromethane	< 0.002
Bromoform	< 0.015
Carbon Tetrachloride	< 0.004
Chlorobenzene	< 0.001
Chlorodibromomethane	< 0.003
Chloroform	< 0.001
1,1-Dichloroethane	< 0.002
1,2-Dichloroethane	< 0.002
1,1-Dichloroethylene	< 0.002
cis-1,2-Dichloroethylene	< 0.002
trans-1,2-Dichloroethylene	< 0.002
1,2-Dichloropropane	< 0.003
cis-1,3-Dichloropropylene	< 0.004
trans-1,3-Dichloropropylene	< 0.004
Ethylbenzene	< 0.001
Methylene Chloride	< 0.002
1,1,2,2-Tetrachloroethane	< 0.002
Tetrachloroethylene	< 0.002
Toluene	< 0.001
1,1,1-Trichloroethane	< 0.002
1,1,2-Trichloroethane	< 0.003
Trichloroethylene	< 0.002
Xylene	< 0.010

** *A less than (<) sign indicates that the compound was nondetectable at the specified detection limit.*

EDI Engineering & Science
Environmental Engineering, Geology, Biology and Chemistry
5555 Glenwood Hills Pkwy SE Grand Rapids MI 49508 P 6, 942 9600
a subsidiary of WW Engineering & Science

Analytic & Biological
Laboratories, Inc.

29079 FORD ROAD ■ GARDEN CITY, MICHIGAN 48135 ■ PHONE: (313) 422-7474 ■ TELEX: 234080

06-23-88

SAMPLE NO: 13535
Page 2

DYNECOL
6520 GEORGIA
DETROIT, MI 48211

TIEN PHAM

SAMPLE DESCRIPTION: Well B-2

TAKEN RECEIVED
06-03-88

Arsenic	<0.25	ppm
Calcium	169.1	ppm
Chromium	0.059	ppm
Lead	<0.2	ppm
Mercury	<0.25	ppm
Nickel	<0.1	ppm
Zinc	0.220	ppm
Chloride	87.48	ppm
Conductivity	1,100	umhos/cm
Nitrogen, Nitrate	1.6395	ppm
pH	7.67	units
Sodium	68	ppm
Sulfate	64.38	ppm

ANALYTIC & BIOLOGICAL LABORATORIES, INC.

Francis B. Mc Laughlin, FAIC
Director of Laboratories

CERTIFIED LABORATORY — U.S. DEPARTMENT OF AGRICULTURE
U.S. DRUG ENFORCEMENT ADMINISTRATION
UNITED STATES FOOD AND DRUG METHODOLOGY
UNITED STATES NUCLEAR REGULATORY COMMISSION
AMERICAN COUNCIL OF INDEPENDENT LABORATORIES
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AMERICAN CHEMICAL SOCIETY
AMERICAN SOCIETY FOR MICROBIOLOGY
UNION INTERNATIONALE des LABORATORIES INDEPENDANTS
ASSOCIATION OF OFFICIAL ANALYTICAL CHEMISTS

Analytic & Biological
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29079 FORD ROAD ■ GARDEN CITY, MICHIGAN 48135 ■ PHONE: (313) 422-7474 ■ TELEX: 234080

06-23-88

SAMPLE NO: 13536

DYNECOL
6520 GEORGIA
DETROIT, MI 48211

TIEN PHAM

SAMPLE DESCRIPTION: Well B-3

TAKEN

RECEIVED
06-03-88

Arsenic	<0.25	ppm
Calcium	47.74	ppm
Chromium	0.062	ppm
Lead	<0.2	ppm
Mercury	<0.25	ppm
Nickel	<0.1	ppm
Zinc	0.304	ppm
Chloride	69.78	ppm
Conductivity	530	umhos/cm
Nitrogen, Nitrate	1.274	ppm
pH	8.16	units
Sodium	42	ppm
Sulfate	54.89	ppm

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Director of Laboratories

CERTIFIED LABORATORY — U.S. DEPARTMENT OF AGRICULTURE
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AMERICAN SOCIETY FOR MICROBIOLOGY
UNION INTERNATIONALE des LABORATORIES INDEPENDANTS
ASSOCIATION OF OFFICIAL ANALYTICAL CHEMISTS

MONTH/YEAR: [illegible]

WELL MONITORING DATA SHEET

DYNECOL, INC.
6520 Georgia
Detroit, MI 48211

1. WELL IDENTIFICATION AND LOCATION

B-1 located at the southwest corner of the property
B-2 located at the north property line
B-3 located at the center of the unloading pad
Leachate Collection Sump located inside the west dike wall

2. PURGE WELLS

Wells Purged By: Don Wilson Date 03/02/88

3. SAMPLE COLLECTION

Samples Collected By: Don Wilson Date 03/03/88

Static Water Elevation (distance from the top of the well casing to the water surface, to the nearest 1/8")

B-1: 3.08 feet B-2: 0 feet B-3: 4.9 feet

4. SAMPLE DELIVERY AND RECEIPT

Samples Delivered By: Bob Pepin Date 03/04/88

Samples Delivered To: A&B Lab Date 03/04/88

Samples Received at Lab By: _____

5. SAMPLE ANALYTICAL RESULTS

PARAMETERS AND UNITS	B-1	B-2	B-3	L.C.S.
pH, Standard Units.....	11.82		8.25	
Spec. Cond., mmhos/cm.....	3,700		395	
Chloride, mg/l.....	816.85		87.34	
Nitrate, mg/l.....	0.3333		0.2777	
Sulfate, mg/l.....	67.55		45.54	
Arsenic, mg/l.....	-0.1		-0.1	
Calcium, mg/l.....	427.1		43.74	
Chromiun Total, mg/l.....	0.01		0.01	
Lead, mg/l.....	-0.05		-0.05	
Mercury, mg/l.....	-0.05		-0.05	
Nickel, mg/l.....	-0.05		-0.05	
Sodium, mg/l.....	379.6		41.28	
Zinc, mg/l.....	0.091		0.118	

Results Certified By: Francis B. McLaughlin Date 3/8/88

MONTH/YEAR: December 87

WELL MONITORING DATA SHEET

DYNECOL, INC.
6520 Georgia
Detroit, MI 48211

1. WELL IDENTIFICATION AND LOCATION

B-1 located at the southwest corner of the property
B-2 located at the north property line
B-3 located at the center of the unloading pad
Leachate Collection Sump located inside the west dike wall

2. PURGE WELLS

Wells Purged By: Don Wilson Date 12-2-87

3. SAMPLE COLLECTION

Samples Collected By: Don Wilson Date 12-3-87

Static Water Elevation (distance from the top of the well casing to the water surface, to the nearest 1/8")

B-1: 2.77 feet B-2: 0 feet B-3: 4.77 feet

4. SAMPLE DELIVERY AND RECEIPT

Samples Delivered By: Bob Pepin Date 12/4/87

Samples Delivered To: A&B Lab Date 12/4/87

Samples Received at Lab By: Shari Dames

5. SAMPLE ANALYTICAL RESULTS

PARAMETERS AND UNITS	B-1	B-2	B-3	L.C.S.
pH, Standard Units	12.02		8.47	
Spec. Cond., mmhos/cm	3,250		385	
Chloride, mg/l	513.35		62.22	
Nitrate, mg/l	-0.01		-0.10	
Sulfate, mg/l	151.4		48.41	
Arsenic, mg/l	-0.25		-0.25	
Calcium, mg/l	503.5		54.09	
Chromiun Total, mg/l	-0.02		-0.02	
Lead, mg/l	-0.25		-0.25	
Mercury, mg/l	-0.25		-0.25	
Nickel, mg/l	-0.1		-0.1	
Sodium, mg/l	142.1		51.71	
Zinc, mg/l	0.083		0.100	

Results Certified By: Francis B. McLaughlin, FAIC Date December 9, 1987

MONTH/YEAR: Sept / 87

WELL MONITORING DATA SHEET

WASTE ACID SERVICES
6520 Georgia
Detroit, MI 48211

1. WELL IDENTIFICATION AND LOCATION

B-1 located at the southwest corner of the property
B-2 located at the north property line
B-3 located at the center of the unloading pad
Leachate Collection Sump located inside the west dike wall

2. PURGE WELLS

Wells Purged By: Don Wilson Date 8-31-87

3. SAMPLE COLLECTION

Samples Collected By: Don Wilson Date 9-1-87

Static Water Elevation (distance from the top of the well casing to the water surface, to the nearest 1/8")

B-1: 2.96 feet B-2: 0 feet B-3: 4.63 feet

4. SAMPLE DELIVERY AND RECEIPT

Samples Delivered By: Bob Repin Date 9-2-87

Samples Delivered To: A&B Lab Date 9-2-87

Samples Received at Lab By: _____

5. SAMPLE ANALYTICAL RESULTS

PARAMETERS AND UNITS	B-1	B-2	B-3	L.C.S.
pH, Standard Units	11.91		8.56	
Spec. Cond., mmhos/cm	3,600		470	
Chloride, mg/l	460.1		69.70	
Nitrate, mg/l	0.2615		0.0361	
Sulfate, mg/l	207.8		46.31	
Arsenic, mg/l	-0.1		-0.1	
Calcium, mg/l	584.6		49.09	
Chromiun Total, mg/l	-0.01		-0.01	
Lead, mg/l	-0.05		-0.05	
Mercury, mg/l	-0.1		-0.1	
Nickel, mg/l	-0.05		-0.05	
Sodium, mg/l	230.4		66.21	
Zinc, mg/l	0.098		0.491	

Results Certified By: _____ Date _____

MONTH/YEAR: JUNE 87

WELL MONITORING DATA SHEET

WASTE ACID SERVICES
6520 Georgia
Detroit, MI 48211

1. WELL IDENTIFICATION AND LOCATION

B-1 located at the southwest corner of the property
B-2 located at the north property line
B-3 located at the center of the unloading pad
Leachate Collection Sump located inside the west dike wall

2. PURGE WELLS

Wells Purged By: Don Wilson Date 6-2-87

3. SAMPLE COLLECTION

Samples Collected By: Don Wilson Date 6-3-87

Static Water Elevation (distance from the top of the well casing to the water surface, to the nearest 1/8")

B-1: 3.56 feet B-2: 0 feet B-3: 5.12 feet

4. SAMPLE DELIVERY AND RECEIPT

Samples Delivered By: Bob Repin Date 6-4-87

Samples Delivered To: A&B Lab Date 6-4-87

Samples Received at Lab By: _____

5. SAMPLE ANALYTICAL RESULTS

PARAMETERS AND UNITS	B-1	B-2	B-3	L.C.S.
pH, Standard Units	12.06		8.25	
Spec. Cond., mmhos/cm	4,000		560	
Chloride, mg/l	662.7		70.91	
Nitrate, mg/l	0.699		0.4682	
Sulfate, mg/l	136.5		61.56	
Arsenic, mg/l	-0.1 *		-0.1 *	
Calcium, mg/l	461.4		59.87	
Chromiun Total, mg/l	0.01		-0.01 *	
Lead, mg/l	-0.1*		-0.1 *	
Mercury, mg/l	-0.1 *		-0.1 *	
Nickel, mg/l	-0.05 *		-0.05 *	
Sodium, mg/l	295.9		54.27	
Zinc, mg/l	0.054		0.329	

Results Certified By: [signature] Date 6/11/87

* - denotes a value of 'less than'.

MONTH/YEAR: March 87

WELL MONITORING DATA SHEET

WASTE ACID SERVICES
6520 Georgia
Detroit, MI 48211

1. WELL IDENTIFICATION AND LOCATION

B-1 located at the southwest corner of the property
B-2 located at the north property line
B-3 located at the center of the unloading pad
Leachate Collection Sump located inside the west dike wall

2. PURGE WELLS

Wells Purged By: Don Wilson Date 3/3/87

3. SAMPLE COLLECTION

Samples Collected By: Don Wilson Date 3/4/87

Static Water Elevation (distance from the top of the well casing to the water surface, to the nearest 1/8")

B-1: 3.42 feet B-2: 6.81 feet B-3: 4.67 feet

4. SAMPLE DELIVERY AND RECEIPT

Samples Delivered By: _____ Date _____

Samples Delivered To: A & B Lab Date _____

Samples Received at Lab By: _____

5. SAMPLE ANALYTICAL RESULTS

PARAMETERS AND UNITS	B-1	B-2	B-3	L.O.D.
pH, Standard Units.....	12.05	7.20	7.94	
Spec. Cond., mmhos/cm.....	3,950	1,950	520	
Chloride, mg/l.....	536.8	149.3	72.115	
Nitrate, mg/l.....	0.6422	0.1303	0.1147	
Sulfate, mg/l.....	108.8	749.5	73.6	
Arsenic, mg/l.....	-0.05	-0.05	-0.05	
Calcium, mg/l.....	558.9	413.4	52.71	
Chromiun Total, mg/l.....	-0.01	-0.01	-0.01	
Lead, mg/l.....	-0.05	-0.05	-0.05	
Mercury, mg/l.....	-0.05	-0.05	-0.05	
Nickel, mg/l.....	0.043	0.063	0.034	
Sodium, mg/l.....	237.7	125.8	61.62	
Zinc, mg/l.....	0.084	0.211	0.104	

Results Certified By: [signature] Date 3/10/8

MONTH/YEAR: 2/87

WELL MONITORING DATA SHEET

WASTE ACID SERVICES
6520 Georgia
Detroit, MI 48211

1. WELL IDENTIFICATION AND LOCATION

B-1 located at the southwest corner of the property
B-2 located at the north property line
B-3 located at the center of the unloading pad
Leachate Collection Sump located inside the west dike wall

2. PURGE WELLS

Wells Purged By: Don Wilson Date 2-9-87

3. SAMPLE COLLECTION

Samples Collected By: Don Wilson Date 2-10-87

Static Water Elevation (distance from the top of the well casing to the water surface, to the nearest 1/8")

B-1: 3.81 feet B-2: 0 feet B-3: 4.83 feet

4. SAMPLE DELIVERY AND RECEIPT

Samples Delivered By: Robert Pepin Date _____

Samples Delivered To: A&B Lab Date _____

Samples Received at Lab By: _____

5. SAMPLE ANALYTICAL RESULTS

PARAMETERS AND UNITS	B-1	B-2	B-3	L.C.S.
pH, Standard Units.....	11.91		8.74	
Spec. Cond., mmhos/cm.....	3,250		515	
Chloride, mg/l.....	628.8		74.41	
Nitrate, mg/l.....	5.02		0.4334	
Sulfate, mg/l.....	119.0		66.2	
Arsenic, mg/l.....	-0.1		-0.1	
Calcium, mg/l.....	367.5		53.74	
Chromiun Total, mg/l.....	-0.01		-0.01	
Lead, mg/l.....	0.05		-0.05	
Mercury, mg/l.....	-0.05		-0.05	
Nickel, mg/l.....	-0.02		-0.02	
Sodium, mg/l.....	248.9		53.83	
Zinc, mg/l.....	0.072		0.073	

Results Certified By: [signature] Date FEB 17, 87

MONTH/YEAR: Oct 86

WELL MONITORING DATA SHEET

WASTE ACID SERVICES
6520 Georgia
Detroit, MI 48211

1. WELL IDENTIFICATION AND LOCATION

B-1 located at the southwest corner of the property
B-2 located at the north property line
B-3 located at the center of the unloading pad
Leachate Collection Sump located inside the west dike wall

2. PURGE WELLS

Wells Purged By: Don Wilson Date 10/2/86

3. SAMPLE COLLECTION

Samples Collected By: Rick Meirow Date 10/3/86

Static Water Elevation (distance from the top of the well casing to the water surface, to the nearest 1/8")

B-1: 1.875 feet B-2: MT feet B-3: 4.667 feet

4. SAMPLE DELIVERY AND RECEIPT

Samples Delivered By: T. Pham Date 10/3/86

Samples Delivered To: A & B Lab Date 10/3/86

Samples Received at Lab By: _____

5. SAMPLE ANALYTICAL RESULTS

PARAMETERS AND UNITS	B-1	B-2	B-3	L.C.S.
pH, Standard Units.....	11.92		8.33	
Spec. Cond., mmhos/cm.....	5,100		540	
Chloride, mg/l.....	431.9		74.52	
Nitrate, mg/l.....	0.9832		0.1049	
Sulfate, mg/l.....	206.4		53.2	
Arsenic, mg/l.....	-0.075		-0.075	
Calcium, mg/l.....	654.4		41.47	
Chromiun Total, mg/l.....	-0.015		-0.015	
Lead, mg/l.....	-0.075		-0.075	
Mercury, mg/l.....	-0.05		-0.02	
Nickel, mg/l.....	-0.02		-0.02	
Sodium, mg/l.....	108.4		49.87	
Zinc, mg/l.....	-0.005		-0.005	

Results Certified By: _____ Date 10-9-86

WELL MONITORING DATA SHEET

WASTE ACID SERVICES
6520 Georgia
Detroit, MI 48211

1. WELL IDENTIFICATION AND LOCATION

B-1 located at the southwest corner of the property
B-2 located at the north property line
B-3 located at the center of the unloading pad
Leachate Collection Sump located inside the west dike wall

2. PURGE WELLS

Wells Purged By: Rick Meibow Date 7-18-86

3. SAMPLE COLLECTION

Samples Collected By: Rick Meibow Date 7-18-86

Static Water Elevation (distance from the top of the well casing to the water surface, to the nearest 1/8")

B-1: 35½ in ~~feet~~ B-2: Dry feet B-3: 56 in ~~feet~~

4. SAMPLE DELIVERY AND RECEIPT

Samples Delivered By: Tien Pham Date 7-18-86

Samples Delivered To: A & B Lab Date 7-18-86

Samples Received at Lab By: E J Coleman

5. SAMPLE ANALYTICAL RESULTS

PARAMETERS AND UNITS	B-1	B-2	B-3	L.C.S.
pH, Standard Units	11.87		7.70	
Spec. Cond., mmhos/cm	6,550		720	
Chloride, mg/l	993.7		73.24	
Nitrate, mg/l	0.8380		0.0323	
Sulfate, mg/l	227.9		66.14	
Arsenic, mg/l	-0.1		-0.1	
Calcium, mg/l	629.6		62.98	
Chromiun Total, mg/l	-0.01		0.024	
Lead, mg/l	-0.1		-0.1	
Mercury, mg/l	-0.05		-0.05	
Nickel, mg/l	0.142		0.060	
Sodium, mg/l	51.10		315.8	
Zinc, mg/l	0.084		0.087	

Results Certified By: _____ Date _____

NOTE: "-" denotes a quantity of "less than"

WELL MONITORING DATA SHEET

WASTE ACID SERVICES
6520 Georgia
Detroit, MI 48211

1. WELL IDENTIFICATION AND LOCATION

B-1 located at the southwest corner of the property
B-2 located at the north property line
B-3 located at the center of the unloading pad
Leachate Collection Sump located inside the west dike wall

2. PURGE WELLS

Wells Purged By: DONALD WILSON Date 3/26/86

3. SAMPLE COLLECTION

Samples Collected By: DONALD WILSON Date 3/27/86

Static Water Elevation (distance from the top of the well casing to the water surface, to the nearest 1/8")

B-1: 47 1/4" [redacted] B-2: 85" [redacted] B-3: 75 3/4" [redacted]

4. SAMPLE DELIVERY AND RECEIPT

Samples Delivered By: ROBERT MACKINDER Date 3/27/86

Samples Delivered To: A+B LABORATORIES Date 3/27/86

Samples Received at Lab By: Sandie Gniaspeck

5. SAMPLE ANALYTICAL RESULTS

PARAMETERS AND UNITS	B-1	B-2	B-3	[redacted]
pH, Standard Units	11.95	7.44	8.33	
Spec. Cond., mmhos/cm	5,300	1,590	570	
Chloride, mg/l	1,053	170.1	74.52	
Nitrate, mg/l	-0.1	-0.1	-0.1	
Sulfate, mg/l	82.83	238.2	60.36	
Arsenic, mg/l	0.361	0.210	0.107	
Calcium, mg/l	568.2	240.7	51.29	
Chromiun Total, mg/l	-0.01	-0.01	-0.01	
Lead, mg/l	-0.1	-0.1	-0.1	
Mercury, mg/l	0.156	0.067	-0.05	
Nickel, mg/l	-0.02	-0.02	-0.02	
Sodium, mg/l	391.8	128.3	51.48	
Zinc, mg/l	0.07	0.041	0.108	

Results Certified By: Francis B. Mc Laughlin, FAIC Date April 4, 1986

DEC. 1985

Submitted 1-13-86

WASTE ACID SERVICES
January 10, 1986

	62.50		76 "		N	
	Well# 1		Well# 3		Sample# 100	
Copper	-0.01	ppm	-0.01	ppm	51970	ppm
Lead	-0.05	ppm	-0.05	ppm	-0.05	ppm
Nickel	-0.02	ppm	-0.02	ppm	1.100	ppm
Chromium	-0.01	ppm	-0.01	ppm	0.668	ppm
Zinc	0.012	ppm	0.029	ppm	3.350	ppm
Iron	0.046	ppm	-0.01	ppm	2178	ppm
Cadmium	-0.01	ppm	-0.01	ppm	0.116	ppm
Mercury	-0.1	ppm	-0.1	ppm	-0.1	ppm
Arsenic	-0.1	ppm	-0.1	ppm	-0.1	ppm
Silver	-0.05	ppm	-0.05	ppm	-0.05	ppm
Selenium	-0.1	ppm	-0.1	ppm	-0.1	ppm
Aluminum	-0.1	ppm	-0.1	ppm	24.36	ppm

	Sample 864	
F.O.G.	3.27	%

pH

"-" denotes a quantity of "less than"

WELL MONITORING DATA SHEET

WASTE ACID SERVICES

6520 Georgia
Detroit, MI 48211

1. WELL IDENTIFICATION AND LOCATION

B-1 located at the southwest corner of the property
B-2 located at the north property line
B-3 located at the center of the unloading pad
Leachate Collection Sump located inside the west dike wall

2. PURGE WELLS

Wells Purged By: Donald Wilson Date 9-19-85

3. SAMPLE COLLECTION

Samples Collected By: Robert Mackinder Date 9-20-85

Static Water Elevation (distance from the top of the well casing to the water surface, to the nearest 1/8")

B-1: 43½" ~~feet~~ B-2: DRY feet B-3: 57" ~~feet~~

4. SAMPLE DELIVERY AND RECEIPT

Samples Delivered By: Rick Meirow Date 9-20-85

Samples Delivered To: A+B Labratories Date 9-20-85

Samples Received at Lab By: Sandra J. Kniespeck

5. SAMPLE ANALYTICAL RESULTS

PARAMETERS AND UNITS	B-1	DRY B-2	B-3	L.C.S.
pH, Standard Units	11.91		7.87	
Spec. Cond., mmhos/cm	4,150		530	
Chloride, mg/l	920		72	
Nitrate, mg/l	-0.1		-0.1	
Sulfate, mg/l	210		92	
Arsenic, mg/l	-0.1		-0.1	
Calcium, mg/l	42.13		298.0	
Chromiun Total, mg/l	0.013		-0.01	
Lead, mg/l	-0.01		-0.01	
Mercury, mg/l	-0.05		-0.05	
Nickel, mg/l	-0.01		0.036	
Sodium, mg/l	404.4		48.73	
Zinc, mg/l	0.060		0.072	

Results Certified By: [signature] Date 9-26-85

"–" denotes a quantity of "less than"

WASTE ACID SERVICES
July 22, 1985

	B-1 Sample 1		B-2 Sample 2		B-3 Sample 3	
Sp. Conductance (micromhos/cm)	5,180		760		530	
Sulfate	443.3	ppm	15.9	ppm	60.4	ppm
Chloride	1,240	ppm	30	ppm	76	ppm
Nitrate	-0.1	ppm	-0.1	ppm	0.18	ppm
Calcium	613.6	ppm	106.7	ppm	66.35	ppm
Sodium	536.9	ppm	22.58	ppm	49.88	ppm
Nickel	0.046	ppm	-0.02	ppm	-0.02	ppm
Arsenic	-0.1	ppm	-0.1	ppm	-0.1	ppm
Zinc	0.013	ppm	0.062	ppm	0.043	ppm
T. Chromium	-0.01	ppm	0.020	ppm	-0.01	ppm
Lead	-0.05	ppm	-0.05	ppm	-0.05	ppm
Mercury	-0.05	ppm	-0.05	ppm	-0.5	ppm
pH	11.67	units	7.48	units	8.03	units

"-" denotes a quantity of "less than"

Waste Acid Services April 5, 1985

	B-1 Sample #1		B-2 Sample #2		B-3 Sample #3	
pH	11.53	units	7.09	units	8.15	units
Spec. Conduct	6,300	micromhos/cm	1,980	micromhos/cm	565	micromhos/cm
Chloride	438.8	ppm	196.6	ppm	97.24	ppm
Nitrate	0.14	ppm	0.23	ppm	0.38	ppm
Sulfate	1094	ppm	568.4	ppm	67.60	ppm
Arsenic	-0.1	ppm	-0.1	ppm	-0.1	ppm
Calcium	581.2	ppm	267	ppm	41.49	ppm
Chromium	-0.01	ppm	-0.01	ppm	-0.01	ppm
Lead	-0.01	ppm	-0.01	ppm	-0.01	ppm
Mercury	-0.05	ppm	-0.05	ppm	-0.05	ppm
Nickel	-0.01	ppm	0.021	ppm	-0.01	ppm
Sodium	738.1	ppm	116.3	ppm	48.76	ppm
Zinc	0.014	ppm	0.020	ppm	0.035	ppm

WASTE ACID SERVICES
October 11, 1984

	Well #1 (ppm)	Well #3 (ppm)	WELL #.
pH	11.0 units	7.71 units	M/T
Spec. Conductivity	2630 micromhos	590 micromhos	DRY
Sulfate	140	80	
Chloride	675	100	
Nitrate	0.22	-0.1	
Calcium	105.8	32.97	
Sodium	330.0	73.81	
Nickel	0.091	-0.02	
Arsenic	-0.001	-0.001	
Zinc	0.052	0.026	
Chromium, Total	-0.01	-0.01	
Lead	-0.01	-0.01	
Mercury	-0.002	-0.002	

- denotes a quantity of "less than".

ANALYTIC & BIOLOGICAL LABORATORIES, INC.

WASTE ACID SERVICES
June 11, 1984

	Well B-1 (ppm)	Well B-2 (ppm)	Well B-3 (ppm)
Spec. Conductance	3870 microhmos	4200 microhmos	730 micromhos
pH	6.6 units	6.5 units	7.7 units
Sulfate	708.6	818.0	126
Nitrate	2.95	3.05	2.10
Chloride	780	850	100
Sodium	347.9	270.1	57.91
Calcium	486.7	649.7	76.82
Nickel	0.085	0.048	0.044
Arsenic	-0.02	-0.02	-0.02
Zinc	0.039	0.097	0.188
T. Chromium	0.023	-0.01	-0.01
Lead	-0.10	-0.10	-0.10
Mercury	-0.01	-0.01	-0.01

- denotes a quantity of "less than.

ANALYTIC & BIOLOGICAL LABORATORIES, INC.

WASTE ACID SERVICES
March 6, 1984

	#1 (ppm)	#2 (ppm)	#3 (ppm)	#4 & 5 (pp
pH	6.8 units	6.72 units	7.04 units	5.3 units
Sulfate	242.6	412.2	180.4	258.5
Chloride	1100	480	129	394
Specific Conductance	3630	2420	826	1550
Sodium	656	165	75.57	21.49
Nitrate	1.5	0.65	0.40	2.4
Calcium	437	498	133	343
Nickel	-0.01	0.037	-0.02	-0.02
Arsenic	-0.02	-0.02	-0.02	-0.02
Zinc	0.521	1.404	1.317	1.479
Chromium	-0.01	-0.01	0.399	-0.01
Lead	-0.10	-0.10	-0.10	-0.10
Mercury	-0.05	-0.05	-0.05	-0.05

- denotes a quantity of "less than".

ANALYTIC & BIOLOGICAL LABORATORIES, INC.

WASTE ACID SERVICES
6530 GEORGIA DETROIT, MICHIGAN 48211

GERALD M GROVES
President

Phone
(313) 571-7140

August 15, 1983

Michigan Dept. of Natural Resources
Office of Hazardous Waste Management
P.O. Box 30038
Lansing, MI 48909

Regarding: Quarterly Groundwater Monitoring

Gentlemen:

The three (3) monitoring wells are identified and located on the attached "Site Plan".

Each well was purged on July 20, 1983. Samples were collected from each of the three wells on JUly 22, 1983. The results of these samples are specified below.

Leachate collection sumps had no water accumulation, therefore, no samples could be obtained at this time.

PARAMETER	WELL IDENTIFICATION		
	B-1	B-2	B-3
pH (S.U.)	6.75	6.55	6.65
Specific Conductance (Micromhos/cm^2)	3000.	3000.	1000.
Sulfate (ppm)	LT 1.0	LT 1.0	LT 1.0
Chloride	LT 1.0	LT 1.0	LT 1.0
Nitrate	LT 0.02	0.4	LT 0.1
Calcium	42.92	29.25	11.56
Sodium	237.86	298.23	92.6
Nickol	LT 0.1	LT 0.1	LT 0.1
Arsenic	LT 0.005	LT 0.005	LT 0.005
Zinc	0.53	0.30	0.37
Chromium	LT 0.006	LT 0.5	0.65
Lead	LT 0.04	LT 0.04	LT 0.04
Mercury	LT 0.005	LT 0.005	LT 0.005
Water Level (ft. from top casing)	8.52	5.23	3.67

WASTE ACID SERVICES

HAULERS OF WASTE ACIDS

APPENDIX F

FACILITY INSPECTION FORMS

EPA #MID 074259565

Dynecol, Inc.
6520 Georgia Street
Detroit, Michigan 48211

Telephone: (313) 571-7140

CONTAINER STORAGE FACILITY INSPECTION REPORT

Date of Inspection _____

Name of Inspector _____

Time Inspection Began _____

Time Inspection Completed _____

Inspector's Signature _____

Inspector Note:

Items found to have **NO PROBLEMS,** leave blank and place a check mark in the **INSPECTED** column to indicate that inspection has been performed. Items found to have **PROBLEMS,** indicate with an **X.** Note **NATURE OF PROBLEM** and notify management.

Frequency	Inspection Items	Inspected	Nature of Problem Action Required	Estimated Repair Date	Actual Repair Date	Initialed
Weekly	***Containers***	____	_____	_____	_____	_____
	Placement/ Stacking	____	_____	_____	_____	_____
	Closed	____	_____	_____	_____	_____
	Labeling	____	_____	_____	_____	_____
	Condition	____	_____	_____	_____	_____
	Segregation	____	_____	_____	_____	_____
	Pallet condition	____	_____	_____	_____	_____
	Aisle space	____	_____	_____	_____	_____
	Capacity	____	_____	_____	_____	_____
Weekly	***Containment Area***	____	_____	_____	_____	_____
	Walls	____	_____	_____	_____	_____
	Floor	____	_____	_____	_____	_____
	Sumps	____	_____	_____	_____	_____

Frequency	Inspection Items	Inspected	Nature of Problem Action Required	Estimated Repair Date	Actual Repair Date	Initialed
	Loading/					
Weekly	***Unloading Area***	_____	_____	_____	_____	_____
	Walls	_____	_____	_____	_____	_____
	Floor	_____	_____	_____	_____	_____
	Sumps	_____	_____	_____	_____	_____
		_____	_____	_____	_____	_____
Weekly	***Bulking Area***	_____	_____	_____	_____	_____
	Walls	_____	_____	_____	_____	_____
	Floor	_____	_____	_____	_____	_____
	Sump	_____	_____	_____	_____	_____
Weekly	***Safety/Emergency***					
	Equipment	_____	_____	_____	_____	_____
	Communications	_____	_____	_____	_____	_____
	Fire extinguishers	_____	_____	_____	_____	_____
	Alarm actuators	_____	_____	_____	_____	_____
	Signs	_____	_____	_____	_____	_____
	Sprinkler system	_____	_____	_____	_____	_____
	Spill response	_____	_____	_____	_____	_____
	Personal protective equipment	_____	_____	_____	_____	_____

9.1-A

E.P.A. #MID 074259565

DYNECOL, INC.
6520 GEORGIA ST
DETROIT, MICHIGAN 48211

Ph. # 313 571-7140

DATE OF INSPECTION _____
NAME OF INSPECTOR _____
TIME INSPECTION BEGAN _____
TIME INSPECTION COMPLETED _____
INSPECTOR'S SIGNATURE _____

Inspector Note:
1. Items found to have NO PROBLEMS, LEAVE BLANK AND PUT A CHECK MARK IN EQUIP/STRUCTURES COLUMN to indicate inspection is performed.
2. Items found to have problems, indicate with an X, Note "REMEDIAL ACTION"

INSPECTION REPORT

	EQUIP/STRUCTURE	INSPECTION ITEMS				REMEDIAL ACTION		
	1. Operating Equipment	Erosion Corrosion	Cracks	Leaks	Oper. Error	Nature and Location of the Problem and Action Required	Est. Repair Date	Actual Repair Date
	A. Tanks							
Inspect Shell Weekly / Inspect Lining Monthly	# 1							
	2							
	3							
	4							
	7							
	8							
	9							
	10							
	12							
	13							
	14							
	15							
	16							
	17							
	18							
	19							
	20							
	21							
	22							
	23							
	24							
	25							
	26							
	26 A (mixing)							
	B. Material Trans. Equip.	Corrosion	Leaks	Mal-function	Oper. Error			
Inspect Daily	Pumps							
	Caustic/Lime							
	HCL							
	Transfer							
	Filter							
	Sludge (#1)							
	Sludge (#2)							
	Air Pump (#3)							
	Air Pump (#4)							
	Air Pump (#5)							
	Air Pump (#6)							
	Recirculation (#18)							
	Recirculation (#19)							
	Recirculation (#20)							
	Recirculation (#21)							
	Effluent (#22)							
	Air Pump (#23)							
	Lime (#25)							
	Lime (#26A)							
	Lime (#26B)							
	Pipings							
	Hoses							
	Valves							
	Fittings							

Inspect Daily

C. Material Handling	Malfunction	Damage	Oper. Error	Nature and Location of the Problem and Action Required	Est. Repair Date	Actual Repair Date
Equipment						
Mixer						
A 14						
A 18B						
A 18S						
A 19B						
A 19S						
A 20B						
A 20S						
A 21B						
A 21S						
A 23						
A 26A						
Air Compressor						
# 1						
2						
3						
Fume Scrubber						
Blower						
Recirc. Pump						
Caustic Pump						
Piping						
Values						
Fittings						
Filter Press A						
Hydraulic						
Air						
Plates						
Cloths						
Pipes						
Valves						
Fittings						
Filter Press B						
Hydraulic						
Air						
Plates						
Cloths						
Pipes						
Valves						
Fittings						
Lime Silo #1						
Bin Discharger						
Feeder						
Electrical						
Lime Silo #2						
Bin Discharger						
Feeder						
Electrical						
Screw Conveyor						
Air Dryer						

	B. Electrical Equipment	Malfunction	Damage	Oper. Error	Nature and Location of Problem and Action Required	Est. Repair Date	Act. Repair Date
Inspect Daily	Circ. Breakers						
	Control Panel						
	2. Containment Structure						
	A. Dikes	Erosion	Cracks	Leaks			
	Walls						
	Floor						
	Lead Pad						
	B. Spill Transfer	Malfunction	Damage	Oper. Error			
	Sump Pumps						
	# 1 (Unloading Area)						
	2 (Bldg. # 2)						
	3 (Garage)						
	4 (Sump-South)						
	5 (Sump-N.W.)						
	3. Monitoring Equipment						
	A. Discharge Monitor						
	ph Meters (7)						
	ph Electrodes (6)						
	ph Recorder (1)						
	ph Chart (1)						
	B. Monitoring Wells	Damage	Sampled				
	B-1 (Southeast)						
	B-2 (Northwest)						
	B-3 (West)						
Inspect Weekly	4. Security Equipment	Damage	Malfunction				
	A. Property Line Fence						
	North Fence						
	East						
	West						
	South						
	B. Gates						
	# 1 (Northeast)						
	# 2 (Northwest)						
	# 3 (West)						
	C. Yard Lighting						
	# 1 Pole (Office Bldg.)						
	# 2 (Fuel Storage)						
	# 3 (Garage Roof)						
	# 4 (S.E. Bldg. 2)						
	# 5 (S.E. Bldg. 2)						
	# 6 (N.W. Bldg. 2)						
	# 7 (N.W. Bldg. 2)						
	# 8 (S.W. Prim. Trmt. Area)						
	# 9 (S.W. Press Bldg.)						
	# 10 (S.W. Press Bldg.)						

Inspect Weekly

5. Safety/Emergency	No Access	Malfunction	Nature and Location of the Problem and Action Required	Est. Repair Date	Actual Repair Date
Equipment					
A. Stationary Equip.					
Eyewashes					
Showers					
Water Supply Values					
Alarm Actuator					
#1					
2					
3					
4					
5					
6					
7					
8					

B. Portable Equipment	Out of Place	Malfunction	Reload	Date			
Front End Loader							
Freight Box (w/soda ASH)							
Scott Air Packs (2)							
Fire Extinguisher							
# 1							4
2							
3							
4							
5							
6							
7							
8							
9							

APPENDIX G.1

DOCUMENTATION OF COORDINATION AGREEMENTS

DYNECOL

DYNECOL, INC.

6520 GEORGIA STREET
DETROIT, MICHIGAN 48211
(313) 571-7141

November 25, 1987

Mr. Raymond L. Kunik
Fire Prevention Inspector
Fire Department
Fire Marshal Division
250 W. Larned St.
Detroit, MI 48226

Dear Mr. Kunik:

Referencing your telephone conversation with Mr. Wayne Laraway on Wednesday, 11-25-1987, please find included the following:

1) Copy of Dynecol, Inc. Contingency Plan.

2) Copy of letter to Captain Ameer Aazaad about updated list of emergency coordinators, June 16, 1987.

3) Copy of letter to Captain Ameer Aazaad about updating page 41, page 43, and page 44 of our Contingency Plan, August 19, 1987.

4) Copy of letter to MDNR about SARA Subtittle III Notification, October 14, 1987.

If you need any additional information, please feel free to contact either Mr. Wayne Laraway or myself.

Very truly yours,

Tien H. Pham
Plant Manager

THP/tp

Enclosure

DYNECOL

DYNECOL, INC.

6520 GEORGIA STREET
DETROIT, MICHIGAN 48211
(313) 571-7141

06-01-1987

Detroit Water and Sewerage Department
735 Randolph Street
Detroit, Michigan 48226
Attn: Industrial Waste Control Division
Permit Section.

Dear Sir or Madam:

In compliance with our Waste Water Discharge Permit, please find enclosed an updated copy of our Preparedneess and Prevention Plan.

If you need any additional information, please do not hesitate to contact me at the address listed above. Thank you.

Very truly yours,

Dynecol, Inc.

Tien H. Pham

Tien H. Pham
Plant Manager

Enc.

THP/mag

DYNECOL

DYNECOL, INC.

6520 GEORGIA STREET
DETROIT, MICHIGAN 48211
(313) 571-7141

06-16-1987

Captain Ameer Aazaad
Detroit Fire Department
Fire Marshall Division
250 West Larned Street
Detroit, MI 48226

Dear Sir:

Referencing our Preparedness and Prevention Plan that was previously sent to your attention, please find enclosed an updated list of emergency coordinators.

Please correct your file accordingly.

Thank you.

Very truly yours,

Dynecol, Inc.

Tien H. Pham
Plant Manager

Enc.

THP/mag

DYNECOL

DYNECOL, INC.

6520 GEORGIA STREET
DETROIT, MICHIGAN 48211
(313) 571-7141

06-16-87

Mr. Bill Sherman
Manager
Holy Cross Hospital
Detroit, MI 48234

Dear Mr. Sherman:

Referencing our Preparedness and Prevention Plan that was previously sent to your attention, please find enclosed an updated list of our emergency coordinators.

Please correct your file accordingly.

Thank you.

Very truly yours,

Dynecol, Inc.

Tien H. Pham
Plant Manager

Enc.

THP/mag

DYNECOL

DYNECOL, INC.

6520 GEORGIA STREET
DETROIT, MICHIGAN 48211
(313) 571-7141

06-16-1987

Mr. Horace Lidsay
Mayburry Medical Clinic
8830 W. McNichols
Detroit, MI 48221

Dear Mr. Lindsay:

Referencing our Preparedness and Prevention Plan that was previously sent to your attention, please find enclosed an updated list of our emergency coordinators.

Please correct your file accordingly.

Thank you.

Very truly yours,

Dynecol, Inc.

Tien H. Pham

Tien H. Pham
Plant Manager

Enc.

THP/mag

APPENDIX H

This appendix is reserved for future use.

APPENDIX I.1

PROOF OF FINANCIAL CAPABILITY

APPENDIX I.2

PROOF OF CLOSURE TRUST FUND

APPENDIX I.2

PROOF OF CLOSURE TRUST FUND

TRUST AGREEMENT

Trust agreement, the "Agreement", entered into as of June 9, 1989 by and between Dynecol, Inc. (name of state)(corporation, partnership..) the "Grantor", Comerica Bank (classification of Trustee) the "Trustee", and the Director of the Department of Natural Resources, the "beneficiary".

Whereas, the Grantor has made application for a license to establish, maintain, and/or operate a hazardous waste treatment facility within the State of Michigan in accordance with the provisions of 1979 PA 64, as amended and the administrative rules promulgated thereunder (the "Act");

Whereas, the Director, Department of Natural Resources, the licensing authority, has promulgated administrative rules applicable to the Grantor, requiring that the owner or operator of a hazardous waste treatment facility must provide financial assurance that funds will be available when needed for the cost of proper (closure/post-closure) of the facility(ies); and,

Whereas, the Grantor has elected to establish a (closure/post-closure) trust fund to provide all or part of such financial assurance for the facility(ies) identified herein; and,

Whereas, the Grantor, acting through its duly authorized officers, has selected the Trustee to be the trustee under this Agreement; and

Whereas, the Director approves the trustee as selected by the Grantor; and

Whereas, the Trustee is willing to act as trustee;

Now, therefore, the Grantor and the Trustee agree as follows:

Section 1. Definitions. As used in this Agreement:

(a) The term "Director" means the duly appointed and acting director of the Department of Natural Resources or any successor department or agency or his authorized representative.

(b) The term "fiduciary" means any person who exercises any power of control, management, or disposition or renders investment advice for a fee or other compensation, direct or indirect, with respect to any moneys or other property of this trust fund, or has any authority or responsibility to do so, or who has any authority or responsibility in the administration of this trust fund.

(c) The term "Grantor" means the owner or operator who enters into this Agreement and any successors or assigns of the Grantor.

(d) The term "Trustee" means the Trustee who enters this Agreement and any successor Trustee.

Section 2. Identification of Facilities and Cost Estimates.

This agreement pertains to the facility or facilities owned and/or operated by the Grantor as identified by name, EPA identification number, and location and which have current (closure/post-closure) cost estimates as follows:

Dynecol, Inc.
MID 074259565
6520 Georgia Street
Detroit, MI 48211

The current total cost estimate for the facility(ies) covered by this Agreement is $ 62,100.00 . The portion of this cost estimate covered by this Agreement is $ 62,100.00 , which was initially deposited at the establishment of this (closure/post-closure) trust fund. The cost estimate shall be revised as required by the administrative rules promulgated under 1979 PA 64, as amended. The Trustee shall notify the Director in writing of payments made to the trust fund by the Grantor. The facility name and EPA ID number will be included on the notice.

Section 3. Establishment of Fund.

The Grantor and the Trustee hereby establish a trust fund, the "Fund" for the exclusive use and benefit of the Director as "beneficiary", and intend that no other party shall have access to said Fund without the express written approval and direction of the Director. The Fund is established initially as consisting of the cash and securities (hereinafter referred to as "Trust Assets") described in attached Exhibit A, all of which are acceptable to the Trustee. Such Trust Assets or any other assets subsequently transferred to the Trustee are collectively referred to as the Fund, together with all earnings and profits thereon, less any payments or distributions made by the Trustee pursuant to this Agreement. The Fund will be held by the Trustee, in trust, as hereinafter provided. The Trustee undertakes no responsibility for the amount or adequacy of, nor any duty to collect from the Grantor, any payments required to be made by the Grantor to the Trustee or for payments required of the Grantor to discharge any liabilities of the Grantor as required by the Act or any conditions of licensure.

Section 4. Payment for Closure and/or Post-Closure Care.

The Fund so established shall be used solely to provide for the payment of the costs of (closure/post-closure) of the facility(ies) covered by this Agreement; to reimburse the Grantor for legitimate expenses in carrying out closure/post-closure activities as approved by the Director or to disburse to the Grantor excess funds as determined by the Director not to be required as part of this trust. No payment or disbursement may be made from the Fund without the prior written approval of the Director.

In the event that the Director, in accordance with the administrative rules promulgated under 1979 PA 64, as amended, issues a notice of violation or other order indicating that the Grantor has failed to properly execute its (closure/post-closure) responsibilities, the Director shall have the right to use the money in the Fund to carry out the (closure/post-closure) responsibilities. Upon the written request of the Director, the Trustee shall make such payments and disbursements to the Director or other persons, including the Grantor, all in accordance with the directions of the Director.

Section 5. Payments Comprising the Fund.

Payments made to and Trust Assets placed with the Trustee by the Grantor shall consist of cash and/or direct obligations of the United States of America or the State of Michigan, or obligations the principal and interest of which are unconditionally guaranteed by the United States of America or the State of Michigan, or certificates of deposit of any financial institution to the extent insured by an agency of the United States Government which certificates shall mature not later than one year from the date of deposit.

Section 6. Trustee Management.

The Trustee shall invest and reinvest the principal and income of the Fund and keep the Fund invested as a single fund, without distinction between principal and income, in accordance with investment guidelines and objectives communicated in writing to the Trustee from time to time by the Grantor, subject, however, to the provisions of this Section. In investing, reinvesting, exchanging, selling and managing the Fund, the Trustee or any other fiduciary will discharge his duties with respect to the Fund solely in the interest of the participants and the beneficiary and with the care, skill, prudence, and diligence under the circumstances then prevailing which persons of prudence, acting in a like capacity and familiar with such matters, would use in the conduct of an enterprise of a like character and with like aims, except that:

(i) The Trustee is authorized to invest the Fund in time or demand deposits of the Trustee or any other financial institution to the extent insured by an agency of the United States Government which time and demand deposits shall mature not later than one year from the date of the investment; and

(ii) The Trustee is authorized to invest the Fund in direct obligations of the United States of America or the State of Michigan, or in obligations the principal and interest of which are unconditionally guaranteed by the United States of America or State of Michigan.

(iii) The Trustee is authorized to hold cash while awaiting investment or distribution uninvested for a reasonable time and without liability for the payment of interest thereon.

Section 7. Commingling and Investment.

The Trustee is expressly authorized in its discretion to transfer from time to time any or all of the assets of the Fund to any common, commingled or collective trust fund created by the Trustee in which the Fund is eligible to participate, subject to all of the provisions thereof, to be commingled with the assets of other trusts participating therein so long as such management does not conflict with the requirements of this Fund. To the extent of the equitable share of the Fund in any such commingled trust, such commingled trust will be part of the Fund.

Section 8. Express Powers of Trustee.

Without in any way limiting the powers and discretions conferred upon the Trustee by the other provisions of this Agreement or by law, the Trustee is expressly authorized and empowered:

(a) To make, execute, acknowledge and deliver any and all documents of transfer and conveyance and any and all other instruments that may be necessary or appropriate to carry out the powers herein granted;

(b) To register any securities held in the Fund in its own name or in the name of a nominee and to hold any security in bearer form or in book entry, or to deposit or arrange for the deposit of such securities in a qualified central depository even though, when so deposited, such securities may be merged and held in bulk in the name of the nominee of such depository with other securities deposited therein by another person, or to deposit or arrange for the deposit of any securities issued by the United States Government, or any agency or instrumentality thereof, with a Federal Reserve bank, but the books and records of the Trustee will at all times show that all such securities are part of the Fund;

(c) To deposit any cash in the Fund in interest-bearing accounts maintained or savings certificates issued by the Trustee, in its separate corporate capacity, or in any other banking institution affiliated with the Trustee, to the extent insured by an agency of the United States Government; and

(d) To compromise or otherwise adjust all claims in favor of or against the Fund.

Section 9. Taxes and Expenses.

All taxes of any kind that may be assessed or levied against or in respect of the Fund and all brokerage commissions incurred by the Fund will be paid from the Fund. All other expenses incurred by the Trustee in connection with the administration of this Fund, including fees for legal services rendered to the Trustee, compensation of the Trustee to the extent not paid directly by the Grantor, and all other proper charges and disbursements of the Trustee will be paid from the Fund. Notwithstanding the foregoing, it is the express obligation of the Grantor and the Grantor agrees to pay directly to the Trustee for the benefit of the Fund, on demand, any and all taxes, expenses, costs and fees occasioned by virtue of the Fund so as to maintain, according to Section 2 hereof, the level, amount and value of the Trust Assets exclusively available for the purposes for which the Fund has been created; provided further; that should the Trustee utilize any portion of the Fund for costs, expenses, fees, taxes and the like, the Grantor shall forthwith add to the Fund such assets as will return the Fund to the level, amount and valuation required by Section 2, notwithstanding such disbursements by the Trustee.

Section 10. Annual Valuation.

The Trustee will annually, 30 days preceding the anniversary date of establishment of the Fund, furnish to the Grantor and to the Director a statement confirming the value of the Fund as of the end of that month.

Section 11. Advice of Counsel.

The Trustee may from time to time consult with counsel, who may be counsel to the Grantor, with respect to any question arising as to the construction of this Agreement or any action to be taken hereunder.

Section 12. Trustee Compensation.

The Trustee will be entitled to reasonable compensation for its services as agreed upon in writing from time to time with the Grantor.

Section 13. Successor Trustee.

Upon the written agreement of the Grantor and the Director, with ninety (90) days written notice to the Trustee, the Grantor may replace the Trustee. The Trustee may resign after the giving of ninety (90) days written notice to the Grantor and the Director. In either event, the Grantor will appoint a successor Trustee who will have the same powers and duties as those conferred upon the Trustee hereunder. Upon acceptance of the appointment by the successor Trustee, the Trustee will assign, transfer and pay over to the successor Trustee, the funds and properties then constituting the Fund. If for any reason the Grantor cannot or does not act in the event of the resignation of the Trustee, the Trustee may apply to a court of competent jurisdiction for the appointment of a successor Trustee or for instructions. The successor Trustee shall specify the date on which it assumes administration of the

Fund in writing sent to the Grantor, the Director, and the present Trustee by certified mail ten (10) days before such change becomes effective. Any expenses incurred by the Trustee as a result of any of the acts contemplated by this Section will be paid as provided in Section 9.

Section 14. Instructions to the Trustee.

All orders, requests, and instructions by the Director to the Trustee will be in writing, signed by the Director and the Trustee shall act and in so acting will be fully protected if acting in accordance with such orders, requests, and instructions. The Trustee will have the right to assume, in the absence of written notice to the contrary, that no event constituting a change or a termination of the authority of any person to act on behalf of the Grantor or the Director hereunder has occurred. The Trustee will have no duty to act in the absence of such orders, requests, and instructions from the Director, except as provided for herein.

Section 15. Amendment of Agreement.

This Agreement may be amended by an instrument in writing executed by the Grantor, the Trustee, and the Director, or by the Trustee and the Director if the Grantor ceases to exist.

Section 16. Irrevocability and Termination.

Subject to the right of the parties to amend this Agreement as provided in Section 15 this Fund will be irrevocable and will continue until terminated by the written agreement of the Grantor, the Trustee, and the Director or by the Trustee and the Director if the Grantor ceases to exist.

If the Fund is terminated based upon the Director's determination that the Fund is no longer required under the Act or any successor statute, all remaining Trust Assets less final trust administrative expenses shall be delivered to the Grantor.

If the Trust is terminated for any other reason, the Trust Assets less final trust administrative expenses shall be distributed as directed by the Director.

Section 17. Immunity and Indemnification.

The Trustee will not incur personal liability of any nature in connection with any act or omission, made in good faith, in the administration of this Fund, or in carrying out any directions by the Director issued in accordance with this Agreement. The Trustee will be indemnified and saved harmless by the Grantor, from and against any personal liability to which the Trustee may be subjected by reason of any act or conduct in its official capacity, including all expenses reasonably incurred in its defense.

Section 18. Choice of Law.

This Agreement will be administered, construed and enforced according to the laws of the State of Michigan.

Section 19. Interpretation.

As used in this Agreement, words in the singular include the plural and words in the plural include the singular. The descriptive headings for each Section of this Agreement will not affect the interpretation or the legal efficacy of this Agreement.

In witness whereof the parties have caused this Agreement to be duly executed as of the date first above written.

FOR THE GRANTOR

Dynecol, Inc.

by: Frank R. Biermann
Name: Frank Biermann
Title: President

6/5/89
(Date)

FOR THE TRUSTEE

by: Corporate Trust Division
Name: Comerica Bank
Title: 211 West Fort St.
Address: Detroit, MI

(Date)

FOR THE DIRECTOR, as beneficiary

State of Michigan
Department of Natural Resources
by:
Name:
Title:

(Date)

APPENDIX J

This appendix is reserved for future use.

APPENDIX K

This appendix is reserved for future use.

APPENDIX L.1

MONITORING WELL CONSTRUCTION SKETCHES

Observation Well Installation Report

Observation Well No. W-4-88

Project Dynecol, Inc. *Location* See Site Map

Type of Rig N/A *Installed By* WTD/ELC *Date* 5/20/88 *Time*

Method of Installation Hand Auger

Log of Boring and Observation Well

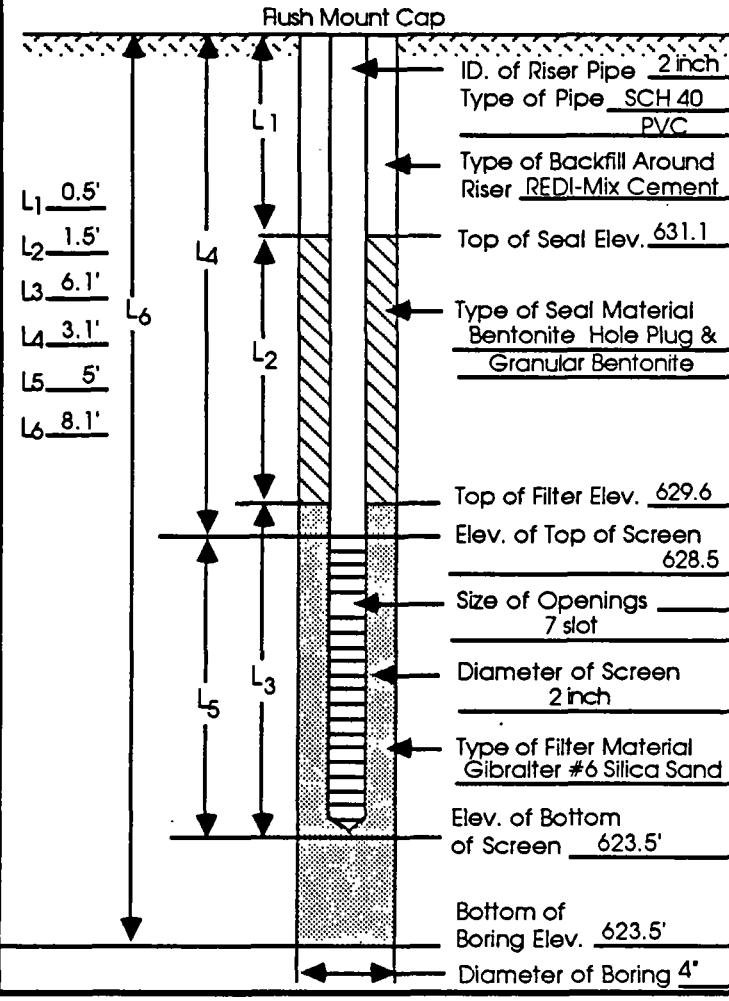
Boring

Depth in ft.	Cored Interval	*Description*
		Concrete
		Gravel/Slag
2		Rubble (concrete & brick slag) in silt and clay matrix
4		Sand - fine, gray-brown, silty with trace organic debris, wet
6		Clay- mottled brown-gray, slightly silty, firm
8		E.O.B. = 8.1'

Observation Well

Type of Monitoring Well 2-inch PVC Casing with stainless steel screen; Perched groundwater within fill

Ground Elev. 631.66 Top of Casing Elev 631.41



Remarks Fitted with internally locking flush mount cap. Slight bend in casing/screen connection necessitates utilizing a 1-1 1/2 inch diameter bailer for sampling. Water sample obtained.

Observation Well Installation Report

Observation Well No. W-5-88

Project Dynecol, Inc *Location* See Site Map

Type of Rig N/A *Installed By* WTD/ELC *Date* 5/20/88 *Time*

Method of Installation Hand Auger

Log of Boring and Observation Well

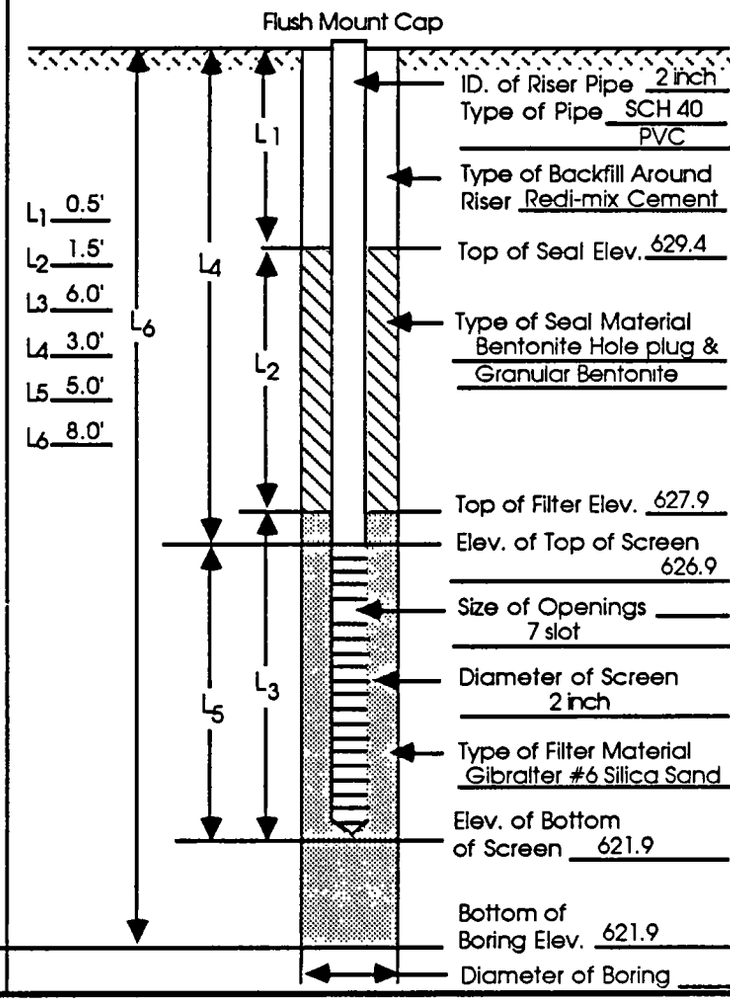
Boring

Depth in ft.	Cored Interval	*Description*
		Concrete
2		Clay, brown, black, sandy
4		Clay, mottled gray to brown, sandy
6		Clay, brown, sandy, silty
8		E.O.B - 8'

Observation Well

Type of Monitoring Well 2-inch PVC casing with stainless steel screen; perched groundwater within fill

Ground Elev. 629.92 Top of Casing Elev 629.66



Remarks Fitted with internally locking flush mount cap. Slight bend in casing/screen connection necessitates utilizing a 1-1 1/2 inch diameter bailer for sampling. No water yielded into well following installation due to low permeability of sandy clay soils.

soil and materials
ngineers, inc.

CLIENT WASTE ACID SERVICES
DETROIT, MICHIGAN

PROJECT MONITORING WELL
INSTALLATION

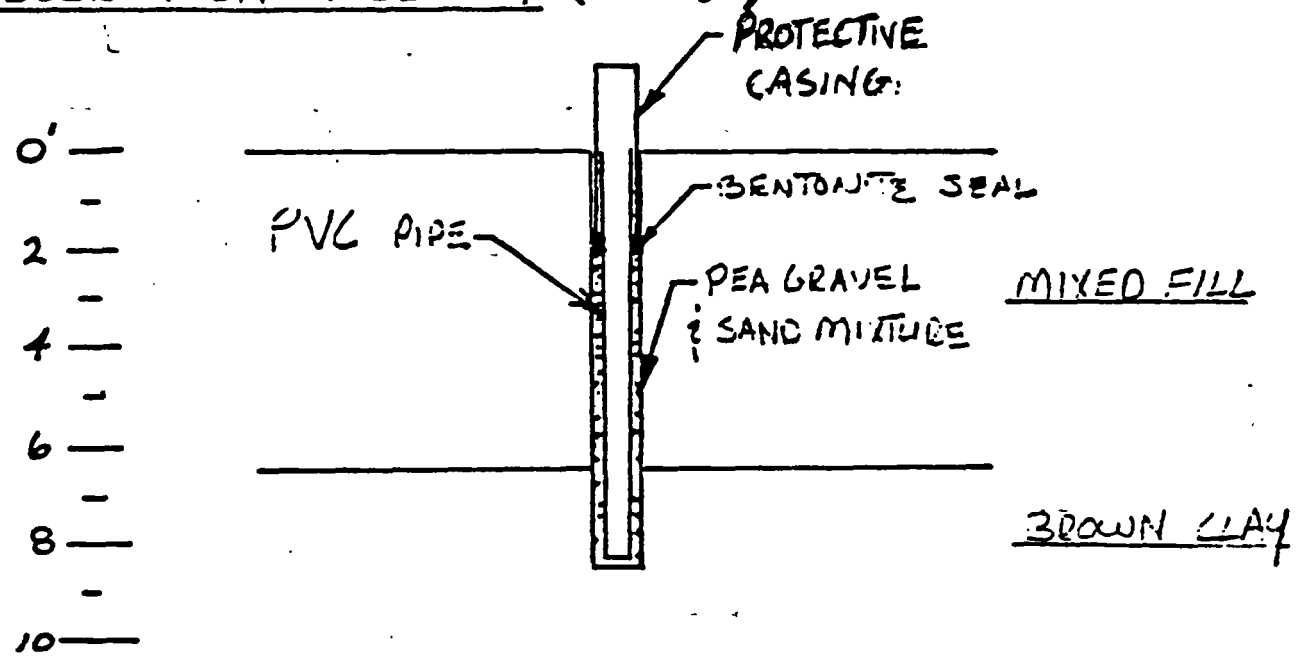
FILE NUMBER 6936

DATE 6-7-83

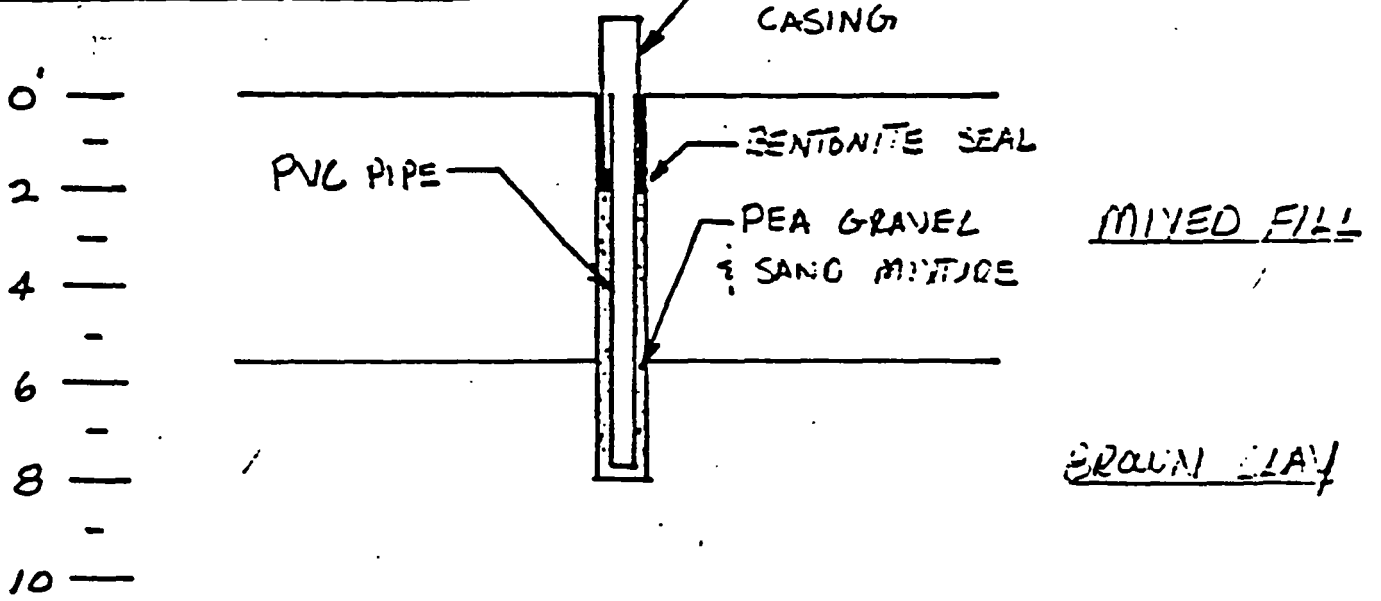
COMPUTED BY TB

CHECKED BY

OBSERVATION WELL #1 (B-1-83)



OBSERVATION WELL #2 (B-2-83)



APPENDIX L.2

FIELD DATA ENTRY FORMS

Dynecol, Inc.
Field Data Entry Form

Monitoring Well B-2-83
T.O.C. Elevation = 632.79

General

Sampled by: _____

Weather and Conditions: _____

_____

Witness: _____

Water Level Measurement

Depth of water from top of casing: _____ feet

Depth of well: _____ feet

Date and time measured: _____

Method used to measure: _____

Decontamination Procedures

Date and time of pre-sampling decontamination: _____

Method of decontamination: _____

Purge

Height of water column (depth of well - depth of water): _____ feet

3 casing volumes (height of column * 1.10): _____ gals.

Method of purging: _____

Date and time purged: _____

Volume purged: _____

Appearance of purge water: _____

Sampling

Date and time sampled: _____

Method used to sample: _____

Appearance of sample: _____

Field filtering: _____

Sample bottles filled: _____

Field Measurements

Measured conductivity: _____

Temperature of sample: _____

Temperature corrected conductivity: _____

Standardized pH meter? _____

Measured pH of pH=7 buffer: _____

Measured pH of sample: _____

Comments: _____

_____

_____

Signature of sampler(s) _____ Date: _____

Dynecol, Inc.
Field Data Entry Form

Monitoring Well B-3-88
T.O.C. Elevation = 631.50

General

Sampled by: _____

Weather and Conditions: _____

_____

Witness: _____

Water Level Measurement

Depth of water from top of casing: _____ feet

Depth of well: _____ feet

Date and time measured: _____

Method used to measure: _____

Decontamination Procedures

Date and time of pre-sampling decontamination: _____

Method of decontamination: _____

Purge

Height of water column (depth of well - depth of water): _____ feet

3 casing volumes (height of column * 0.49): _____ gals.

Method of purging: _____

Date and time purged: _____

Volume purged: _____

Appearance of purge water: _____

Sampling

Date and time sampled: _____

Method used to sample: _____

Appearance of sample: _____

Field filtering: _____

Sample bottles filled: _____

Field Measurements

Measured conductivity: _____

Temperature of sample: _____

Temperature corrected conductivity: _____

Standardized pH meter? _____

Measured pH of pH=7 buffer: _____

Measured pH of sample: _____

Comments: _____

_____

_____

Signature of sampler(s) _____ Date: _____

Dynecol, Inc.
Field Data Entry Form

Monitoring Well W-4-88
T.O.C. Elevation = 631.41

General

Sampled by: _____

Weather and Conditions: _____

_____

Witness: _____

Water Level Measurement

Depth of water from top of casing: _____ feet

Depth of well: _____ feet

Date and time measured: _____

Method used to measure: _____

Decontamination Procedures

Date and time of pre-sampling decontamination: _____

Method of decontamination: _____

Purge

Height of water column (depth of well - depth of water): _____ feet

3 casing volumes (height of column * 0.49): _____ gals.

Method of purging: _____

Date and time purged: _____

Volume purged: _____

Appearance of purge water: _____

Sampling

Date and time sampled: _____

Method used to sample: _____

Appearance of sample: _____

Field filtering: _____

Sample bottles filled: _____

Field Measurements

Measured conductivity: _____

Temperature of sample: _____

Temperature corrected conductivity: _____

Standardized pH meter? _____

Measured pH of pH=7 buffer: _____

Measured pH of sample: _____

Comments: _____

_____

_____

Signature of sampler(s) _____ Date: _____

Dynecol, Inc.
Field Data Entry Form

Monitoring Well W-5-88
T.O.C. Elevation = 629.66

General

Sampled by: _____

Weather and Conditions: _____

_____

Witness: _____

Water Level Measurement

Depth of water from top of casing: _____ feet

Depth of well: _____ feet

Date and time measured: _____

Method used to measure: _____

Decontamination Procedures

Date and time of pre-sampling decontamination: _____

Method of decontamination: _____

Purge

Height of water column (depth of well - depth of water): _____ feet

3 casing volumes (height of column * 0.49): _____ gals.

Method of purging: _____

Date and time purged: _____

Volume purged: _____

Appearance of purge water: _____

Sampling

Date and time sampled: _____

Method used to sample: _____

Appearance of sample: _____

Field filtering: _____

Sample bottles filled: _____

Field Measurements

Measured conductivity: _____

Temperature of sample: _____

Temperature corrected conductivity: _____

Standardized pH meter? _____

Measured pH of pH=7 buffer: _____

Measured pH of sample: _____

Comments: _____

_____

_____

Signature of sampler(s) _____ Date: _____

APPENDIX L.3

STANDARD OPERATING PROCEDURES FOR FIELD DETERMINATION OF PH AND SPECIFIC CONDUCTIVITY

STANDARD OPERATING PROCEDURE FOR FIELD DETERMINATION OF pH, METHOD 423

Soil Sediment, Groundwater, Surface Water, Leachate Analysis

1.0 METHOD SUMMARY

1.1 This is a determination of the activity of the hydrogen ions by potentiometric measurement.

2.0 INTERFERENCES

2.1 Temperature is an important factor. The temperature compensator attached to the instrument automatically corrects the pH value displayed by the meter.

3.0 INSTRUMENTATION

Altex pH meter
pH probe
Temperature compensator

4.0 MATERIALS AND REAGENTS

Sample cups
Prepared pH 4, 7, 10 standards for calibration

5.0 CALIBRATION

During initial setup and calibration, two standards are run.

5.1 Clear the meter by pushing the clear button.

5.2 The prepared pH 7.00 standard is agitated with the pH probe and the standard number 1 button is pushed.

5.3 After the "eye" symbols come on indicating this portion of the calibration procedure is complete, the probe is rinsed with distilled water.

5.4 The second standard pH 10.00 or pH 4.00 is then agitated with the pH probe while pushing the calibration button. When the "eye" symbol reappears, calibration is complete.

5.5 Verify meter calibration by analyzing the third standard as described in Section 6.0. A +0.05 pH acceptance limit should be used in determining calibration acceptability. If unacceptable, recalibrate as described in 5.1.

6.0 PROCEDURE

6.1 Prepare and analyze samples without delay.

6.2 Place about 50 mls of sample into a plastic cup and stir with the pH probe.

6.3 Allow the pH reading to stabilize. Record the pH value on the well sampling record form. Rinse the probe with distilled water and verify calibration by submersing in a prepared pH standard as described in 5.5.

6.4 Proceed to the next sample or location; verify calibration before each measurement.

7.0 Quality Control

7.1 Document all calibrations and verification readings, including time and meter readings.

7.2 Run duplicate measurements on each batch or every 10th sample.

STANDARD OPERATING PROCEDURE FOR FIELD DETERMINATION OF CONDUCTIVITY, METHOD 205

Groundwater, Surface Water, and Wastewater

1.0 METHOD SUMMARY

1.1 Conductivity is a numerical expression on aqueous solution's ability to carry an electric current. This is dependent on the presence of ions, their concentrations, mobility, valence, and on the temperature of the solution.

1.2 The conductivity probe is immersed in a sample and the conductivity is read directly off of the meter scale.

2.0 INTERFERENCES

2.1 Temperature greatly influences the electrolytic conductivity of a sample. Therefore, it is extremely important accurate temperature measurements are made.

3.0 INSTRUMENTATION

3.1 Conductance meter YSI Model 32.

4.0 MATERIALS AND REAGENTS

Conductivity cell
Thermometer
Specimen containers

5.0 STANDARD

5.1 Primary Working Standard:

Potassium chloride standard 0.01N: Dissolved 0.7456 g anhydrous KCl in deionized water and dilute to 1 liter at 25°C. Conductivity = 1,413 umhos/cm.

6.0 CALIBRATION

6.1 Check the conductivity of the standard prior to actual sample evaluation. Record the temperature of each standard.

6.2 Calculate the conductivity at 25°C. making adjustments for the temperature, see 8.1 for equation.

7.0 PROCEDURE

7.1 Rinse the cell with deionized water.

7.2 Measure the conductivity of each sample by swirling the cell in a portion of the sample. Record the conductivity reading and the temperature.

7.3 Calculate the conductivity at 25°C as outlined in Section 8.1.

8.0 CALCULATIONS

8.1 Conductivity at 25°C = $\frac{K}{1 + 0.0191\ (t-25)}$

K = measured conductivity
t = temperature of sample, °C

9.0 QUALITY CONTROL

9.1 Document all calibrations and verification of readings including time and meter readings.

9.2 A blank of deionized water is run and should have a conductivity of less than 5 umhos/cm.

9.3 The initial standard is checked after every 10th sample.

APPENDIX L.4

QUALITY ASSURANCE/QUALITY CONTROL FOR THE EDI ENGINEERING & SCIENCE LABORATORY

EDI ENGINEERING & SCIENCE

ANALYTICAL SERVICES DIVISION

QUALITY ASSURANCE/QUALITY CONTROL MANUAL

Revised: 8/22/86

EDI ANALYTICAL SERVICES DIVISION
QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES MANUAL

TABLE OF CONTENTS

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3.0	Facilities and Equipment	10 - 15
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5.0	Method Certification	18 - 20
6.0	Analyst Training and Certification	21 - 23
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1.0 THE PURPOSE OF THE MANUAL

The purpose of this manual is to specify procedures and technical requirements to be used by the EDI Engineering & Science chemistry laboratories to assure that the data generated by the laboratory is accurate, reproducible and timely. This manual provides the chemistry laboratory a quality control plan which is to be used by every individual involved in the analytical efforts at EDI. This manual conforms to and is an extension of the EDI Quality Control Manual. If a conflict should arise, the EDI Corporate Quality Control Manual shall take precedence.

1.1 THE NEED FOR ANALYTICAL QUALITY CONTROL

There is a growing importance attached to the measurement of the concentration of any contaminant in water, effluents, and solid samples. As with any type of measurement the results of the methods utilized to measure the concentrations of these contaminants generally differ from the true concentration, i.e. all results are subject to error. Many experimental studies have shown that errors can arise which are as large as a 50 percent variations from the true value, and in fact, may vary between laboratories. Inaccurate analytical results restrict the ability of the analyst and the recipient of the data to draw valid conclusions and usually lead to false or misleading conclusions. Examples of common problems which arise during an analytical effort are as follows:

A. Results, which are compared between two or more laboratories, are in error relative to each other.

B. Results are to be used to decide if a water quality standard has been observed especially as the level of the analysis approaches the detection level.

C. The analytical method, such as GCMS analysis, is only semi-quantitive in nature and, therefore, relative errors are anticipated between equivalent laboratories and even equivalent instruments.

D. An inappropriate test procedure has been used to determine the analyte, resulting in values that do not represent the true sample concentration, i.e. direct aspiration of a turbid sample.

There is also increasing concern about the control of these errors being expressed at the local, the national and the international levels. The concern centers around the need to have a maximum amount of valid information obtained in a cost effective manner. In order to control errors, it is necessary to be able to measure the magnitude of these errors. This manual identifies the activities that are involved in the measurement and control of error. EDI considers analytical quality control of great importance, and requires that it be a primary feature in any analytical effort. The EDI requirements for analytical quality control are in concert with the quality control needs and demands of other organizations, such as the Environmental Protection Agency, the Michigan Department of Natural Resources, various state regulatory agencies, and such organizations as may need to insure their product quality.

Approximately twenty to thirty percent of all the available effort for routine analysis is absorbed in the execution of quality control requirements. It is often argued that the extent of this effort is too great with respect to routine laboratories and their need to be profitable in their operation. The argument therefore claims that extensive quality control is an impractical expectation for a routine laboratory. However, the corporate policy at EDI demands that the appropriate level of quality control be applied to all analytical effort at EDI, regardless of the sample lot.

In the total effort, it is preferable to obtain twenty to thirty percent fewer results of known accuracy for each analytical batch than it is to obtain larger numbers of results of undefined accuracy. Due to the fact that all analytical procedures are subject to errors derived from many sources, it is not reasonable to assume that quality control is unnecessary with a "good" analyst. However, even a "good" analyst may not have an adequate idea of his (her) accuracy. Multiple studies by the EPA, both within laboratories and between laboratories, has shown this reasoning to be generally unsound.

2.0 QUALITY ASSURANCE ORGANIZATION AND RESPONSIBILITIES

2.1 Objective of the QA Program at EDI

The purpose of the quality control program is to continuously monitor error, both random and systematic, which inhibits the production of reliable and defensive analytical data. Error is inherent in any analytical routine, even with the most rigorous controls, and thus, a good QC program addresses not only the basic control techniques but also statistical means of measuring precision and accuracy and the confidence limits on these measurements.

The purpose of this manual is to specify the procedures, records, Chain-of-Command, and technical requirements which will be adhered to by the laboratories of EDI. This manual conforms to and is an extension of the EDI Quality Assurance Manual and as such, gives final authority to the Corporate QA Manager.

2.2 Organization

Quality control at EDI begins with the bench analyst and moves up through the Chain of Command ultimately residing at the level of the President. A QC program which is administered only at the upper levels of management is doomed to failure and is unfair to the bench level analyst who needs a means by which he can observe the quality of his work. Quality Control is a two way program at EDI where directives from management are as important as suggestions and assistance from the bench analyst.

2.2.1 QC Chain of Command Flow Chart

The following flow chart represents both the QA Chain of Command (solid line) and the Administrative Chain of Command (dotted). The flow chart represents the philosophy of EDI relative to the interaction of QC and production. Although the QC Coordinator reports to the Director of Analytical Services in the supervisory Chain-of-Command, his responsibilities for quality control require that

he answer to the Corporate QC officer. The QC coordinator acts as an immediate record keeper, QC administrator and liason to the lab manager.

However, when a question relative to the quality of analytical data arises, the QA coordinator, in conjunction with the Corporate QC Officer, has the right to prevent data dissemination. In cases of conflict, the Corporate QC Officer has final authority except when a compromise or directive is issued by the Chief Operating Officer or the President.

2.2.2 Responsibilities and Objectives of the Corporate QA Manager

2.2.2.1 Objectives

- o To develop and implement a Company wide quality assurance program
- o To assist management with the integration of individu quality assurance programs into all operations
- o To establish an attitude that focuses on defining causes of nonconformance and eliminating them
- o To assist managers in defining performance requirements

2.2.2.2 Responsibilities

The EDI Quality Assurance Manager (QAM) is responsible for developing and administering the EDI QA program. The QAM will conduct laboratory program audits and take appropriate action as necessary. This staff member will serve as the final authority in all laboratory QA programs. In addition, the QAM will serve as an arbitrator and final authority in all QA/QC problems which might arise in t

laboratory. A formal audit will be performed on the individual laboratories at least once per year by the QAM. The results of this audit will be submitted to the President. Prior to implementation, all QA/QC manuals and programs will be reviewed and approved by the QAM.

2.2.3 Responsibilities of the Laboratory QC Coordinator

2.2.3.1 To monitor the Quality Assurance activities in the laboratory insuring adherence to all policies and procedures.

2.2.3.2 To identify problem areas and help in recommending improvement and changes.

2.2.3.3 To keep abreast of changing development in analytical QC particularly requirements set by regulatory agencies.

2.2.3.4 To arrange or produce random blind control samples.

2.2.3.5 To approve all laboratory data prior to recording such data for report generation purposes.

2.2.3.6 To maintain QC on all analytical activities and update control limits in a timely manner.

2.2.3.7 Maintain balance and controlled temperature apparatus record books on a daily basis and insure that such records are maintained on every piece of equipment.

2.2.3.8 To assure that bottle preparation, approval and storage meet established criteria.

2.2.4 Responsibilities of the Sample Coordinator

A full position description of the Sample Coordinator can be found in the "EDI Log-in Manual".

- To insure that all samples received at EDI are properly preserved, split, logged-in, and stored in agreement with the log-in manual.

- To insure that all COC shipments are handled according to established procedures including storage, sample tracking and completion of files.

- To insure that all project sheets and subsequent paperwork is completed and filed.

- To insure that labile samples are distributed in a timely manner.

- To cooperate with the QC coordinator in introducing blind samples.

2.2.5 Responsibilities of the Analytical Staff

- To insure that all records are generated and recorded on a daily basis.

- To insure that the following bench level QC requirements are met.

- To fill out lab notebooks daily is required.

- To provide for QC on every batch of samples at a minimum of

  10% duplicate
  10% blanks
  10% matrix spike
  method spikes, at least one per set of samples

- To insure that instruments are calibrated prior to initiating any analysis and that no analyses are started unless calibration has been satisfactorily completed.

- To insure that every batch of analyses meets established QC guidelines or is reanalyzed automatically.

- To inform the lab manager of any reoccurring problems or systematic trends which may effect quality.

2.2.6 Responsibilities of the Laboratory Supervisor

- To insure that sufficient competent staff is available to administer QC.

- To insure that all participating analysts are certified in the test they are performing.

- To insure that effective training and orientation takes place for every new analyst.

- To insure that all QC procedures, directives or project oriented requirements are met.

- To review all preliminary reports and approve them prior to the generation of a final report.

- To interface with the QC coordinator and corporate QC Manager on a routine and consistent basis.

- To take responsibility for immediate solutions to QC problems which may slow or stop production.

2.2.7 Responsibilities of the Data Coordinator

The Data Coordinator's (DC) responsibilities are:

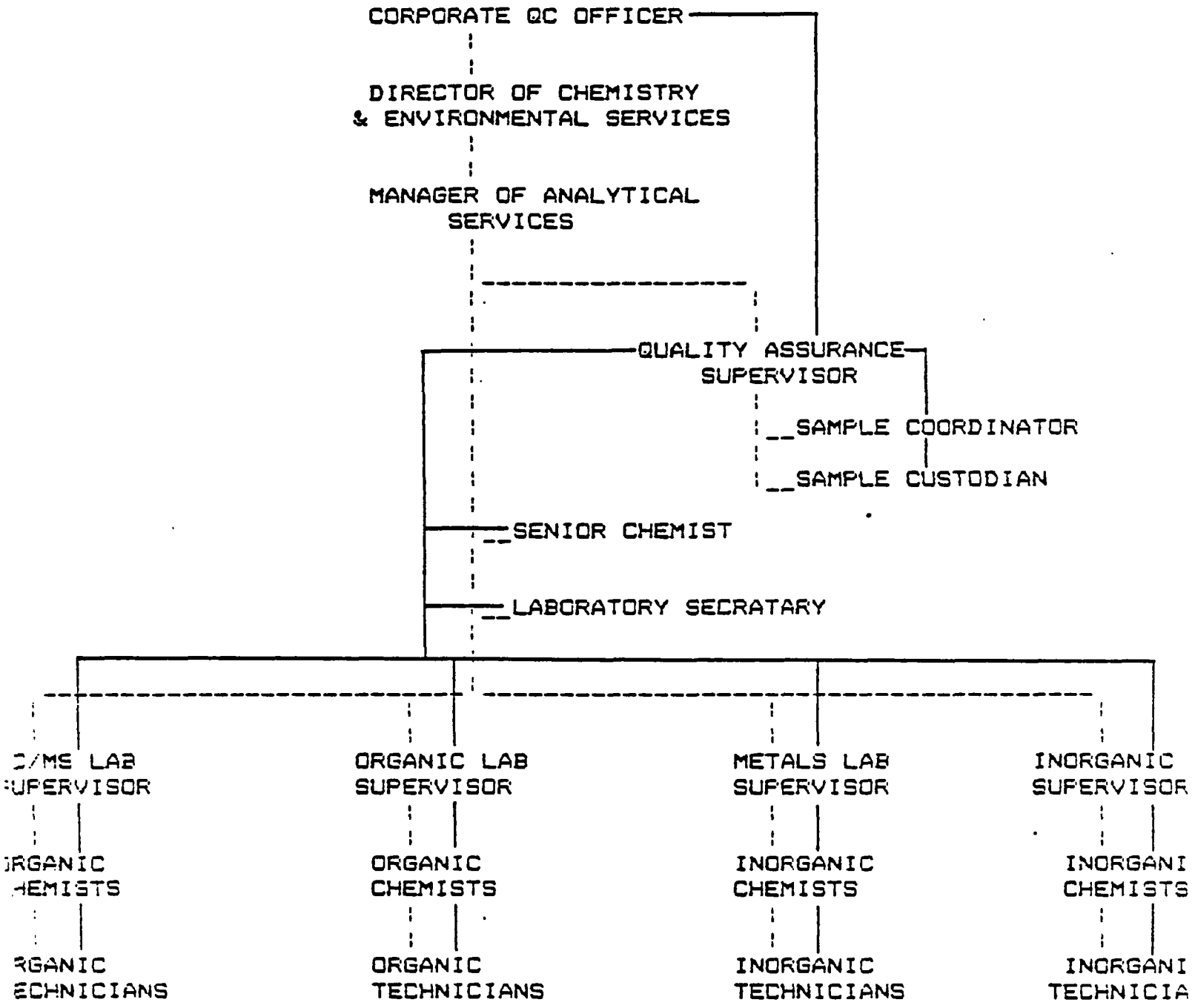
- To enter all data generated into the appropriate records.

- To insure that the QC Coordinator has signed the data forms (bench sheets prior to entry).

- To inform the QC Coordinator when a project is complete and read for a preliminary report.

- To provide corrections to all reports from preliminary report feedback.

QUALITY CONTROL CHAIN OF COMMAND FLOW CHART



ADMINISTRATIVE FLOW = _____

QUALITY CONTROL FLOW = _____

3.0 FACILITIES AND EQUIPMENT

3.1 The physical plant layout diagram is enclosed. The approximate square footage allocated to each analysis area is presented as well as the number of personnel normally working in each area. A listing of equipment presently utilized by EDI is also enclosed.

3.2 The quality of the analytical instrumentation utilized by EDI is of great importance considering its ultimate effect on data quality. The following guidelines exist for the procurement of analytical instrumentation:

3.2.1 Equipment Need

An equipment need is identified by the Lab Manager or the Director of Environmental Services as a result of:

- o New Contractural Effort
- o Regulatory Changes
- o Normal Upgrade/Replacement
- o Capacity Improvements

3.2.2 Procurement Procedure

The performance specifications defined by the need are used to identify prospective equipment suppliers. The Lab Manager mails the performance specifications to the prospective equipment suppliers. Those suppliers able to meet the performance specifications are asked to provide a quotation for the purchase or lease of the equipment. An evaluation of the quotations is made by the Lab Manager with consideration given to such items as: equipment ease of use, degree of automation, specification compliance, potential for computerization, price and space requirements.

A written recommendation by the Lab Manager is presented to the Director of Environmental Services and the Quality Assurance Office for their review and comment.

A final recommendation by the Director of Environmental Services is made to the President of EDI and the Corporate Quality Assurance Officer. The final approval is granted based on the assurance of complying with all regulatory and corporate guidelines for the generation of the highest quality data.

3.3 Chemical Procurement and Inventory Procedure

All reagent specifications are dictated by the EPA/APHA or NIOSH approve analytical methods. These reagent specifications are identified and maintained on the chemical inventory index card system. The chemical inventory index card system assures the order of chemical use and minimizes the possibility of exceeding their useful shelf life. The addition of a new method or a change in an existing method that requires a corresponding addition or change in a reagent used for that method will be identified by the Lab Area Supervisor or Group Leader. The Supervisor or Group Leader will prepare the chemical inventory index.

All reagent specifications, available vendors and amount(s) received are recorded on the chemical inventory index cards.

All chemical reagents are received by the sample coordinator. The sample coordinator notifies a designated laboratory aid that a delivery has arrived. The aid opens the shipping package and compares the packing slip with the contents. Discrepancies are identified to the Lab Manager. The materials receipt is identified and recorded on the chemical inventory. The materials are then inventoried on the chemical inventory index. The index system identifies the amount(s) received and when. When the last bottle/container of the chemical remains, the chemical is placed on an open order sheet located in the lab.

The group leader/supervisor for that lab area is responsible for picking up the chemical open order sheet each week and preparing a purchase order. The purchase order is approved by the Lab Manager and a typed purchase order is issued to the approved vendor that has been previously identified as being able to supply the specified material. The receipt of the new order initiates the inventory system activities.

3.4 Preventative Maintenance

Every analytical instrument has a separate maintenance log book as identified in the Document Control Section No. 7.3.9. The required maintenance activities have been developed by the Lab Manager and each Group Leader/Area Supervisor. The maintenance activities comply with manufacturer specifications and working experience requirements.

Each maintenance log book contains a table indicating the frequency and type of maintenance required. The maintenance activity is documented each day or as the frequency requirements dictate.

Analysts are assigned the responsibility of maintaining various instruments or equipment in their respective laboratory areas. The Group Leader or Area Supervisor is responsible for checking the maintenance log books each week and signing off as checked. The Quality Assurance Officer is notified of any deviations or lack of maintenance activity performance, and corrective actions are taken.

EQUIPMENT

ANALYTICAL AREA	EQUIPMENT/ INSTRUMENT NAME	MANUFACTURER	MODEL NO.
Wet Chemistry	Analytical Balance	Mettler	AE163
	Auto-analyzer	Alpkem (refurbished Technicon	
	Beckman pH meter	Beckman-Altex	070
	Spectrophotometer	Hitachi	100-40
	Conductivity Meter	HACH	portable
	Dri-Block-digestor	Tecam	DB-3H
Atomic Absorption	Atomic absorption Spectrophotometer	Varian Perkin-Elmer	AA-575 5000
Gas Chromatography	Analytical balance	Mettler	AE 163
	Gas Chromatograph #1	Varian	3700
	Gas Chromatograph #2	Varian	3760
	Gas Chromatograph #3	Varian	3760
	Gas Chromatograph #4	Varian	3400
	Integrators (3)	Varian	4270
	Chart recorder (2)	Various	
GC/MS Spectrometry	Gas chromatography/ Mass spectrometer	Finnegan MAT	OWA 20B
	Gas chromatography/ Mass spectrometer	Finnegan MAT	OWA 20B
	Nine Track Magnetic Tape System	Data General	6021

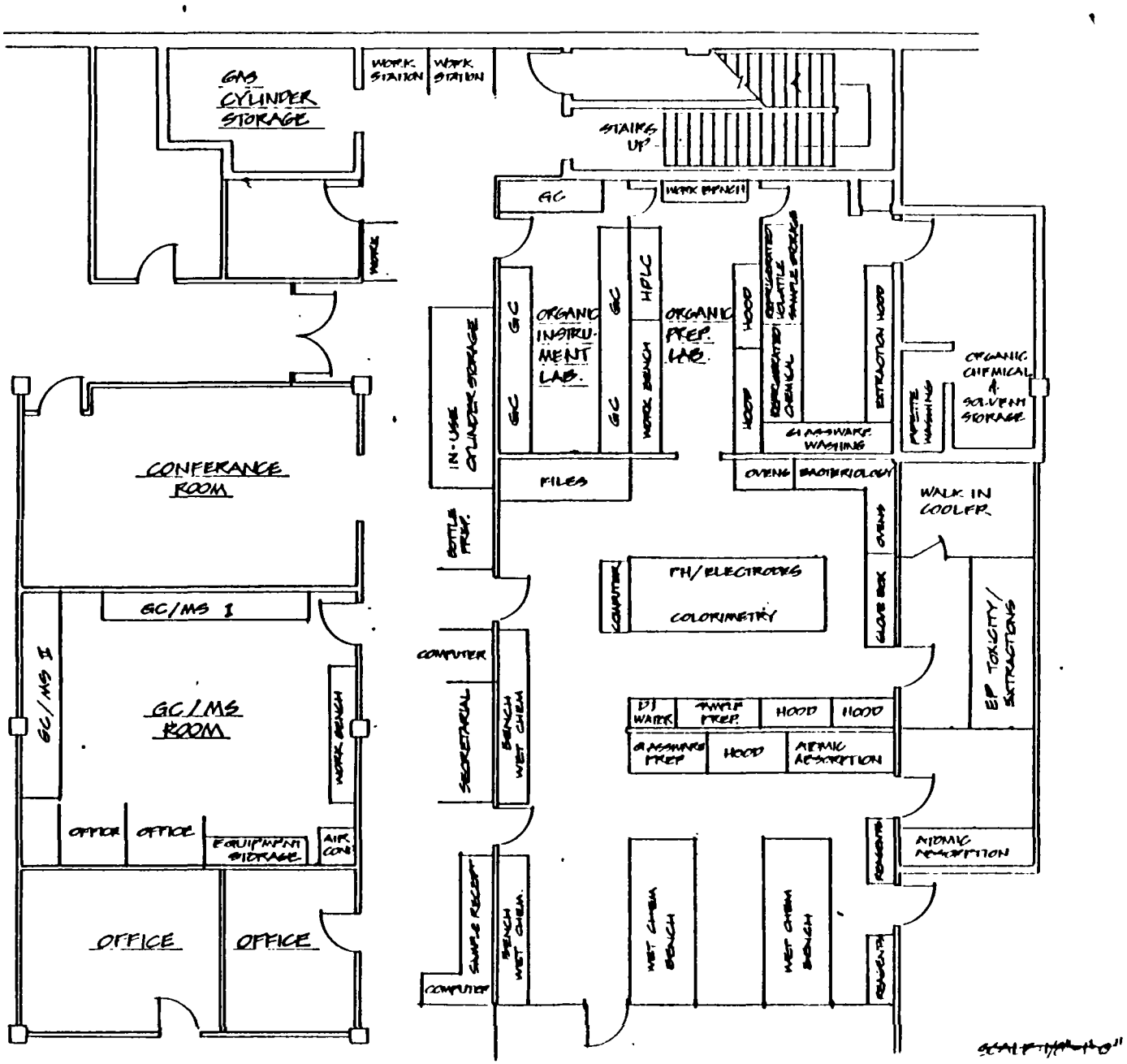
PHYSICAL PLANT

Laboratory Name and Address: EDI ENGINEERING & SCIENCE
611 Cascade West Parkway S.E.
Grand Rapids, MI 49506

Name of Laboratory Manager: John P. Dullaghan

Describe or attach a drawing of the laboratory layout, indicating the general areas of analysis, the space allotted to each and the number of personnel generally assigned to each area.

ANALYSIS	SPACE ALLOTTED, FT^2	NUMBER OF PERSONNEL
MICROBIOLOGY	Approx. 30	1
WET CHEMISTRY	" 970	5
ATOMIC ABSORPTION/EMISSION	" 300	1
GAS CHROMATOGRAPHY (GC)	" 380	3
GC/MASS SPECTROMETRY	" 500	3
SAMPLE RECEPTION	" 100	1
ADMINISTRATIVE (TYPING, ETC.)	" 400	4
STORAGE (CYLINDERS, WASTES)	" 400	1



EDI ENGINEERING & SCIENCE

ANALYTICAL LABORATORY

4.0 ANALYTICAL METHODOLOGIES

4.1 Methods Utilized

The EDI Laboratory maintains and updated reference volumes of approved analytical methodologies for environmental and non-environmental analysis. A responsibility of the Lab Manager and the Director of Environmental Services is to continually seek and review regulatory method changes and their impact on current laboratory practices. The most commonly referenced materials include:

- "Methods for Chemical Analysis of Water and Wastes" EPA-600/4-79-020 revised March 1972.

- "Manual of Analytical Procedures" NIOSH, Volumes 1 & 2, Third Edition, Feb., 1984.

- Standard Methods for the Evaluation of Water and Wastewater, APHA, AWWA, WPCF 1980.

- "Handbook for Analytical Quality Control in Water and Wastewater Laboratories", EPA 600/4-79-019, March 1979.

- "Physical and Chemical Methods for the Evaluation of Solid Waste" EPA-SW846 Second Edition, 1982.

- "Guidelines Establishing Text Procedures for the Analysis of Pollutants" Proposed Regulations. CFR December 3, 1979; updated Oct. 26, 1984.

4.2 Method Calibration and Operating Procedures

All methods utilized by EDI have been certified in accordance with the specifications outlined in the Method Certification Section No. 5.0.

A standard operating procedure manual exists for all analytical procedur The S.O.P's include specific calibration procedures that must be followe by an analyst prior to conducting sample analysis. The analyst is

required to perform and document the calibration procedure. The calibration activity is identified by each analyst in their lab notebooks. The actual standards utilized and resulting measurements are found in each instrument log book. It is the responsibility of each analyst to document all calibration and operating procedures utilized, in their personal log books as well as in the instrument log books. The area group leaders and/or supervisors review this information each week when they sign off indicating the information has been reviewed. It is the responsibility of the group leaders and/or supervisors to notify the Quality Assurance Officer when deviations occur so that corrective actions can be taken. The corrective action will be to identify whether the information is simply missing (not entered) and to have it recorded or if the calibration has not been performed, to not release data generated that day and require those samples to be rerun.

5.0 METHOD CERTIFICATION

All methods used by EDI which were not developed by EDI will be certified prior to their use. Method Certification is contiguous with the certification of the analyst and requires essentially the same analytical program. Method certification is necessary in order to establish detection limits, method application limits and criteria for control limits. In most cases, detection limits and recoveries stated in a method are obtained under ideal conditions and do not reflect real world solutions, e.e. silty well water and industrial effluent versus a drinking water supply. Method certification falls into 2 categories: 1) Methods being employed for the first time and 2) Methods which are to replace currently certified methods (replacement methods). In either case, analysis of client sample may not proceed until certification has occurred.

5.1 Method Certification

5.1.1 Linear Range

The first step in certifying a method is to establish the linear range (operating range) of the method. A method may be used only over the range in which it is linear. Some methods do not have linear ranges but curves from which results are calculated. For the moment we will ignore methods with curves. A linear range must be established independent of the method data since instruments can effect the range. Standards and multiple detections will be used for establishing the linear range. For example, a range of 1 to 1000 has 3 decades (3 orders of magnitude or 10^3). Therefore, a range of 1 to 1000 requires 11 levels of test standards (.5, 1, 2,5,10,20,50,100,200,500,1000). Notice that each decade follows the 0.5x to 10x rule, i.e. the area 10 to 100 is covered by 5,10,20,50 and 100. The range to be attempted is dependent on the method, the instrument and the analytical supervisor. If the responses show linearity, the range has been established. If,

however, a curve develops or there appear to be two linear ranges, the standards must be repeated including additional levels to verify the status of the questionable area.

5.1.2 Working Curves

Some methods operate from a curve response, i.e. sodium by emission spectroscopy. The method will indicate the working curve which must be verified. The method with working curves requires a full curve each time an analysis is to be performed.

5.1.3 The Generation of the Method Detection Limit

The method detection limit (MDL) is defined as the minimum concentration of a substance that can be identified, measured and reported with 99% confidence that the analyte concentration is greater than zero and determined from analysis of a sample in a given matrix containing analyte.

Scope and Application

This procedure is designed for applicability to a wide variety of sample types ranging from reagent (blank) water containing analyte to wastewater containing analyte. The MDL for an analytical procedure may vary as a function of sample type. The procedure requires a complete , specific and well defined analytical method. It is essential that all sample processing steps of the analytical method be included in the determination of the method detection limit.

The MDL obtained by this procedure is used to judge the significance of single measurement of a future sample.

The MDL procedure was designed for applicability to a broad variety of physical and chemical methods. To accomplish this, the procedure was made device or instrument independent.

Procedure

1. Make an estimate of the detection limit using one of the following:

   (a) The concentration value that corresponds to an instrument signal/noise ratio in the range of 2.5 to 5. if the criteria for qualitative identification of the analyte is based upon pattern recognition techniques, the least abundant signal necessary to achieve identification must be considered in making the estimate (PCB).

   (b) The concentration value that corresponds to three times the standard deviation of replicate instrumental measurements for the analyte in reagent water.

   (c) The concentration value that corresponds to the region of the standard curve where there is a significant change in sensitivity at low analyte concentrations i.e. a break in the slope of the standard curve.

   (d) The concentration value that corresponds to known instrumental limitations.

   It is recognized that the experience of the analyst is important to this process. However, the analyst must include the above considerations in the estimate of the detection limit.

2. Prepare reagent (blank) water that is as free of analyte as possible. Reagent or interference free water is defined as a water sample in which analyte and interferent concentrations are not detected at the method detection limit of each analyte of interest. Interferences are defined as systematic errors in the measured analytical signal of an established procedure caused by the presence of interfering species (interferent). The interferent concentration is presupposed to be normally distributed in representative samples of a given matrix.

3. (a) If the MDL is to be determined in reagent water (blank) prepare a laboratory standard (analyte in reagent water) at a concentration which is at least equal to or in the same concentration range as the estimated MDL (Recommend between 1 and 5 times the estimated MDL) Proceed to Step 4.

(b) If the MDL is to be determined in another sample matrix, analyze the sample. If the measured level of the analyte is in the recommended range of one to five times the estimated MDL proceed to Step 4.

If the measured level of analyte is greater than five times the estimated MDL, add a known amount of analyte to bring the concentration of analyte to between one and five times the MDL in the case where an interference is coanalyzed with the analyte.

If the measured level of analyte is greater than five times the estimated MDL there are two options:

(1) Obtain another sample of lower level of analyte in same matrix if possible.

(2) The sample may be used as is for determining the MDL if the analyte level does not exceed 20 times the MDL of the analyte in reagent water. The variance of the analytical method changes as in the analyte concentration increases from the MDL, hence the MDL determined under these circumstances may not truly reflect method variance at lower analyte concentrations.

4. (a) Take a minimum of seven aliquots of the sample to be used to calculate the MDL and process each through the entire analytical method. Make all computations according to the defined method with final results in the method reporting units. If blank measurements are required to calculate the measured level of analyte, obtain separate blank measurements for each sample aliquot analyzed. The average blank measurement is subtracted from the respective sample measurements.

(b) It may be economically and technically desirable to evaluate the estimated MDL before proceeding with 4a. This will: (1) prevent repeating this entire procedure when the costs of analyses are high and (2) insure that the procedure is being conducted at the correct concentration. It is quite possible that an incorrect MDL can be calculated from data obtained at many times the real MDL even though the background concentration of analyte is less than five times the calculated MDL. To insure that the estimate of the MDL is a good estimate, it is necessary to determine that a lower concentration of analyte will not result in a significantly lower MDL. Take two aliquots of the sample to be used to calculate the MDL and process each through the entire method, including blank measurements as described above in 4a. Evaluate these data:

(1) If these measurements indicate the sample is in the desirable range for determining the MDL, take five additional aliquots and proceed. Use all seven measurements to calculate the MDL.

(2) If these measurements indicate the sample is not in the correct range, reestimate the MDL, obtain new sample as in 3 and repeat either 4a or 4b.

5. Calculate the variance (S^2) and standard deviation (S) of the replicate measurements, as follows:

$$S^2 = \frac{1}{n-1}\left[\sum_{i=1}^{n} X_i^2 - \frac{\left(\sum_{i=1}^{n} X_i\right)^2}{n}\right]$$

$$S = \sqrt{S^2}$$

where the $x_1 i$ = 1 to n are the analytical results in the final method reporting units obtained from the n sample aliquots and

X_i^2 refers to the sum of the X values from i = 1 to n.

6. (a) Compute the MDL as follows:

$$MDL = t_{(n-1),\, 1-\alpha=.99)} \cdot S$$

where:

MDL - the method detection

$t_{(n-1,1-\alpha=.99)}$ = the students' t value appropriate for a 99% confidence level and a standard deviation estimate with n-1 degrees of freedom. See Table.

S = standard deviation of the replicate analyses.

(b) The 95% confidence limits for the MDL derived in 6a are computed according to the following equations derived from percentiles of the chi square over degrees of freedom distribution (X^2/df) and calculated as follows:

MDL_{lcl} = 0.69 MDL
MDL_{ucl} = 1.92 MDL

where MDL_{lcl} and MDL_{ucl} are the lower and upper 95% confidence limits respectively based on seven aliquots.

7. Optional iterative procedure to verify the reasonableness of the estimated MDL and calculated MDL of subsequent MDL determinations.

(a) If this is the initial attempt to compute MDL based on the estimated MDL in Step 1, take the MDL as calculated in Step 6, spike in the matrix at the calculated MDL and proceed through the procedure starting with Step 4.

(b) If the current MDL determination is an iteration of the MDL procedure for which the spiking level does not permit qualitative identification, report the MDL as that concentration between the current spike level and the previous spike level which allows qualitative identification.

(c) If the current MDL determination is an iteration of the MDL procedure and the spiking level allows qualitative identification, use S^2 from the current MDL calculation and S^2 from the previous MDL calculation to compute the F ratio.

$$\text{if } \frac{S_A^2}{S_B^2} < 3.05$$

then compute the pooled standard deviation by the following equation:

$$\text{Spooled} = \left[\frac{6S_A^2 + 6S_B^2}{12} \right]^{1/2}$$

if $\frac{S_A^2}{S_B^2} > 3.05$, respike at the last calculated MDL and process the samples through the procedure starting with step 4.

(c) Use the Spooled as calculated in 7b to compute the final MDL according to the following equation:

MDL = 2.681 (Spooled)

where 2.681 is equal to $t(12, 1-\alpha = .99)$

(d) The 95% confidence limits for MDL derived in 7c are computed according to the following equations derived from percentiles of the chi squared over degrees of freedom distribution.

$MDL_{lcl} = 0.72\ MDL$
$MDL_{ucl} = 1.65\ MDL$

where LCL and UCL are the lower and upper 95% confidence limits respectively based on 14 aliquots.

Reporting

The analytical method used must be specifically identified by number or title and the MDL for each analyte expressed in the appropriate method reporting units, if the analytical method permits options which affect the method detection limit these conditions must be specified with the MDL value. The sample matrix used to determine the MDL must also be identified with the MDL value. Report the mean analyte level with the MDL if a laboratory standard or a sample that contained a known amount analyte was used for this determination, report the mean recovery, and indicate if the MDL determination was iterated.

If the level of the analyte in the sample matrix exceeds 10 times the MDL of the analyte in reagent water, do not report a value for the MDL

Reference

Glaser, J.A. Foerst, D.L. McKee, G.D. Quave, S.A. and Budde, W.L. "Trace Analysis for Wastewater, "Environmental Science and Technology, 15, 1426 (1981)

Table of Students' t Values at the 99 Percent Confidence Level

Number of Replicates	Degrees of Freedom (n-1)	$t_{(n-1,\,1-\alpha=.99)}$
7	6	3.143
8	7	2.998

Table of Students' t Values at the 99 Percent Confidence Level (Cont'd)

Number of Replicates	Degrees of Freedom (n-1)	$t_{(n-1,\ 1-\alpha=.99)}$
9	8	2.896
10	9	2.821
11	10	2.764
16	15	2.602
21	20	2.528
26	25	2.485
31	30	2.457
61	60	2.390
		2.326

5.1.4 Method Spikes

Method spikes will be carried out over 2 separate days at the specified levels including blanks and calibration standards. The data obtained at the 2x or 5x level (for each certified range) will be used to establish a mean and standard deviation for initial control charts. Once this data has been generated and approved by the analytical manager, the method has preliminary certification and is ready for application to real world samples. These control limits will be updated with every batch of samples until 30 numbers have been developed to establish reliable control limits. After 30 data points the DC will provide updated control limits with each additional 20 numbers.

5.2 Replacement Method Certification

When a new method is to be employed (where a new method is defined as including a new instrument method, i.e. flame vs flameless AA or Hall vs ECD), the method must be certified prior to its use on client samples.

Certification follows the procedures described in Sections 5.1. The results of these tests are important but are not necessarily compared to the current method. The detection limit may change and the work range may change but if they meet the needs of the lab, these changes are to be ignored. One may elect to utilize a t-test analysis to identify the method differences as being significant or not.

5.2.1 Comparison by the t-Test

One sample will be analyzed a minimum of 4 times by each method. The results will be subject to a t-test analyses. If the t-test indicates statistical correlation, regardless of the correlation coefficient, the new method is certified. If the t-test fails, refer to Section 5.2.2 below.

5.2.2 Decisions on Certification

The purpose of a new method is to improve accuracy, precision and efficiency. Efficiency is of no consequence if a method is imprecise and inaccurate, and therefore, is not a consideration in certifying new methods. However, a new method may fail the t-test because it is more accurate and/or more precise. Careful consideration and more analyses may be necessary with a new method by the analytical manager and supervisor.

6.0 ANALYST TRAINING AND CERTIFICATION

6.1 Rational

Consistent with requirements by the EPA and other regulatory agencies for analyst training and certification programs, EDI has a strict policy relative to the training and certification of analysts prior to their involvement in the analysis of client samples. The program is necessary in order to maintain continuity in all analytical programs and to insure the integrity of all data.

6.2 Training

The supervisor is responsible for training all new personnel. This training will be in conjunction with the group (workstation) and group leader if applicable. Training will include, but not be limited to, EDI QC requirements, paperwork flow, lab safety and organizational structure. In addition, the new analyst will be given copies of the QC manual, log-in manual and methodologies which the analyst will be required to read. Training in the methods to be used will be initiated prior to analyst certification.

6.3 Certification

Each new EDI analyst will be required to receive certification on all methods which he is to perform. Certification insures that the analyst can meet EDI detection limits and quality control limits as established for the method. Certification includes two parts, both of which must be completed satisfactorily.

6.3.1 Method Spikes

Analysis of spiked lab pure water at the levels of 0.5x, 1.0x, 2.0x, 5.0x and 10x where x is the established detection limit. This will include 2 blanks and a duplicated spike at 2.0x or 5.0x and will occur on 2 separate days. The data, where the duplicated

results are averaged. These results must match current EDI Schwart control chart limits. Additional parameters such as consistent instrument calibration curves will be evaluated.

6.3.2 Check Sample Analysis

The analyst will test a known blind check sample in duplicate including a blank. All the data must fall within established control limits for the parameters.

6.3.3 Current Analysts Training

The EDI analyst, who is assigned a new method, must complete the certification program for the methods as outlined above prior to performing analyses on client samples.

6.4 Recertification

All EDI analysts will recertify on all their respective methods when required or demonstrated by two method spike performance failures following the procedures set forth in Section 6.3.1. The results must meet previous data, assuming that the same methods are employed.

6.5 Performance Audits

The Analytical Manager, in cooperation with the Data Coordinator and Corporate QC Manager, will perform individual audits on all aspects of the operation biannually. These audits will include recertification data, control limits, all levels of records and laboratory performance on all check samples and instituted blind QC samples. A report of the audit results including recommendations will be forwarded to the President of EDI.

7.0 DOCUMENT CONTROL, FLOW AND STORAGE

7.1 Purpose

The paperwork trail must be designed to insure that after the issuance of a report, anyone - a client, a lawyer or the President of EDI - can track a single sample result back through EDI records to the origin of the standards used in calibration and the identity of the person who prepared the sample bottles.

7.2 Paperwork Flow

As shown in Figure 1, "Flow Diagram" the paperwork trail is eventually the same for routine work as it is for samples under Chain-of-Custody. The general axiom is that a COC procedure is doomed to failure without a pre-existing scheme of tight sample and analytical control available as a routine measure. This contention, however, is only of minimal consequence with respect to the need for detailed records. The records trail can provide the following:

- Answers to questions of analytical integrity for results which are 2 months or two years old.

- Assistance in finding and solving random and systematic problems.

- Assistance in preventing long term degradation of analytical integrity.

- Assistance in insuring continuity of analytical effort despite personnel and mechanical changes.

7.3 Document Requirements

The following subsection identifies all documents which are generated during the course of any project:

7.3.1 Project Sheets

Every sample or group of samples which enter the EDI facility must be accompanied by the appropriate project sheet which has been properly filled out and provided to the Sample Coordinator (SC). The SC may not log-in samples for which there are not project sheets or for which there the project sheet is incomplete. An example project sheet is attached as Figure 2.

7.3.2 New Project Approval Form

Projects which require testing or analyses not routinely provided at EDI must have prior approval on a "EDI Project Approval Form" and commitment from the Analytical Manager and the head of the appropriate analytical group(s). For the project manager's purpose, the approval forms insure that the analytical testing area has received notification and will be prepared. For the analytical managers purpose, proper notification has been received and sufficient time has been allotted for preparation and development. Projects requiring rush turn around on modified methods must be approved as well. An example of a New Project Approval Form is attached as Figure 3.

7.3.3 Problem Project Sheets

When the Sample Coordinator (SC) identifies a problem with a sample shipment or project sheet, a Problem Project Sheet will be initialed and sent to the project manager for resolution. See Figure 4.

7.3.4 Chain-of-Custody Forms

There are three forms for Chain-of-Custody samples. All three

forms must be properly completed and included in the project file for each and every COC project.

7.3.4.1 COC Shipping Record

The shipping record must be received in the shipping container with every COC shipment. The form attached as Figure 5 is identical to the form used by the EPA. This form will be used by EDI field samplers and returned with the samples. Other forms of a similar nature may be used by other clients. However, the information required on the EDI form must be present on any other client form or they run the risk of their COC being rejected as a continuous trackable COC event.

7.3.4.2 COC Project Log-in Form

This form, attached as FIgure 6, is to be used for the receipt of any COC shipment regardless of the origin of the shipping record. COC projects which have poor or nonexistent shipping records will be logged-in (with notification of the deficiency to the Project Manager) and this form will be completed. The form is completed by the Sample Coordinator and placed immediately in the COC Project File.

7.3.4.3 COC Sample Control Record

This form is used as a record of the movement of COC samples in and out of the COC locked storage. The analyst signs samples in and out each time a sample(s) is removed for any analysis. A copy of the form is attached as Figure 7. After all analyses are complete, the Sample Coordinator files the form in the COC project file.

7.3.5 Work Sheets/Project Sheets

Work sheets are the analytical assignment forms generated by the computer or the lab manager within 24 hours after log-in for each project or group of projects. The work sheets are divided into work stations, i.e. the analytes for which one or more analysts has sole responsibility. In many cases, the work sheets will have an entry position for the results of each analyses for each sample. In either case, the work sheet, upon completion of all analyses, will be turned into the appropriate supervisor with the proper bench sheets attached. Unless specifically advised, data will not be accepted on any form other than the project approval form sheets.

7.3.6 Bench Sheets

The analysis of every analyte or group of analytes needed, i.e. VOA's requires a specific bench sheet which includes all results from the analysis of a group of samples. There are specific bench sheets for each analyte including specific requirements for their use. Examples of each bench sheet, can be found in Figures 8, 9 and 10.

7.3.7 Lab Notebooks

The lab notebooks are the daily records of all activities of an analyst, or group of analysts, working in the lab. The notebooks will be bound and paginated. The notebook will be cleanly labeled on the inside cover with the date issued, the analyst's name, and the date completed. There are several specific rules which will be follows:

o All entries are in ink

o There are no erasures, obliterations, or white outs allowed

- o Corrections are single lined and initialed
- o A new page is started each day or with every batch of samples
- o Empty space is covered with a Z and signed and dated across the obtuse line
- o Any and all work, observations and errors are noted
- o Problem areas identified

When the instrument has just been repaired, a lamp changed, new column installed, detector repaired, or changed in any other manner, the log will also contain:

- o A comment relative to the change or repair
- o Reference page number to the Instrument Maintenance Log

The organic log books will also contain the following information relative to GC and GCMS oven and column conditions UNLESS they are exactly as specified in the referenced method which then will be commented on as such:

- o column used (packing, diameter, length, type)
- o capillary as split or splitless
- o current type and flow
- o make up flow if appropriate
- o oven temperature and program if appropriate
- o injector temperature

o detector temperature

o ion chamber voltage (GCMS)

7.3.9 Instrument Maintenance Log

The instrument maintenance log is a bound and paginated log which is used to track potential maintenance problems. The log is used every time the instrument is used but may contain several entries on one page. Entries on days where calibrations are correct may be as simple as "calibration met requirements". Anytime the instrument is repaired or modified in any way, the event must be noted with all specifics, including what was done, by whom, and why. A two detector GC has one log tracking, two detectors.

7.3.10 Oven, Refrigerator and Freezer Temperature Logs

Each oven, insulator or furnace, plus all cold storage devices, will have their temperatures checked and recorded daily, or at a minimum, 5 days a week. Each device will have a thermometer in place or a temperature recorder in-place which will be checked by the Data Coordinator. A bound log book with 31 entries will be used to record all entries for each device upon which the DC will record the date and temperature and will initial the entry. The DC will have an NBS thermometer which will move between devices to act as a QC check for the primary temperature device. The log will include the second temperature when measured monthly.

7.3.11 Balance Logs

An Area Analyst will check all balances in the laboratory every day (or at least 5 days a week) using NBS class S weights. The analyst

will record each day's reading in a log developed to handle every balance. A balance which fails to meet criteria will be removed from service until repaired. The DC will insure that every balance is serviced and calibrated annually recording such service in the log.

7.3.12 Standard Record Books

Every standard used in the laboratory must be labeled and the label will possess the following information:

- The analyte or analytes contained in the standard
- The concentration
- The solvent
- The preservative, i.e. nitric acid
- The date made
- The Standard Reference Number

The last item, Standard Reference Number, is the identified standard and dilution sequence no. taken from the Standard Record Book in which the standard solution data is recorded.

All standards (including dilutions) will be recorded in a Standard Record Book assigned to the work station. Two record books will be used, each of which has a different purpose. The record books are subtitled as follows:

7.3.12.1 Stock Standards Log

This book contains standards starting with the identification of the starting material. One standard and/or standard mix with it's corresponding dilutions are identified.

7.3.12.2 Working Standards Log

A working standard reference number is assigned and the corresponding dilutions are identified.

7.3.13 Control Charts

Each analytical method will require at least one control chart. Some tests may involve several control charts, i.e. duplicate, matrix spikes and method spikes. The QC coordinator will supply the limits to be used to the work station involved. Every data point generated with every analytical batch will be plotted on the chart. Every out-of-control data point will be noted and an action indicated as to the disposition of the data. Completed control charts will be turned in to the DC for permanent change.

7.3.14 Preliminary Reports

After all data has been entered for a project, the computer will flag a project ready for a preliminary report. The report will be identical to the final report in content except for the following:

- o Preliminary Report will be reviewed and corrected if necessary on each page in large type.

- o Comments necessary to the project will be printed under each sample or at the end of the report.

The DC will print the preliminary report and issue a copy along with the project file to the lab supervisor for review and corrections. The supervisor will sign off on the preliminary report after including comments, if appropriate, indicating that corrections are necessary. Afterwards, the supervisor(s) will pass the preliminary report to the QC Supervisor (QC) who will review and correct the report including a signature and comment. The QC will return the preliminary report and file to the DC. The DC will make all corrections as required and review report structure for completeness. If no corrections are required, the DC will sign and date the preliminary report and place it in the Project File. The DC will then print a Final Report. When corrections are necessary, the DC will execute all corrections and indicate such changes on the initial preliminary, which is then filed in the project file. A new preliminary is then printed and issued for review.

7.3.15 Final Report

After the preliminary report has been corrected and cleared all reviews, the DC will manually alter the computer flag and print a Final Report which will be placed in the project file folder and forwarded to the AM for approval. Space will be provided on the c.o.c. project file folder for the signatures of the Analytical Manager, the Corporate QC Manager and the Project Manager, all of whom are thus certifying that the report is complete, correct and defensible. The DC will then arrange for delivery of the final report.

7.3.16 Project Files

The Project File is the comprehensive record of every project completed at EDI. A project file initially consists of a file folder set up by the Lab Secretary (LC) at the time of log-in. Chain-of-Custody projects will be stored in a locked COC file with strict limited access while routine project files are stored in a separate nominally limited access file. The LS will be responsible for including the following in the project file:

- Project Sheets
- Project Approval Sheets (if applicable)
- Problem Project Sheets
- Chain-of-Custody Forms (3 each)
- All correspondence or documents received with the samples

The Lab Secretary (LS) will be responsible for the inclusion of the following:

- Preliminary Reports
- Separate Report Papers, i.e. Field Reports (if applicable)
- Final Report
- Any additional paperwork which may follow the report

All project files are stored for a period of 4 years.

8.0 INTRODUCTION

All samples received at the EDI Engineering and Sciences must be logged in before any work is performed on the samples. This procedural requirement is specific not only to the chemistry lab, but the micorbiological laboratory. The purpose of the log-in procedure, including sequential numbers assigned to all samples received in the facility, is to insure that EDI has a means by which samples can be tracked, data can be stored, and quality control can be tracked for any sequence of events during a particular analytical period. In handling projects in this manner, EDI, or the client, can insure a consistent and documented sequence of events under any analytical situation.

Management acknowledges that there are situations in which log-in of samples will be difficult due to rapid turn around requirements for particular compounds that may decompose or volatilize. An example of this kind of analysis is the total coliform samples which can be anticipated and for which holding times are short. The project approval form discussed within this manual will make it possible to preassign project numbers to samples arriving at the facility. Should a secondary mode of operation be necessary for the receipt of such samples, a mechanism will be developed between the sample coordinator and the Quality Assurance Supervisor. Any deviation from the standard log-in procedures detailed herein will be at the discretion of the laboratory supervisor or the laboratory manager. The execution of the log-in procedures for Chain-of-Custody samples (see Section 8.8) is extremely crucial. Samples, that have been designated for Chain-of-Custody by a client, possess the potential of involvement in litigation or other legal situations., i.e. standards development or patents. By breaking Chain-of-Custody requirements, all results are invalid for such purposes.

8.1 PROJECT INFORMATION

All information relative to a specific project must be recorded on a project approved form by the manager responsible for that project prior to

the receipt and log-in of samples. Projects, and therefore samples which are not routine to the EDI laboratory, must have prior approval via the New Project Approval Form before samples may be received.

8.2 NEW PROJECT APPROVAL

The project approval form include the following information:

* Client name, address, and client contact personnel
* Anticipated due date of the report (i.e. report in client hands by _____)
* Compound names or computer test codes or group computer test code
* Project and sample comments
* Contract number or purchase order for project
* Instructions relative to the proper completion of the project
* Pricing information relative to the proper completion of the project
* Chain-of-custody requirements
* Specific report requirements
* Additional requirements such as rush, hazardous, labile

8.3 NEW PROJECT APPROVAL

If a new project will require support from the analytical facilities, that project must be approved by the laboratory supervisors and the laboratory manager prior to project pricing and sample receipt. Routine samples are those samples and analyses which are continuously processed by EDI, such as priority pollutant samples, microbiological samples, and drinking water samples.

Projects which are non-routine are those that may require special testing, or which request parameters not routinely run within the laboratory, special holding times, or rush turn around. Non-routine projects will require that a New Project Approval Form be completed which includes the signatures of all the parties involved with the project. For example, if specific physical testing is necessary, the supervisor of the physical testing facility and the laboratory manager will have to sign off

on the form thereby agreeing, not only to the project content, but for the turn around, the report requirements, the detection limits and the quality control reports that may be necessary to properly carry out the project requirements. Projects and/or samples arriving at EDI which are non-routine in nature, and for which there is no signed Project Approval For,, will not be processed. In this case, the manager responsible for the non-routine project will be advised of the problem and will then explain to the client why the delay is necessary for the execution of testing before proceeding to obtain the necessary approvals. The Project Approval Form must be completed and signed by all parties prior to the start of log-in.

8.4 SAMPLE RECEIPT

8.4.1 Introduction

All samples will be received at the EDI facilities by the Sample Coordinator (SC). The job description for the Sample Coordinator is attached as Figure 11. It will be the responsibility of the SC to determine: a) whether or not the proper project sheet is available for the arriving samples; b) whether or not the samples require chain of custody; c) whether or not the samples are labile in nature and require immediate attention; d) the manner in which those samples will be split, preserved and stored or routed. It is the objective of the SC to insure that the receipt of all samples is consistent with the requirements of the EDI Manual and that all pertinent information relative to those samples is recorded. This information may be used in client reports, communicated to the laboratory or to the client and, in some cases, reported to a legal authority relative to Chain-of-Custody samples.

8.4.2 Examination of Shipping Container

Immediately upon receipt of a sample shipment at EDI, the SC will examine the shipping container (the container may be a box, a cooler, a styrofoam container, etc.) to ascertain and document the

condition of the samples and to process Chain-of-Custody papers, where appropriate. The SC will record the condition of the shipping container, the identification of the shipper, the presence or absence of any seals on the container (if it is Chain-of-Custody), and the labeling which may include special instructions prior to opening the container. If the shipping container is damaged, a report will be sent immediately to the shipper and the lab supervisor (see Section 8.15.2, Problem Project Sheet).

8.4.3 Carrier Sign Off for Chain-of-Custody Container

Should the SC identify the shipping container as being a Chain-of-Custody container, the SC will attempt to have the carrier's representative sign off on the Chain-of-Custody papers which should be available either on the outside of the shipping container, or immediately inside. An example of a Chain-of-Custody record is attached as Figure 5. In the event that the carrier's representative is unwilling to cooperate in this fashion, the SC will identify, in the proper position on the Chain-of-Custody document, the shipment number, the date of receipt, and sign off, attaching a copy of the shipping log for that particular container.

8.5 EXAMINATION OF CONTAINER CONTENTS

Unless the shipping container contents are marked "hazardous" the SC will proceed to open the sample container. If the SC had not previously identified the project sheet appropriate for these samples, the SC will attempt to ascertain immediately the origin of the samples found in this container and obtain the appropriate project sheet. If a project sheet is not found, the SC will lock up the samples and notify the lab manager as described in Section 2.0. The SC will identify whether or not all the samples have arrived intact, whether or not the labels are intact and attached properly, and whether or not the samples have leaked in any fashion. The SC will also identify any shipping instructions, field instructions, or any other materials that may be present in the shipping container.

8.5.1 Chain-of-Custody Shipments

Should the SC identify the shipping container as a Chain-of-Custody project, the SC will immediately follow the procedure outlined in Section 4.0, "Chain-of-Custody Samples".

8.6 PROJECT VERIFICATION

The sample coordinator, having opened the shipping container and examined all the samples, will verify that the project sheet matches the samples, the number of samples received is consistent with the project sheet, and that the requirements identified on the project sheet are consistent with any paperwork obtained which will include the project sheet and any other documents in the sample container. The project files will be kept by the SC in a locked filing cabinet. If all required project information is not complete, the SC will fill out a Problem Project Sheet (see Section 5.2) and turn it over to the Project Manager.

8.7 LABILE SAMPLE DISTRIBUTION

Should the SC identify labile samples within the shipping container, (i.e. coliforms or nitrites) for which there is a very short holding time and a need to rapidly move the samples into the laboratory, the SC will make every effort to immediately log-in those samples. Should log-in be delayed, the SC will coordinate with the responsible analytical group in order to move the samples into analysis. The coordinated effort will included means by which the SC can label the samples after log-in and insure that the results correlate with the proper samples. The SC will provide computer generated sample identification to the responsible analytical group. It will be the responsibility of the SC, once labile samples have been distributed to the laboratory to insure that those samples are properly logged in and that they are labeled with properly sequenced numbers. The agreement that is made between the SC and the appropriate laboratory manage or laboratory supervisor will be based on the premise that the SC understands that he/she is ultimately responsible and will be held accountable for any samples that are lost in such a

movement. Consequently, the SC will find the samples that are labile and apply the necessary labels.

If a shipping container is labeled "Hazardous", the SC will immediately notify the laboratory supervisor who will determine the extent of hazard and/or the manner in which the samples will be handled. The supervisor will involve the laboratory manager as needed in resolving questions of hazardous samples.

Figure 11

POSITION DESCRIPTION FOR SAMPLE COORDINATOR

General

The Sample Coordinator (SC) is responsible for the receipt, log-in, and storage of all client samples at EDI. The SC is responsible for the receipt, storage and custody of all Chain-of-Custody (COC) samples including distribution of COC samples to lab personnel per EDI COC procedures (section 4.0, EDI Log-in Procedure). In order to ensure the successful analyses of samples, it is critical that the SC obtain and communicate to Project Manager, lab supervisors, and lab personnel, all information necessary for the processing interpretation and reporting of all samples analyzed.

Qualifications

High School Diploma and a minimum of 2 years of college or equivalent. A knowledge of chemistry and testing procedures helpful. Excellent verbal, written and organization skills, including a propensity for detail necessary for successful completion of job.

Reporting Relationships

The SC will report to the laboratory manager. The SC will communicate closely with the Director and Project Managers to obtain project information.

Specific Responsibilities

The SC's duties and responsibilities shall include, but not be limited to:

1. Sample receipt.
2. Insuring that COC sample receipt includes shipper's signature on COC forms.
3. Inspection of sample shipping containers for presence/absence and condition of:
   a) custody seals, locks, "evidence tape", etc.
   b) container breakage and/or container integrity
4. Recording conditions of both shipping containers and sample containers (bottles, jars, cans, etc.) in appropriate logbooks or on appropriate forms.
5. Signing appropriate documents shipped with samples (i.e., Chain-of-Custody record(s).
6. Verifying and recording agreement or non-agreement of information on sample documents (i.e., separate tags, Chain-of-Custody records, traffic reports, airbills, etc.) on appropriate forms and on the EDI project sheet.
7. Initiating the sample and project log-in procedures on appropriate laboratory documents and according to the EDI Log-in Procedures document, including the initiation of project files with sample control records.
8. Marking or labeling samples with laboratory sample numbers, as appropriate.
9. Placing samples and spent samples into appropriate storage and/or secure areas.
10. Controlling access to samples in storage and assuring that laboratory operating procedures are followed when samples are removed from and returned to storage.
11. Monitoring storage conditions for proper sample preservation such as refrigeration temperature and prevention of cross-contamination.
12. Returning shipping containers to the proper client or licensed disposal facility.

13. Providing for the splitting of samples into required alequots, including preservation for each working station.

8.8 CHAIN-OF-CUSTODY SAMPLES

8.8.1 Continuance of Log-In Procedures for Chain-of-Custody Samples

All samples in the possession of EDI under Chain-of-Custody (COC) procedures must be traceable from the time the samples are received at the EDI door (or collected by EDI staff) until results are reported and sample disposition has been determined from the client. For any samples that may be collected during enforcement investigations, under litigatory requirements, or evidentiary in nature, Chain-of-Custody procedures are required.

8.8.2 Examination of Container Contents

Although Section 8.4.2 under Sample Receipt discusses the thorough examination of container contents, the proper examination of a container which is involved in a Chain-of-Custody procedure is even more important. For example, should the sample labels be mismarked or a particular sample to somewhat strange in nature, it is necessary to note all observations and deviations from the project sheet. It is better to be overly observant than to allow possible anomalies to go unnoticed. It is the SC's responsibility to examine whether or not each of the sample containers are individually sealed, whether those seals are intact, whether a sampler's initials are on the seals, and whether or not the paperwork matches the contents of the package. In addition, the SC must note whether or not all the dates and times are consistent, and whether or not the sample description on the paper work matches the description on the sample container.

8.9 PROJECT VERIFICATION

In the same manner in which the examination of the container contents is critical to a COC project, the verification of the project is equally important. These project verification steps include not only the need to follow the requirements identified in Section 8.6, but also thorough examination of all aspects of the project and the consistency of all the paper work involved with those particular samples in that shipping container. It is also important that the SC place in the COC project file: the shipping document; a signed Chain-of-Custody document including the sign off from the shipper's representative (See Section 8.4.3); a copy of the project sheet; a copy of the Project Approval Form is appropriate; a copy of the filed sampling report if appropriate; and originals of all paperwork received for the project. The COC project file is kept in locked storage in the possession of the SC.

8.10 CHAIN-OF-CUSTODY LOG-IN

The log-in procedure identified in section 8.15 titled "Log-in", is followed in the same manner for Chain-of-Custody samples with a few modifications. Those areas which are changed are addressed in the following sections:

- -SAMPLE STORAGE
- -PROJECT FILES
- -LABORATORY ACCESS
- -DATA STORAGE

8.11 CHAIN-OF-CUSTODY SAMPLE STORAGE

All samples received under Chain-of-Custody procedures will be kept under locked storage and will be distributed for analysis to the laboratory only when the analyst has signed for the samples on the form shown in Figure 7. The SC or a designated representative will provide access to COC storage. Records of movement of all COC samples within the lab facility must be recorded.

8.12 CHAIN-OF-CUSTODY PROJECT FILES

All Chain-of-Custody project files will be kept in a project folder in a locked cabinet with all related documents and paperwork relative to those files.

8.13 MAINTENANCE OF LAB CUSTODY

Laboratory custody must be consistent with all the Chain-of-Custody requirements from the beginning of sampling to the final report. To this end, every analyst requiring access to the Chain-of-Custody samples will go to the SC for access to the COC locked sample storage. The SC will insure that the analyst signs for the receipt of all COC samples on the form shown in Figure 7 and that the analyst returns and signs in those same samples on the same day for which they were signed out. This documentation, after the completion of all analyses, will be placed in the locked Chain-of-Custody project file by the SC.

8.13.1 Sample Custodian

The COC sample custodian at EDI will be designated as the Sample Coordinator (SC). The SC is responsible for following the COC requirements outlined in these procedures for all samples received at EDI.

8.13.2 Lab Custodial Responsibilities

It will be the responsibility of every analyst signing for a Chain-of-Custody sample or samples to insure that; a) these samples are kept in a minimum access facility; b) they are within their possession during the particular period during which they are being analyzed; and c) the analyst returns those samples to the Chain-of-Custody lock-up in the manner prescribed. The analyst will sign out and return the samples to COC lock-up on the same day. The analyst will be using the SC as the sample custodian for all COC samples. Due to the legal implications for the client of breaking the COC procedures and possibility of legal action that could be

taken against EDI, errors in the execution of Chain-of-Custody procedures will not be tolerated.

8.14 CHAIN-OF-CUSTODY SAMPLE DISPOSAL

All samples received for COC procedures will be stored in the EDI COC lock-up facilities until a final report is issued. It will be the responsibility of the Project Manager, in cooperation with the SC, to obtain information from the client relative to the length of time the COC samples will be stored. It is anticipated that for long term storage, i.e. more than 30 days, the client will reimburse EDI an appropriate rate for keeping completed samples under Chain-of-Custody procedures. No Chain-of-Custody samples may be discarded until written permission is received from the client relative to disposal of those samples.

8.15 LOG-IN

8.15.1 Introduction

After the Sc has inspected the shipping containers, the project sheets, the samples and any documentation required in Sections 8.4 and 8.8, the SC will insure that all pertinent information is entered on the project sheet. There are specific areas of the project sheet that are to be completed by the SC, i.e., date and time received. The EDI project sheet is included as Figure 2.

Minimum information required for log-in include:

* Client's name and Client contact, as well as client #, is assigned.
* The due date
* The analytical test or test codes or group tests
* Specific project comments
* Contract requirements
* Contract number

* Pricing if necessary
* The approval for for non-routine projects
* Chain-of-Custody, if required
* Specific report requirements

8.15.2 Project Problems

If any of the information identified in sub-section 8.15.1 is missing, the SC will immediately notify the Project Manager, via a Problem Project Sheet, (Figure 4) of the discrepancy. The Project Manager will make all reasonable efforts to insure that the answers are provided to the SC immediately.

Simple Project Sheet deficiencies such as client number, extra comments, or the contract number, should not prevent log-in. The SC will proceed with log-in addressing the unknowns as subjects that must be changed or modified once the information is received. It is the responsibility of the SC to log-in all samples as received at EDI whenever possible.

8.15.3 Samples on Hold

When there is a considerable amount of inadequate information on a project sheet, i.e. a missing test, or broken samples, the entire project will be placed on hold until the information is available or the corrective actions have been taken to insure that NSF is not held responsible for a poorly handled project. The SC will notify the Project Manager via a Problem Project Sheet as to the hold status of the project and the reasons for the hold. The Project Manager will make every attempt to quickly identify the necessary actions that will be taken for those samples or the remaining samples for that project. The Project Manager may approve log-in of the remaining samples for a portion of the project in order to insure that the project progresses. Projects that are placed on hold will be locked in a "project hold" area, (like the Chain-of-Custody sample storage area) so that those samples are not lost or confused within the system. The SC will insure that those

samples are retrieved and logged in as soon as the appropriate changes have been made and the samples are freed for log-in.

8.15.4 Handling Labile Samples

All samples received by the SC that are labile in nature, i.e. coliforms, need to be logged into the facility in a very rapid fashion in order that they may e attended to within the analytical holding time. The most labile of all samples are the microbiological samples, which must be forwarded to the micro lab as soon as possible. The SC and the Project Managers responsible for micro work will attempt to insure that appropriate information is available to the SC in order that the SC can assign numbers for all labile samples. These numbers can be assigned in advance and samples may be logged into the system as soon as they are received. Samples such as nitrites, which are labile but have a somewhat longer holding time, will usually be logged into the system like normal samples. However, slow shipment or other problems may require the lab to initiate the analyses immediately. In such a case, assuming a project sheet was initiated in advance o sample receipt, the SC can assign laboratory in an expedient fashion. The SC will make all efforts to insure that samples move through the laboratory in a timely fashion when holding times are of utmost importance to the proper completion of the analytical requirements.

8.16 COMPUTER LOG-IN

It is anticipated that all samples received at EDI will be logged on to the computer by the SC. The computer assigns a sequential number to every sample. Additional codes such as the month and the year of the samples may be added in front of the sequential number for continuous identification of these samples. The SC will have the computer generate these sequential numbers for each sample in every project. A project identifier will be printed on the labels which are attached to every sample and every aliquot of a sample.

8.17 SAMPLE SPLITTING FOR THE CHEMICAL LABORATORY

The EDI Project Manager will attempt to insure that all samples received at the EDI facility are received in the appropriate containers with the correct preservatives (Samples which must be split at log-in are subject to added error). The labels and the appropriate preservatives are identified in the EDI Quality Control Manual and attached as a supplement to this section in Appendix I.

8.17.1 Bottles and Preservative Requirements

The EDI analytical facility has a series of bottle and preservative requirements that must be met before the log-in of samples into the laboratory. In the event that EDI is unable to provide sample bottles, or circumstances prevent the splitting of samples in the field, the SC will provide sample splitting services. These services will include taking the sample as received and subsampling it into the appropriate bottle and preservative requirements as set forward on the attached list of bottle and preservative requirements.

8.17.2 Inorganic Samples

The SC will insure that sufficient sample volume is available before initiating the splitting of a sample. If uncertain, the SC will involve the inorganic lab lead in order to insure that all areas of the lab have sufficient samples. In the event that sufficient samples does not exist, the SC will identify the sample as a problem and will notify the Project Manager immediately for resolution. The sample will be logged in only after a resolution has been reached.

8.17.3 Organic Analysis

When a bulk sample arrives for organic/inorganic analysis and sufficient sample exists, the SC will transfer the sample to the

organic preparation supervisor who will split the organic aliquots and return all aliquots to the SC. The remaining sample will then be returned to the SC who will split off the inorganic aliquots into the proper preserved containers.

8.17.4 Solid Samples Splitting

When solid samples, such as sediment or soil, are to be received at EDI, every attempt will be made by the Project Manager and field sampling personnel to insure that two samples are provided as replicates for the appropriate tests. One of these samples will be assigned to the organic facility; the other will be assigned to the inorganics facility. If only one sample is received and if organic analyses are required, the organics preparation chemist will be responsible for the initial splitting of the sample. Solid samples will be made homogenious by either one or all of the following manners:

* Stirring especially when volatile organic analytes are required
* Air Drying and Grinding
* Particle separation (Sieving)
* Quartering by ASTM Procedures

The lead organic chemist and the SC are responsible for the decisions on how a solid sample will be split. Problems or concerns which may arise on a solid sample will be addressed to the Project Manager and the laboratory manager for resolution. After the organic portions have been removed or split, the remaining sample will be provided to the inorganic facilities for any further splitting they deem necessary.

8.18 SAMPLE LABELING

All samples received at the EDI facility will be labeled by the SC at the time of log-in. These labels will include information such as the requested sample number, the client number if supplied, the contract, the

EDI project number, and/or the client. It is anticipated that sequential sample labels will be provided by the computer after the SC has logged the project into the computer.

8.19 DISTRIBUTION AND STORAGE

Logged samples will be taken by the SC to the appropriate walk-in cooler for cold storage or to the room temperature storage area indicated for metals.

COC samples are stored as set forth in Section 4.0.

8.20 PROJECT FILES

8.20.1 Routine Project Files

The SC will obtain a manila folder and label that manila folder with the name and number of the project. The folder will indicate the EDI project number, the EDI contract number, and Chain-of-Custody if applicable. With the agreement of the laboratory supervisor (lead), the project manager, and the laboratory manager, a particular project folder may include a series of projects logged in under sequential numbers. An example would be a daily log-in for the same project for a week or month before a new project folder is generated. It is, however, the responsibility of the SC to insure that all logged projects are filled in a project file folder.

8.20.2 Chain-of-Custody File Folder

The SC, upon logging in any Chain-of-Custody project, will provide the same type of manila folder project file, as discussed in Section 5.7.1, for each project. However, the project folder will be maintained in the locked Chain-of-Custody file and cabinet and will be kept by the sample coordinator.

8.21 SAMPLE STORAGE

8.21.2 Non Chain-of-Custody Storage

The SC, after completing all the log-in processes of various samples connected with a particular project, will store the samples in the designated areas in the EDI laboratory.

* Routine Water and Solid Samples: Samples which need to be refrigerated will be stored in the walk in facility designated for all routine water and soil samples.

* Routine Volatile Water and Solid Samples: All these samples will be placed in the designated VOA refrigerator located within the analytical facility. No other samples or standards may be stored in the VOA refrigerator.

* Routine Water and Solid Samples for Metal Parameters: The preserved water samples and solid samples, which are not preserved, may be stored on shelves designated for the metals analysis.

* Odoriforous and Hazardous Samples: These samples will be stored in a hooded facility within the laboratory which is designated for odoriforous and hazardous samples. These samples will be identified to the lab personnel and noted on the log-in procedures in order to insure that the lab personnel are aware of the problems with these samples.

8.22 CHAIN-OF-CUSTODY SAMPLE STORAGE

All samples that are involved as physical evidence in a legal procedure or simply identified as Chain-of-Custody will be handled under certain procedural safeguards. These safeguards have been tentatively identified in section 4.0 but for purposes or reiteration are again addressed below:

NOTE: For any legal proceedings, the court must be shown that the laboratory is a secured area, that all samples have been stored in a secured fashion, and samples can be accounted for at all times.

8.22.1 Chain-of-Custody Water and Solid Samples

All samples of this nature will be stored within the locked cabinets in the designated walk-in cooler for routine samples. Keyed access is available only through the SC.

All samples received for metals analysis under Chain-of-Custody procedures, whether they be liquid or solids(s), will be stored in a locked cabinet which does not need to be in the walk-in facility. Such a cabinet will be designated and placed by the inorganic lab supervisor.

8.22.2 Water and Soil Samples for Metals

8.23 GENERAL LAB SECURITY

Access to the EDI lab will be handled in a secured fashion restricting entrance only to those people designated as having access to the laboratory facilities. Restricted access applies to all areas in which samples are stored or analysis takes place. It will be the responsibility of all the analysts, as well as the supervisors and the SC, to insure that the safeguards employed, including locked doors and limited access, are followed and maintained at all times.

9.0 DATA HANDLING, REPORTING, RECORDKEEPING AND VALIDATION

There are two significant aspects of any analytical procedure:

A. The selection and use of a method appropriate for the analyte and matrix
B. The collection, control and interpretation of the data generated.

Encompassing these two components is the Quality Assurance program. The QA program provides means by which method selection can be validated, the method can be controlled and the appropriate data generated, displayed and reduced.

The following sections deal with error, data handling, data validation, data reporting and data recordkeeping.

9.1 ERROR: IT'S NATURE AND SIMPLE STATISTICAL CONCEPTS

9.1.1 Random Errors

Repeated analysis of identical aliquots of a homogeneous sample does not give a series of equivalent results. The results will differ among themselves and they will be more or less scattered about some value. The scatter can be attributed to random error, so named because the prediction of the sign or magnitude of the error of any particular result is not possible at the time of analysis.

One therefore, says that each result must have an uncertainty attached to it, and can be regarded only as an estimate of the true value. Generally that estimate will differ from the true value. Random errors are caused by uncontrolled and/or uncontrollable random variations in factors which affect analytical results, i.e.

variations in the volumes of the reagents added, variations in the concentrations of reagents, variations in the time allotted for the chemical analysis, a contaminated glassware, poor quality reagents, instrumental fluctuations. Among the various texts that are available discussing errors, the terms repeatabiilty, reproducibility and precision have been used to denote the scatter of results. The term "precision" will be used throughout this manual and is the most common term used for random error in this country and especially by the EPA.

Precision does improve as the scatter among results becomes smaller. All analytical results have random error present which necessitates statistical techniques to evaluate the results and to provide correct inferences of the true value of the result.

9.2 SYSTEMATIC ERRORS

Systematic errors are indicated by the tendency of results to be greater or smaller than, the true value. It is necessary to take care in exactly defining systematic error because the analysis is also subject to random error. The mean of n analytical results on the same sample approaches a definite value u as the number of results increases indefinitely. When u differs from the true value Tau results are said to be subject to systematic error of the magnitude B, wherein B is equal u minus Tau. Bias is the term used synonymously with systematic error and will be used in that fashion throughout this manual. Analytical methods, which are subject to interferences from substances present in the sample, or methods that only recover a fraction of the material present are an example of systematic error.

It is impractical to make an indefinitely large number of analysis on a single sample in order to determine the true value of u is known. At the same time a practically obtained value for a sample that is based on minimal analysis is subject to random error, so that the experimental estimates of bias will also be subject to random error. Therefore, statistical techniques are also required when bias is to be estimated.

The basic difference between random and systematic error is that, in principal, the latter may be predicted so that a correction can be made to eliminate its effect. An example of this allowance can be accounted for in the effect of flouride in the determination of aluminum by absorbance measurements. This effect is overcome by adding to the calibration standards an amount of flouride equal to the flouride content of the sample. The added fluoride in the calibration standards then eliminates the systematic error of fluoride interference. However, it must be recognized that the complete elimination of systematic error may require such detailed knowledge of the properties of the sample that the correction of the analytical system is impractical and would in fact increase the amount of random error. Thus, in all applications where unbiased results are necessary, the approach to be used is to devise and use analytical systems capable of giving results which have negligible systematic error.

9.3 TOTAL ERROR

Some analysts use the term accuracy to denote only systematic error. The term accuracy as applied in this manual will denote total error of the results. In other words, accuracy represents the combined systematic and random error of the results and, therefore, the accuracy of an analysis improves as the total error becomes smaller. For the purposes of visually seeing random and systematic error, Figure 6-1 should be referred to for any easy identification of the various types of error.

9.4 STATISTICAL TECHNIQUES

Statistical techniques are essential to the measurement of analytical error. This manual and this section recognize that many analysts have had little experience with statistical technique. This section is, therefore, written in such a way as to explain simple but basic concepts of the statistical approach and to describe the particular techniques most commonly required in dealing with analytical errors. There are a large number of text books dealing with statistics and this particular section does not attempt to replace these books. The intention is merely to

present the essential aspects in the simplest manner possible. Certain approximations have been used when considered appropriate and no previous knowledge of statistics has been assumed. Should the analyst be interested in consulting additional texts for a more rigorous and detailed treatment of the subject, he is referred to the references at the end of section 9.0.

Analysts who are unfamiliar with statistical approach, may find this section on first glance rather complicated. In order to understand statistics for the QC function, it is important not to be put off by the first impression.

The fundamental statistical concepts are essentially simple and equivalent to the intuitive common sense, or perhaps scientific approach, adopted by any good analyst.

9.4.1 Random Error Distribution

If the results from the analysis of numerous aliquots of a homogeneous sample are plotted on a histogram, it is generally found that the proportion of the results deviating from the mean increased, i.e., as the deviation of the results from the mean grows broader. In other words, the probability of obtaining a random error of a given size decreases as the size of the error increases. The basis of statistical techniques is to quantitatively estimate the probabilities of errors of different sizes so that one can deduce the probable random error of a particular analytical result. If the analyst were to increase the number of analysis of a single sample indefinitely, and the size of the intervals used for plotting the histogram were decreased, the latter would tend to smooth the curve. This limiting curve is the frequency distribution of results and defines a relationship between the magnitude of the result and the probability of obtaining such a value. Throughout this manual, it will be assumed that the analytical results follow the normal distribution which is defined by the following equation:

$$p(x) = \mu \pm \sigma$$

Where: μ = the mean of all the conceptionally infinite number of results.

σ = the standard deviation of results

p(x) = the probability density which is interpreted by noting that the probability of obtaining a result between the values a & b is the area of the curve between those values.

and this interval can be evaluated given the equation for P(X).

The peak of this distribution curve occurs at x=u, the theoretically perfect mean established by an infinite number of results. The width (which is indicated by the scatter results) is determined solely by the standard deviation of the test. For example, 95% of the area under the curve, i.e. 95% of all results, is enclosed within the limits plus or minus 1.96. Such properties allow limits for the uncertainty of an individual analytical result to be calculated. Taking the current discussion, for example, on no more than 5 occasions in one hundred will the result differ from the mean u be more than 1.96. Thus, an analyst may attach to a result limits that define the range in which the true mean is expected to lie. The statement, R-1.96 is less than u which is less the R+1.96, is an accurate statement on 95% of all occasions. "R" in this particular case would stand for the result. By referring to texts on statistics, there are statistical tables which included a tabulation of areas enclosed between specific limits as an analyst might want to define them. It should be noted that the distribution is always symmetrical about the mean. In other words, if one is using the 1.96 levels 5% of the results will be outside of the range of u +/- 1.96, but only 2.5% of all results will exceed u + 1.96 and 2.5% of the results will be less than u - 1.96.

Focusing this into a discussion more pertinent to the laboratory and, perhaps more viable with respect to occurrences within the laboratory, let us discuss the rare exception in which an analyst is taking 20 tests on a particular sample using the 1.96 level. Considering that 5% of the results will lie outside that level, the analyst has 1 chance in 20 of missing the true value outside the stated confidence range. At the same time one can decrease this chance by increasing the allowable range. For instance, if the range is R =/- 2.58 the results will be included on 99% of the occasions or 99% of the tests. However, by increasing the confidence limit, one is also increasing the uncertainty in the true value. In this case, uncertainty can be decreased by taking the mean of several analytical results or by decreasing the value.

These statistical concepts allow valuable quantification of the random error of an analytical result and emphasize that decisions, based on the significance of the result, have some risk of being wrong. Knowledge of the standard deviation, of the results is, therefore, vital in reaching objective decisions. Use of the standard deviation will be explained in the following sections dealing with data handling and validation.

9.4.2 Data Handling, Reporting, Recordkeeping

A flow diagram, Figure 1, delineates the original and procedural steps in data generation.

The initiation of an analysis starts with the completion of a project approval form. The information is computer entered. The computer entry internally creates a report form and inventories the analysis by parameter or compound. The computer entry function of all analytical work requests is a shared responsibility of the sample coordinator and data coordinator. A copy of the analysis request form is manually inserted into a three ring binder notebook

for laboratory reference use. The maintenance of the laboratory job reference notebook is a responsibility of the sample coordinator. The group leader/supervisors requests from the data coordinator (D.C.), the computer generated analytical bench sheets for a given parameter each morning or the prior day. The samples and parameters testing sequence is dictated by a weekly work schedule. The weekly work schedule is developed manually each week by the group leaders/area supervisors and approved each week by the laboratory manager. The schedule is developed from a computer printout that inventories and ages by project job or parameter. Contractual due dates and sample holding times are the compliance criteria by which all schedules are judged.

The bench sheets examples are shown in Figure 8, 9, 10,. The bench sheets identify to an analyst the proper samples to analyze that day. The analyst lab notebook and the bench sheets constitute the two raw data reporting locations. The content of the laboratory notebook is defined in an earlier section, 7.3.7. The analyst completes the benchsheet information, attaches a drawn calibration curve and follows the analytical sample sequence identified in section 10.0. The analyst identifies which sample(s) were utilized for precision and accuracy determinations. The analyst will assess the data set as being in control or not. The assessment will be described in the data validation section to follow. The analyst will submit to respective group leaders or supervisors all of the abovementioned data and a written statement that the data set is in control for their review. An approved data set is signed off and the group leaders/supervisors transfer the approved data to all appropriate worksheets in the laboratory job reference notebook. The bench sheets and calibration curves are permanently stored. The last entry into the worksheet constitutes a completed project subject to computer generation of a preliminary report. The group leader/supervisors provide the DC with the approved worksheets for computer entry and preliminary report generation. The remaining activities related to preliminary report, final report generation and review and project filing are identified in this manual under sections 7.3.14, 7.3.15 and 7.3.16 respectively.

9.5 DATA VALIDATION

The data validation process includes a set of computerized and manual checks at various appropriate levels of the measurement process.

The data validation process starts with the laboratory analyst. The analyst verify in their lab notebook that all method specific operational parameters are utilized or met. This information is specifically documented in all instrument logbooks. The analyst then verifies that the calibration of the equipment is linear and documents this in the instrument logbooks. If the operating parameters of a particular method are modified, it should be written in the analyst lab notebook and approved via signature by the group leader/supervisor in the lab notebook. A non-calibrated system must be identified by the analyst and corrections made to achieve calibration prior to sample analysis.

The generation of sample data by an analyst will include the generation of quality control data for each sample set. The monitoring of method blanks, sample spikes, method spikes and sample duplicate analysis is accomplished by the utilization of Schwart Quality Control Charts. All quality control data is entered on the precision and accuracy data summary form, Figure 11a. The analyst computes the data precision and accuracy and compares the computed value to the acceptance intervals identifies on the form for that parameter, method, and matrix. The computed value will be determined in control if it lies within the acceptance interval. If the computed value is deemed out-of-control the data set is not submitted for supervisor approval but is brought immediately to the attention of the supervisor and quality assurance officer that an out-of-control condition exists. Jointly, a review is conducted to determine the cause(s) and conduct corrective action. The data set is rerun once the corrective actions have taken place and the new data reviewed as stated above.

The DC receives all the completed precision and accuracy data summary forms and enters the data into the laboratory quality control computer system. The system produces summary reports each day of all quality control data generated for review by the quality assurance officer. The

computer system also generates all Schwart Control Charts for method blanks, method spikes, sample duplicates and sample spikes. The charts are permanently maintained and reviewed each week by the group leader/-supervisor and the quality assurance officer. The weekly generated charts provide an accurate review of all recently (last 30) qc data points and allows the monitoring of data trends or other anomalies to the system.

10.0 GENERAL QUALITY CONTROL PRACTICES

The Quality Assurance/Quality Control practices at EDI are based on several of the following government guidelines:

- o "Handbook for Analytical Quality Control in Water and Wastewater Laboratories" EPA 600/4-79-019, March 3, 1979

- o The Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act (Federal Register, Dec. 3, 1979, updated on October 26, 1984.)

- o Manual of Analytical Methods for the Analysis of Pesticides in Humans and Environmental Samples" EPA 600/8-80-038 June 1980.

- o ASTM

The quality control procedures used during analysis are described below and do conform with sample control and document control requirements described for the EPA Contract Lab Program (CLP). The specific sample and document control practices employed at EDI may be found in the appropriate sections of this manual identified as Sample Control (section 8.0) and Document Control (section 7.0).

The procedures described here will deal with the analytical quality control techniques. The quality control checks routinely performed during sample analysis include method blank analysis to identify potential method interferences, reagent blank analysis to establish analyte levels, duplicate analysis to establish analytical precision, spiked and blank analysis to determine analytical accuracy. The frequency of these quality assurance checks are defined in the EPA CLP and result in the following analytical run sequence:

Method Blank
Reagent Blank
Standard

Sample #1
#2
#3
#4
#5
#6

Spiked Blank
Sample #7
#8
#9
#10

Sample Duplicate #10
Sample #11
Sample Spiked #11
Sample #12

Any high level concentrations of analyte will be followed by a method blank. The exact analytical sequence is left to the discretion of the analyst.

10.1 The level of laboratory quality assurance effort for routine analytical services (RAS) provided by EDI is specified in Table 1. The quality assurance level of effort for the Contract Lab Program (CLP) is specified in the protocol document and will be complied with.

10.2 ACCURACY, PRECISION AND SENSITIVITY OF ANALYSES

The fundamental QA objective with impacting accuracy, precision and sensitivity of laboratory analytical data is to achieve the QC acceptance criteria of the analytical protocols. The accuracy and precision requirements for routine analytical services (RAS) for organic and inorganics are shown in Tables 2 and 3, respectively. These QC control limits should be completely met without any outliers.

These limits are three (3) standard deviations from the mean and reflect control limit criteria established and utilized on Schwart Control Charts for precision and accuracy.

The standard operating procedures that would lead to an outlier being identified and the resulting corrective actions is described in section 9.0, Data Reporting, Validation and Handling. In general, if an out-of-control result occurs the analyst will identify it as such and report the occurence to the Group Leader and/or Area Supervisor. The Group Leader and/or Area Supervisor will review the data with the analyst to identify the problem, implement a corrective action(s) and then re-analyze the sample(s). The Group Leader and/or Area Supervisor will report the out-of-control occurence to the Quality Assurance Officer that day in writing. The corrective action(s) will be identified in the analyst notebook and in writing to the QA Supervisor. The QA Supervisor will review the Schwart Chart later that day or the next day to identify a successful corrective action via a new in-control data point for the same data set. The sensitivities required for RAS analyses are the method detection limits shown in Tables 4 and 5.

The accuracy and precision requirements for Chain-of-Custody (C.O.C.) samples from the CLP-HSL are specified in the protocols. The sensitivities required for Hazardous Substance List (HSL) analysis of organic compounds will be the EDI operational detection limits, shown in Table 6. Table 7 indicates HSL analyses for inorganic compounds as identified in the CLP. The sensitivity for these compounds is based upon the EDI operational detection limits as shown on the table.

TABLE 1

QA LEVEL OF EFFORT FOR ROUTINE ANALYTICAL SERVICES

PARAMETER	METHOD BLANKS	SPIKES OR SURROGATES	LAB DUPLICATES	REFERENCE SAMPLES
Base/Neutral/Acid Compounds	One per set of samples or a minimum of 1 in 10	Surrogates added to each sample and matrix/method spikes added to one sample per set	A minimum of 1 in 15	Quarterly
Volatiles	One per day or 8-hour shift	Surrogates added to each sample and matrix/method spikes added to one sample per set	A minimum of 1 in 15	Quarterly
Pesticides & PCBs	One per set of samples or a minimum of 1 in 10	Matrix/method spike per set of samples or a minimum of 1 in 10	A minimum of 1 in 10	Quarterly
Metals	One per 10 samples or each set	One matrix spike per 10 samples; one method spike per set	One per 10 samples	Quarterly
Cyanide	One per analytical run or at least one per day	One matrix spike per 10 samples; one method spike per set	One per analytical run or at least one per set-up	Quarterly
Alkalinity	One per set of samples	NA	One per set of samples or at least one per 10 samples	Quarterly
Chloride	One per set of samples	One matrix spike per 10 samples; one method spike per set	One per set of samples	Quarterly
Fluoride	One per set of samples	One matrix spike per 10 samples; one method spike per set	One per set of samples or at least one per 10 samples	Quarterly
Sulfate	One per set of samples	One matrix spike per 10 samples; one method spike per set	One per set of samples or at least one per 10 samples	Quarterly
Ammonia Nitrogen	One per set of samples	One matrix spike per 10 samples; one method spike per set	One per set of samples or at least one per 10 samples	Quarterly

Table 1 (Continued)

QA LEVEL OF EFFORT FOR ROUTINE ANALYTICAL SERVICES

PARAMETER	METHOD BLANKS	SPIKES OR SURROGATES	LAB DUPLICATES	REFERENCES SAMPLES
TKN	One per set of samples	One matrix spike per 10 samples; one method spike per set	One per set of samples or at least one per 10 samples	Quarterly
Nitrate and Nitrite	One per set of samples	One matrix spike per 10 samples; one method spike per set	One per set of samples or at least one per 10 samples	Quarterly
TOC	One per set of samples	One matrix spike per 10 samples; one method spike per set	One per set of samples or at least one per 10 samples	Quarterly
Total Phosphorus	One per set of samples	One matrix spike per 10 samples; one method spike per set	One per set of samples or at least one per 10 samples	Quarterly

TABLE 2

ACCURACY AND PRECISION CRITERIA FOR ORGANICS FROM RAS

PARAMETER	AUDIT	COMPOUNDS	CONTROL LIMITS
Volatiles	Method Blank	---	d.l.
	Matrix Spike Duplicate Precision	---	<17% RPD (95% CI)
	Surrogate Spike Recovery	D_4-1,2-dichloroethane	70-115%
		D_6-benzene	70-115%
		Dioethylbenzene	70-115%
	Method Spike Recovery	benzene	37-151%
		1,2-dichloroethane	49-155%
		1,1,1-trichloroethane	52-162%
		trans-1,2-dichloroethane	49-155%
		trans-1,2-dichloropropene	17-183%
		cis-1,2-dichloropropoene	0-227%
		ethyl benzene	37-162%
		toluene	47-162%
		1,1,2,2-tetrachloroethane	46-157%
		bromoform	45-170%
Pesticides & PCBs	Method Blank	---	d.l.
	Sample Duplicate	---	34% RPD (95% CI at level >1 ppb)
	Method Spike Recovery (normal pesticide analysis is run)	endrin	69-119%
		lindane	62-118%
		dieldrin	20-136%
		aldrin	50-166%
		4,4-DDD	10-145%
		4,4-DDT	10-203%
		endosulfan II	---
		endosulfan sulfate	10-100%

Table 2 (Continued)

ACCURACY AND PRECISION CRITERIA FOR ORGANICS FROM RAS

PARAMETER	AUDIT	COMPOUNDS	CONTROL LIMITS
		4,4 -DDE	10-136%
		heptachlor	10-192%
		chlordane	65-129%
Base/Neutral/Acid Compounds	Method Blank	---	d.l.
	Method Blank	---	<38% RPD (95% CI)
	Surrogate Spike Recovery	Pentafluorophenol	10-86%
		2-fluorophenol	10-103%
		2,4,6-tribromophenol	43-105%
		D_5-nitrobenzene	29-107%
		2-fluorobiphenyl	25-119%
		decafluorobiphenyl	42-112%
	Method Spike Recovery	phenol	10-121%
		2-chlorophenol	23-134%
		1,4-dichlorobenzene	20-124%
		benzyl alcohol	10-124%
		n-nitrosodipropylamine	10-127%
		1,2,4-trichlorobenzene	22-147%
		4-chloraniline	10-100%
		p-chloro-a-cresol	10-130%
		acenaphthene	47-145%
		2,4-dinitrotoluene	39-139%
		4-nitrophenol	10-132%
		pentachlorophenol	14-176%
		Di-n-butyl phthalate	1 -118%
		pyrene	52-115%
		1,3-dichlorobenzene	10-172%
		2,6-dinitrotoluene	50-158%

TABLE 3

ACCURACY AND PRECISION CRITERIA FOR INORGANICS FROM RAS

PARAMETER	AUDIT	CONTROL LIMITS
Metals and Other Inorganics	Method Blank	± d.l.
	Sample Duplicates	± d.l. or ± 10% RPD
	Method Spikes	85-115%

NOTE: RPD = relative percent difference

TABLE 4

OPERATING DETECTION LIMITS FOR ORGANICS FROM RAS

Pesticides and PCBs

CAS NO.	COMPOUND	OPERATING DETECTION LIMIT (ug/L)
319-85-7	β-BHC	0.1
319-84-6	α BHC	0.1
319-86-8	δ-BHC	0.1
76-44-8	heptachlor	0.1
58-89-9	γ-BHC (Lindane)	0.1
309-00-2	aldrin	0.1
1024-57-3	heptachlor epoxide	0.1
959-98-8	endosulfan I	0.1
72-55-9	4,4 -DDE	0.1
60-57-1	dieldrin	0.1
72-20-8	endrin	0.1
72-54-8	4,4 -DDD	0.1
33212-65-9	endosulfan II	0.1
50-29-3	4,4 -DDT	0.1
57-74-9	chlordane	0.1
8001-35-2	toxaphene	1.0
72-43-5	methoxylchlor	1.0
8001-35-2	aroclor 1016	1.0
11097-69-1	aroclor 1242	1.0
11096-82-5	aroclor 1248	1.0
11104-28-2	aroclor 1254	1.0
12674-11-2	aroclor 1260	1.0

TABLE 4 (Continued)

Base/Neutral and Acid Extractable Compounds

CAS NO.	COMPOUND	OPERATING DETECTION LIMIT (ug/L)
62-53-3	aniline	5
111-44-4	bis (2-chloroethyl) ether	4
108-95-2	phenol	2
95-57-8	2-chlorophenol	2
541-73-1	1,3-dichlorobenzene	3
106-46-7	1,4-dichlorobenzene	3
95-50-1	1,2-dichlorobenzene	3
100-51-6	benzyl alcohol	10
118-60-1	bis (2-chloroisopropyl) ether	1
95-48-7	2-methylphenol	5
67-72-1	hexachloroethane	7
621-64-7	N-nitrosodipropylamine	4
98-95-3	nitrobenzene	4
108-39-4	4-methylphenol	5
78-59-1	isophorone	2
88-75-5	2-nitrophenol	5
105-67-9	2,4-dimethylphenol	3
11-91-1	bis (2-chloroethoxy) methane	4
120-83-2	2,4-dichlorophenol	3
120-82-1	1,2,4-trichlorobenzene	3
91-20-3	naphthalene	1
106-47-8	4-chloroaniline	5
87-68-3	hexachlorobutadiene	5
65-85-0	benzoic acid	50
91-57-6	2-methylnaphthalene	1
59-50-7	p-chloro-m-cresol	4
77-47-4	hexachlorocyclopentadiene	10
95-95-4	2,4,5-trichlorophenol	5
88-06-2	2,4,6-trichlorophenol	5
91-58-7	2-chloronaphthalene	2
208-96-8	acenaphthylene	1
131-11-3	dimethyl phthalate	2
606-20-2	2,6-dinitrotoluene	9
83-32-9	acenaphthene	2
99-09-2	3-nitroaniline	50
132-64-9	dibenzofuran	10
51-28-5	2,4-dinitrophenol	50.0
121-14-2	2,4-dinitrotoluene	10
86-73-7	fluorene	1
100-02-7	4-nitrophenol	15
7005-72-3	4-chlorophenyl phenyl ether	3
84-66-2	diethyl phthalate	2
534-52-1	4,6-dinitro-2-methylphenol	10

TABLE 4 (Continued)

CAS NO.	COMPOUND	OPERATING DETECTION LIMIT (ug/L)
122-66-7	1,2-diphenylhydrazine (azobenzene)	1
86-30-6	N-nitrosodiphenylamine (diphenylamine)	2
100-01-6	4-nitroaniline	50
101-55-3	4-bromophenyl phenyl ether	7
118-74-1	hexachlorobenzene	5
87-86-5	pentachlorophenol	20
85-01-8	phenanthrene	1
120-12-7	anthracene	1
84-72-2	di-n-butyl phthalate	1
206-44-0	fluoranthene	1
129-00-0	pyrene	1
85-68-7	butyl benzene phthalate	3
218-01-9	chrysene	5
56-55-3	benzo(a)anthracene	5
117-81-7	bis (2-ethylehexyl) phthalate	2
117-84-0	di-n-octyl-phthalate	2
205-99-2	benzo(b)fluoranthene	5
207-08-9	benzo(k)fluoranthene	5
50-32-8	benzo(a)pyrene	5
193-39-5	ideno(1,2,3-cd)pyrene	10
53-70-3	dibenzo(a,h)anthracene	10
191-24-3	benzo(ghi)perylene	10
92-87-5	benzidine	50
91-94-1	3,3-dichlorobenzidine	20
	octachlorocyclopentene	10

TABLE 4 (Continued)

Volatile Compounds

CAS NO.	COMPOUND	OPERATING DETECTION LIMIT (ug/L)
74-87-3	chloromethane	10
74-83-9	bromomethane	10
75-01-4	vinyl chloride	10
75-00-3	chloroethane	10
75-09-2	methylene chloride	2
107-02-8	acrolein	15
67-64-1	acetone	10
107-13-1	acrylonitrile	15
75-15-0	carbondisulfide	1
75-35-4	1,1-dichloroethene	1
75-34-3	1,1-dichloroethane	2
156-60-5	trans-1,2-dichloroethene	2
67-66-3	chloroform	2
78-93-3	2-butanone	10
107-06-2	1,2-dichloroethane	2
71-55-6	1,1,1-trichloroethane	2
56-23-5	carbon tetrachloride	2
108-05-4	vinyl acetate	10
75-27-4	bromodichloromethane	2
78-87-5	1,2-dichloropropane	3
10061-02-6	trans-1,3-dichloropropane	4
79-01-6	trichloroethene	2
71-43-2	benzene	1
124-48-1	chlorodibromomethane	3
79-00-5	1,1,2-trichloroethane	3
10061-01-05	cis-1,3-dichloropropene	4
110-75-8	2-chloroethylvinyl ether	10
75-25-2	bromoform	15
108-10-1	4-methyl-2-pentanone	5
519-78-6	2-hexane	100
127-18-4	tetrachloroethene	2
79-34-5	1,1,2,2-tetrachloroethane	2
108-88-3	toluene	1
108-90-7	chlorobenzene	1
100-41-4	ethylbenzene	1
100-42-5	styrene	10
	m-xylene	10
95-47-6	o-xylene, p-xylene	10

TABLE 5

OPERATING DETECTION LIMITS FOR INORGANICS FROM RAS

PARAMETER	DETECTION LIMIT (ug/L)
Aluminum	250
Chromium	10
Barium	250
Beryllium	10 5
Cobalt	10
Copper	10
Iron	10
Nickel	10
Manganese	10
Zinc	20
Boron	500
Vanadium	100
Silver	10
Arsenic	2
Antimony	100
Selenium	2
Thallium	50
Mercury	0.2
Tin	500
Cadmium	10 5
Lead	20 5
Cyanide	10
Alkalinity ($CaCO_3$)	1000
Chloride	1000
Fluoride	200
Sulfate	5000
Ammonia Nitrogen	50
TKN	1000
Nitrate and Nitrite	50
TOC	5000
Total Phosphorus	10

Other inorganic detection limits can be provided when requested.

TABLE 6

METHOD DETECTION LIMITS FOR ORGANICS FROM CLP

VOLATILES	CAS NO.	DETECTION LIMITS* LOW WATER[a] ug/L	LOW SOIL/SEDIMENT[b] ug/Kg
Chloromethane	74-87-3	10	10
Bromomethane	74-83-9	10	10
Vinyl Chloride	75-01-4	10	10
Chloromethane	75-00-3	10	10
Methylene Chloride	75-09-2	5	5
Acetone	67-64-1	10	10
Carbon Disulfide	75-15-0	5	5
1,1-Dichloroethene	75-35-4	5	5
1,1-Dichloroethane	75-35-3	5	5
trans-1,2-Dichloroethene	156-60-5	5	5
Chloroform	67-66-3	5	5
1,2-Dichloroethane	107-06-2	5	5
2-Butanone	78-93-3	10	10
1,1,1-Trichloroethane	71-55-6	5	5
Carbon Tetrachloride	56-23-5	5	5
Vinyl Acetate	108-05-4	10	10
Bromodichloromethane	75-27-4	5	5
1,1,2,2-Tetrachloroethane	79-34-5	5	5
1,2-Dichloropropane	78-87-5	5	5
trans-1,3-Dichloropropene	10061-02-6	5	5
Trichloroethene	79-01-6	5	5
Dibromochloromethane	124-48-1	5	5
1,1,2-Trichloroethane	79-00-5	5	5
Benzene	71-43-2	5	5
cis-1,3-Dichloropropene	10061-01-5	5	5
2-Chloroethyl Vinyl Ether	100-75-8	10	10
Bromoform	75-25-2	5	5
2-Hexane	591-78-6	10	10
4-Methyl-2-pentanone	108-10-1	10	10
Tetrachloroethene	127-18-4	5	5
Toluene	108-88-3	5	5
Chlorobenzene	108-90-7	5	5
Ethyl Benzene	100-41-4	5	5
Styrene	100-42-5	5	5
Total Xylenes		5	5

[a]Medium Water Contract Required Detection Limits (CRDL) for Volatile HSL Compounds are 100 Times the Individual Low Water CRDL.

[b]Medium Soil/Sediment Contract Required Detection Limits (CRDL) for Volatile HSL Compounds are 100 Times the Individual Low Soil/Sediment CRDL.

Table 6 (Continued)

SEMI-VOLATILES	CAS NO.	DETECTION LIMTS* LOW WATER[c] ug/L	LOW SOIL/SEDIMENT[d] ug/Kg
N-Nitrosodiomethylamine	62-75-9	10	330
Phenol	108-95-2	10	330
Aniline	62-53-3	10	330
bis(2-Chloroethyl) ether	111-44-4	10	330
2-Chlorophenol	95-57-8	10	330
1,3-Dichlorobenzene	541-73-1	10	330
1,4-Dichlorobenzene	106-46-7	10	330
Benzyl Alcohol	100-51-6	10	330
1,2-Dichlorobenzene	95-50-1	10	330
2-Methylphenol	95-48-7	10	330
bis(2-Chloroisopropyl) ether	39638-32-9	10	330
4-Methylphenol	106-44-5	10	330
N-Nitroso-Dipropylamine	621-64-7	10	330
Hexachloroethane	67-72-1	10	330
Nitrobenzene	98-95-3	10	330
Isophorone	78-59-1	10	330
2-Nitrophenol	88-75-5	10	330
2,4-Dimethylphenol	105-67-9	10	330
Benzoic Acid	65-85-0	50	330
bis(2-Chloroethoxy) methane	111-91-1	10	330
2,4-Dichlorophenol	120-83-2	10	330
1,2,4-Trichlorobenzene	120-82-1	10	330
Naphthalene	91-20-3	10	330
4-Chloroaniline	106-47-8	10	330
Hexachlorobutadiene	87-68-3	10	330
4-Chloro-3-methylphenol (para-chloro-meta-cresol)	59-50-7	10	330
2-Methylnaphthalene	91-57-6	10	330
Hexachlorocyclopentadiene	77-47-4	10	330
2,4,6-Trichlorophenol	88-06-2	10	330
2,4,5-Trichlorophenol	95-95-4	50	1600
2-Chloronaphthalene	91-58-7	10	330
2-Nitroaniline	88-74-4	50	1600
Dimethyl Phthalate	131-11-3	10	330
Acenaphthylene	208-96-8	10	330
3-Nitroaniline	99-09-2	50	1600
Acenaphthene	83-32-9	10	330
2,4-Dinitrophenol	51-28-5	50	1600
4-Nitrophenol	100-02-7	50	1600
Dibenzofuran	132-64-9	10	330
2,4-Dinitrotoluene	121-14-2	10	330

[c]Medium Water Contract Required Detection Limits (CRDL) for Semi-Volatile HSL Compounds are 100 Times the Individual Low Water CRDL.

[d]Medium Soil/Sediment Contract Required Detection Limits (CRDL) for Semi-Volatile HSL Compounds are 60 Times the Individual Low Soil/Sediment CRDL.

C/ES2/32a

Table 6 (Continued)

SEMI-VOLATILES	CAS NO.	DETECTION LIMITS* LOW WATER[c] ug/L	LOW SOIL/SEDIMENT[d] ug/Kg
2,6-Dinitrotoluene	606-20-2	10	330
Diethylphthalate	84-66-2	10	330
4-Chlorophenol Phenyl ether	7005-72-3	10	330
Fluorene	86-73-7	10	330
4-Nitroaniline	100-01-6	50	1600
4,6-Dinitro-2-methylphenol	534-52-1	50	1600
N-nitrosodiphenylamine	86-30-6	10	330
4-Bromophenyl Phenyl ether	101-55-3	10	330
Hexachlorobenzene	118-74-1	10	330
Pentachlorophenol	87-86-5	50	1600
Phenanthrane	85-01-8	10	300
Anthracene	120-12-7	10	330
Di-n-buylphthalate	84-74-2	10	330
Fluoranthene	206-44-0	10	330
Benzidine	92-87-5	100	1600
Pyrene	129-00-0	10	330
Butyl Benzyl Phthalate	85-68-7	10	330
3,3 -Dichlorobenzidine	91-94-1	20	660
Benzo(a)anthracene	56-55-3	10	330
bis(2-ethylehexyl)phthalate	117-81-7	10	330
Chrysene	218-01-9	10	330
Di-n-octyl Phthalate	117-84-0	10	330
Benzo(b)fluoranthene	205-99-2	10	330
Benzo(k)fluoranthene	207-08-9	10	330
Benzo(a)pyrene	50-32-8	10	330
Indeno(1,2,3-cd)pyrene	193-39-5	10	330
Dibenz(a,h)anthracene	53-70-3	10	330
Benzo(g,h,i)perylene	191-24-2	10	330

[c]Medium Water Contract Required Detection Limits (CRDL) for Semi-Volatile HSL Compounds are 100 Times the Individual Low Water CRDL.

[d]Medium Soil/Sediment Contract Required Detection Limits (CRDL) for Semi-Volatile HSL Compounds are 60 Times the Individual Low Soil/Sediment CRDL.

Table 6 (Continued)

PESTICIDES	CAS NO.	DETECTION LIMITS* LOW WATER[e] ug/L	LOW SOIL/SEDIMENT[f] ug/Kg
alpha-BHC	319-84-6	0.05	2.0
beta-BHC	319-85-7	0.05	2.0
delta-BHC	319-86-8	0.05	2.0
gamma-BHC (Lindane)	58-89-9	0.05	2.0
Heptachlor	76-44-8	0.05	2.0
Aldrin	309-00-2	0.05	2.0
Heptachlor Epoxide	1024-57-3	0.05	2.0
Endosulfan I	959-98-8	0.05	2.0
Dieldrin	60-57-1	0.10	4.0
4,4 -DDE	72-55-9	0.10	4.0
Endrin	72-20-8	0.10	4.0
Endosulfan II	33213-65-9	0.10	4.0
4,4 -DDD	72-54-8	0.10	4.0
Endrin Aldehyde	7421-93-4	0.10	4.0
Endosulfan Sulfate	1031-07-8	0.10	4.0
4,4 -DDT	50-20-3	0.10	4.0
Endrin Ketone	53494-70-5	0.10	4.0
Methyoxychlor	72-43-5	0.5	20.0
Chlordane	57-74-9	0.5	20.0
Toxaphene	8001-35-2	1.0	40.0
Aroclor 1016	12674-11-2	0.5	20.0
Aroclor 1221	11104-28-2	0.5	20.0
Aroclor 1232	11141-16-5	0.5	20.0
Aroclor 1242	53469-21-9	0.5	20.0
Aroclor 1248	12672-29-6	0.5	20.0
Aroclor 1254	11097-69-1	1.0	40.0
Aroclor 1260	11096-82-5	1.0	40.0

[e]Medium Water Contract Required Detection Limits (CRDL) for Pesticide HSL Compounds are 100 Times the Individual Low Water CRDL.

[f]Medium Soil/Sediment Contract Required Detection Limits (CRDL) for Pesticide HSL Compounds are 60 Times the Individual Low Soil/Sediment CRDL.

*Detection limits listed for soil/sediment are based on net weight. The detection limits calculated by the laboratory for soil/sediment, calculated on dry weight basis, as required by the contract, will be higher.

Specific detection limits are highly matrix dependent. The detection limits listed herein are provided for guidance and may not always be achievable.

TABLE 7

METHOD DETECTION LIMITS FOR INORGANICS FROM CLP

ELEMENT	CONTRACT REQUIRED DETECTION LEVEL[1,2] (ug/L)
Aluminum	200
Antimony	60
Arsenic	10
Barium	200
Beryllium	5
Cadmium	5
Calcium	5000
Chromium	10
Cobalt	50
Copper	25
Cyanide	10
Iron	100
Lead	5
Magnesium	5000
Manganese	15
Mercury	0.2
Nickel	40
Potassium	5000
Selenium	5
Silver	10
Sodium	5000
Thallium	10
Tin	40
Vanadium	50
Zinc	20

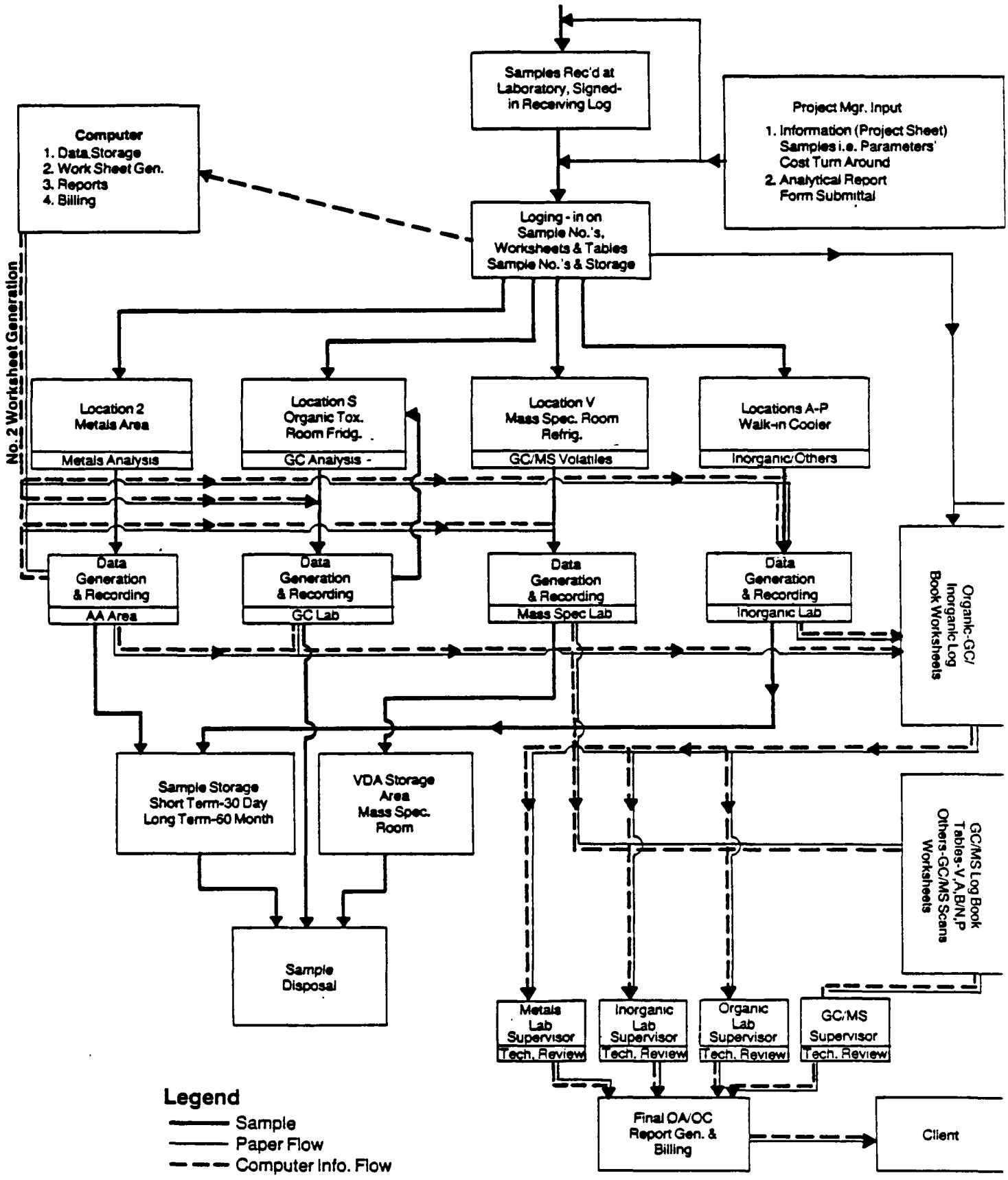
1: Any analytical method specified in SOW Exhibit D may be utilized as long the documented instrument or method detection limits meet the Contract Required Detection Level (CRDL) requirements. Higher detection levels may <u>only</u> be used in the following circumstance:

If the sample concentration exceed two times the detection limit of the instrument or method in use, the value may be reported even though the instrument or detection limit may not equal the contract required detection level.

2: These CDRL are the instrument detection limits obtained in pure water that must be met using the procedure in Exhibit E. The detection limits for samples may be considerably higher depending on the sample matrix.

Sample & Document Flow Diagram

Figure 1



Analytical Services Project Sheet

A To be completed prior to submittal Pg. of

Client Name: _____ Date of Request: _____

Project No. _____ Samples will arrive on/about: _____

Project Manager _____ Number of Samples _____ Turnaround _____

Job Description _____

Quality Control RAS ☐ SAS ☐ CLP ☐ COC: Field ☐ Lab ☐ None ☐

B To be completed at sample log-in

Sampled By: _____

Sample Locations: _____

Date Sampled: _____ Time: _____ am pm

Date Received: _____ Time: _____ am pm

Received By: _____

Date Logged In: _____ By _____

Worksheet: _____ Shelf Letter: _____

C Laboratory processing record

Client No.: _____ Job No.: _____

Lab Project Manager: _____

Invoice Amt: _____ Factor: _____

Analyst: _____

Date Analysis Completed _____ am ☐ pm ☐

Quality Control Review By: _____

Date Reported to Office: _____

Date of Final Report: _____

D Data: List parameters requested prior to submittal.

Cpd. No.	Sample ID: Matrix: _____					O.D.L	Units
—	Parameter(s)	#	#	#	#	—	—

E Comments: _____

Schduled Laboratory Completion Date: _____

Route To:

From:

Date:

EDI Laboratory
New Project Approval Form

Request for Budget: _____

Request for Work: _____

Client Information

Name: _____

Address: _____

_____

Billing Address: _____

_____

Client Contact: _____

Phone Number: _____

LCS or CCS

Quotation No: _____

P.O. Number: _____

Contract No.: _____

Lab Project No.: _____

CCS Project No.: _____

Project Information

Project Description: _____

_____

Site/Sample Hazards: _____

_____

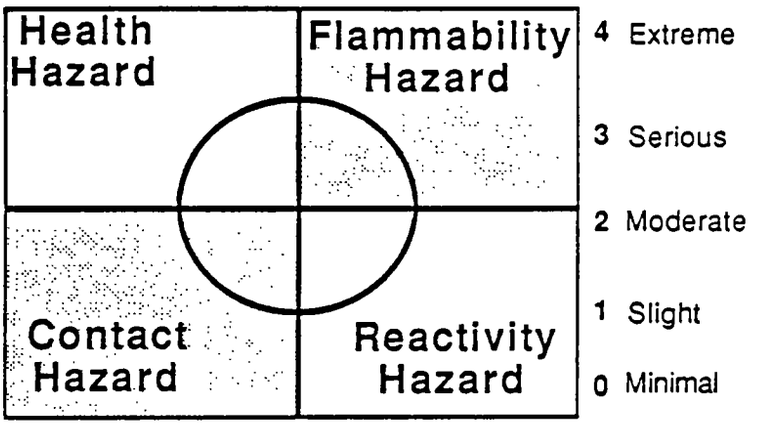
_____

_____

Sample Disposal Instructions: _____

_____

_____



SampleStorage: Short Term (30 Days) _____, Long Term (90 Days) _____, Other _____

Sample Containers: please ship ☐ will pick up ☐ not required ☐

when: _____ carrier: _____

Turnaround: (3weeks) _____ (2 weeks) _____ (1 week) _____ (48-72 hrs) _____ (< 24 hrs) _____

Frequency of sample reciept: weekly _____ monthly _____ quarterly _____ one time _____ other _____

Samples Scheduled to Arrive: _____ am ☐ pm ☐

Contract Dates: beginning _____ ending _____

Project Analytical Cost

Cost/Sample: _____ X Number of Samples _____ X Turnaround Factor _____ = _____

Other Costs (sampling) _____

Project Cost: _____

Project Acceptance *(project manager & area supervisors must sign and return to the laboratory manager)*

Name:	Date:	Name:	Date:
1. _____	_____	3. _____	_____
2. _____	_____	4. _____	_____

Internal Use Only:

	$ Amount	O	$ Amount	M	$ Amount	S	$ Amount

Discount % _____

FIGURE 4

ROUTE TO:_____ DATE:_____
TIME:_____

EDI LABORATORY
PROBLEM PROJECT REPORT

SAMPLES RECEIVED ON _____ AT _____AM/PM FROM:_____
AND DESCRIBED AS _____ WERE RECEIVED HAVING THE
FOLLOWING DEFICIENCIES.

- REQUEST FORM - ABSCENT/INCOMPLETE [ ]
- CHAIN-OF-CUSTODY - ABSCENT/INCOMPLETE [ ]
- CHAIN-OF-CUSTODY - DOES NOT MATCH SAMPLE TAGS [ ]
- SAMPLE BOTTLES - BROKEN [ ]
- SAMPLES ABSCENT - QUAN. DOES NOT MATCH REQUEST FORM [ ]
- SAMPLE BOTTLES - INCORRECT FOR ANALYSIS [ ]
- SAMPLE PRESERVATIVES - INCORRECT FOR ANALYSIS [ ]
- SAMPLE VOLUMES - INCORRECT FOR ANALYSIS [ ]
- SAMPLE TAGS - WRONG I.D./ABSCENT [ ]
- FIELD FORMS - ABSCENT/INCOMPLETE [ ]
- CUSTODY SEALS - ABSCENT/NOT INTACTED [ ]
- SMO FORMS - ABSCENT [ ]
- NON-ROUTINE PROJECT - NO PRIOR APPROVAL [ ]

THE SAMPLES IN QUESTION WILL BE PROCESSED AS IS__ PLACED ON HOLD __

UNTIL THE CORRECTIVE ACTIONS OR DIRECTIVES ARE ISSUED.

THANK YOU
EDI LABORATORY
SAMPLE COORDINATOR

_____

EDI Engineering & Science
Environmental Engineering
Geology, Biology and Chemistry

Chain of Custody Record

023

Client: _____ Samplers (Signature): _____

Project No: _____

Sample Location	Date	Time	Sample Type			No. of Containers	Analysis Required
			Water		Other		
			Comp.	Grab.			

Relinquished by: (signature)	**Received by:** (signature)			**Date**	**Time**
Relinquished by: (signature)	**Received by:** (signature)			**Date**	**Time**
Relinquished by: (signature)	**Received by:** (signature)			**Date**	**Time**
Relinquished by: (signature)	**Received by:** (signature)			**Date**	**Time**
Dispatched by: (signature)	**Date**	**Time**	**Received for Lab by:**	**Date**	**Time**
Method of Shipment:					
Comments:					

FIGURE 6

EDI LABORATORY CHAIN-OF-CUSTODY LOG-IN FORM

DOCUMENT CONTROL #_____

sample custodian (signiture):_____ date:_____

circle the apropriate response

1. **custody seals** present/absent case number_____
   intact/not intact airbill # _____

2. **chain-of-custody COC** present/absent

3. **sample tags** present/absent
   sample tag #'s listed/not listed on-COC

4. **SMO forms** present/absent

date received	time received	COC record number	SMO sample numbers	corresponding		information OK
				tag #	lab #	

remarks: (condition of shipment) _____

FIGURE 7

EDI LABORATORY
INTERNAL CUSTODY
SAMPLE CONTROL RECORD

DOCUMENT CONTROL # ________________
EDI PROJECT NUMBER: ________________

sample no.(s)	removed by: (signature)	reason (parameter)	date and time removed	date and time returned

DATE OF PLACEMENT IN PROJECT FILE________________

SAMPLE COORDINATOR______________________________

FIGURE 8

EDI SPECTROPHOTOMETRIC WORKSHEET

PARAMETER: MBAS-SURFACTANTS
METHOD:
DATE:
ANALYST:

PROJECT	CLIENT	WRK#	SAMPLE #	MACHINE READING	DILUTION FACTOR	REPORTED CONC	STANDARD 1 ABS	STANDARD 1 CONC	STANDARD 2 ABS	STANDARD 2 CONC	STANDARD 3 ABS	STANDARD 3 CONC	DOWNFIELD VERIFICAT.	DUPL. CONC
25229	BOC GROUP - LANSING	4	65699											
25229	''	8	65702											
25229	''	12	65706											
25229	''	12	65707											
25229	''	12	65708											
25229	''	16	65709											
25229	''	16	65710											
25229	''	16	65711											
25229	''	16	65712											
25229	''	24	65717											

QUALITY CONTROL DATA SUMMARY

PROJECT	QCSAMPLE / CLIENT	SAMPLE#	INSTRUMENT READING	DILUTION FACTOR	TEST RESULT	DUPLICATE RESULT	SPIKE RESULT	SPIKE QUANTITY	% RECOVERY / DIFFERENCE
99991	METHOD SPIKE | EPA ERA					- - - -			
99991	METHOD BLANK					- - - -	- - -	- - - -	
	MATRIX SPIKE/					- - - -			
	DUPLICATE/						- - -	- - - -	

FIGURE 9

EDI GRAVIMETRIC BENCH SHEET

Mg/L TS=(A-B)X1000

MLS OF SAMPLE

A=WT. OF DISH+DRY RESIDUE
B=WT. OF DISH

PARAMETER: RESIDUE,NONFILTERABL
METHOD:
DATE:
ANALYST:

PROJECT	CLIENT	WRK#	SAMPLE #	I.D.	DISH + RESIDUE	DISH WEIGHT	MLS OF SAMPLE	REPORTED CONC.
25229	BOC GROUP - LANSING	3	65699					
25229	''	7	65702					
25229	''	11	65706					
25229	''	11	65707					
25229	''	11	65708					
25229	''	15	65709					
25229	''	15	65710					
25229	''	15	65711					
25229	''	15	65712					
25229	''	19	65713					

QUALITY CONTROL DATA SUMMARY

PROJECT	QCSAMPLE / CLIENT	SAMPLE#	DISH + RESIDUE	DISH WEIGHT	MLS OF SAMPLE	TEST RESULT	DUPLICATE RESULT	SPIKE RESULT	SPIKE QUANTITY	% RECOVERY / DIFFERENCE
99991	METHOD SPIKE | EPA ERA						- - - - - -			
99991	METHOD BLANK						- - - - - -	- - -	- - - -	
	MATRIX SPIKE/						- - - - - -			
	DUPLICATE							- - -	- - - -	

FIGURE 10

EDI TITRIMETRIC BENCH SHEET

PARAMETER: CHLORIDE
METHOD:
ANALYST:

PROJECT	CLIENT	WRK#	SAMPLE #	DATE OF ANALYSIS	ml SAMPLE	ml TITRANT	NORMALITY TITRANT	CONC. Mg/l
25229	BOC GROUP - LANSING	12	65706					
25229	''	12	65707					
25229	''	12	65708					
25229	''	16	65709					
25229	''	16	65710					
25229	''	16	65711					
25229	''	16	65712					
25229	''	24	65717					
25229	''	24	65718					
25229	''	24	65719					

QUALITY CONTROL DATA SUMMARY

PROJECT	QCSAMPLE / CLIENT	SAMPLE#	ML SAMPLE	ML TITRANT	TEST RESULT	DUPLICATE RESULT	SPIKE RESULT	SPIKE QUANTITY	% RECOVERY / DIFFERENCE
99991	METHOD SPIKE | EPA ERA					- - - - -			
99991	METHOD BLANK					- - - - -	- - -	- - - -	
	MATRIX SPIKE/					- - - - -			
	DUPLICATE/						- - -	- - - -	

EDI ENGINEERING & SCIENCE
QA/QC
PRECISION/ACCURACY
DATA SUMMARY

PARAMETER _____ MATRIX TYPE. _____

METHOD: _____ UNIT OF MEASURE: _____

CLASS. ___

ACCEPTANCE INTERVALS. MEAN = _____ S D = _____

Upper & Lower Warning Limits = +/-2x _____ = _____

Upper & Lower Control Limits = +/-3x _____ = _____

Date of Analysis	Project Number	Sample Number	Analyst Initials	Conc Dup #1	Conc Dup #2	Conc Sample+ Spike	Amount Spiked	Comments %R % Relative Std Dev.

STANDARD OPERATING PROCEDURE

Sample Container, Cleaning Procedure Prior to Sampling:

TYPE	SIZE(ml)	ANALYSIS	CLEANING PROCEDURE
Plastic	125	Unspecified	D.I. Rinse
	250	Unspicified	D.I. Rinse
	500	Radiological	D.I. Rinse
	1000	Metals	HNO_3, Rinse + D.I.
	1000	Cyanides	NaOH Rinse + D.I.
	1000	General Inorganics	D.I. Rinse
	1000	Nutrients	H_2SO_4 Rinse + D.I.
Glass	125	Sulfide	D.I. Rinse
	125	TOC	D.I. Rinse + Bake*
	250	TOX	Solvent Rinse + Bake*
	500	Phenols	H_2SO_4 Rinse + D.I.
	500	Organic	Solvent Rinse + Bake
	1000	Organic	Solvent Rinse + Bake
	40	VOA	D.I. + Bake or Purchase cleaned (Supelco)

APPENDIX M

This appendix is reserved for future use.

APPENDIX N.1

COPIES OF FACILITY REPORTING FORMS

Phone 313 571-7140
W.A.S.—EPA #MID 074259565

DYNECOL, INC.

6520 GEORGIA ST.
DETROIT, MICHIGAN 48211

DAILY LOG

Date _____

GENERATOR	DATE	DRIVER	TRACTOR	TRAILER	INVOICE	MANIFEST	CODE	GALLONS	ACID	IRON	SP. GR.	PRODUCT	TESTED	SO2	T31	T23	T44	T40	RECEIVING TANK

REMARKS

DISPOSAL AT W.A.S.
GAL.
DISPOSAL AT ALT.
GAL.

ALTERNATE DISPOSAL

HCL	
H2S04	
Hn03	
PHOS	
CAUSTIC	
LIME	
RINSE	
TOTAL GALLONS	
DAY	
MONTH	
YEAR	

9.7 a

E.P.A. #MID 074259565

DYNECOL, INC.
6520 GEORGIA ST
DETROIT, MICHIGAN 48211

Ph. # 313 571-7140

DATE OF INSPECTION _____

NAME OF INSPECTOR _____

TIME INSPECTION BEGAN _____

TIME INSPECTION COMPLETED _____

INSPECTOR'S SIGNATURE _____

Inspector Note:
1. Items found to have NO PROBLEMS, LEAVE BLANK AND PUT A CHECK MARK IN EQUIP/STRUCTURES COLUMN to indicate inspection is performed.
2. Items found to have problems, indicate with an X. Note "REMEDIAL ACTION"

INSPECTION REPORT

	EQUIP/STRUCTURE	INSPECTION ITEMS				REMEDIAL ACTION		
	1. Operating Equipment	Erosion Corrosion	Cracks	Leaks	Oper. Error	Nature and Location of the Problem and Action Required	Est. Repair Date	Actual Repair Date
	A. Tanks							
Inspect Shell Weekly / Inspect Lining Monthly	# 1							
	2							
	3							
	4							
	7							
	8							
	9							
	10							
	12							
	13							
	14							
	15							
	16							
	17							
	18							
	19							
	20							
	21							
	22							
	23							
	24							
	25							
	26							
	26 A (mixing)							
	B. Material Trans. Equip.	Corrosion	Leaks	Mal-function	Oper. Error			
Inspect Daily	Pumps							
	Caustic/Lime							
	HCL							
	Transfer							
	Filter							
	Sludge (#1)							
	Sludge (#2)							
	Air Pump (#3)							
	Air Pump (#4)							
	Air Pump (#5)							
	Air Pump (#6)							
	Recirculation (#18)							
	Recirculation (#19)							
	Recirculation (#20)							
	Recirculation (#21)							
	Effluent (#22)							
	Air Pump (#23)							
	Lime (#25)							
	Lime (#26A)							
	Lime (#26B)							
	Pipings							
	Hoses							
	Valves							
	Fittings							

Inspect Daily

C. Material Handling	Malfunction	Damage	Oper Error	Nature and Location of the Problem and Action Required	Est. Repair Date	Actual Rep. Date
Equipment						
Mixer						
A 14						
A 18B						
A 18S						
A 19B						
A 19S						
A 20B						
A 20S						
A 21B						
A 21S						
A 23						
A 26A						
Air Compressor						
# 1						
2						
3						
Fume Scrubber						
Blower						
Recirc. Pump						
Caustic Pump						
Piping						
Values						
Fittings						
Filter Press A						
Hydraulic						
Air						
Plates						
Cloths						
Pipes						
Valves						
Fittings						
Filter Press B						
Hydraulic						
Air						
Plates						
Cloths						
Pipes						
Valves						
Fittings						
Lime Silo #1						
Bin Discharger						
Feeder						
Electrical						
Lime Silo #2						
Bin Discharger						
Feeder						
Electrical						
Screw Conveyor						
Air Dryer						

	B. Electrical Equipment	Malfunction	Damage	Oper. Error	Nature and Location of Problem and Action Required	Est. Repair Date	Act. Repair Date
Inspect Daily	Circ. Breakers						
	Control Panel						
	2. Containment Structure						
	A. Dikes	Erosion	Cracks	Leaks			
	Walls						
	Floor						
	Load Pad						
	B. Spill Transfer	Malfunction	Damage	Oper. Error			
	Sump Pumps						
	# 1 (Unloading Area)						
	2 (Bldg. # 2)						
	3 (Garage)						
	4 (Sump-South)						
	5 (Sump-N.W.)						
	3. Monitoring Equipment						
	A. Discharge Monitor						
	ph Meters (7)						
	ph Electrodes (6)						
	ph Recorder (1)						
	ph Chart (1)						
	B. Monitoring Wells	Damage	Sampled				
	B-1 (Southeast)						
	B-2 (Northwest)						
	B-3 (West)						
Inspect Weekly	4. Security Equipment	Damage	Malfunction				
	A. Property Line Fence						
	North Fence						
	East						
	West						
	South						
	B. Gates						
	# 1 (Northeast)						
	# 2 (Northwest)						
	# 3 (West)						
	C. Yard Lighting						
	# 1 Pole (Office Bldg.)						
	# 2 (Fuel Storage)						
	# 3 (Garage Roof)						
	# 4 (S.E. Bldg. 2)						
	# 5 (S.E Bldg. 2)						
	# 6 (N.W. Bldg. 2)						
	# 7 (N.W. Bldg. 2)						
	# 8 (S.W. Prim. Trmt. Area)						
	# 9 (S.W. Press Bldg.)						
	# 10 (S.W. Press Bldg.)						

Inspect Weekly

S. Safety/Emergency	No Access	Malfunction	Nature and Location of the Problem and Action Required	Est. Repair Date	Actual Repair Date
Equipment					
A. Stationary Equip.					
Eyewashes					
Showers					
Water Supply Values					
Alarm Actuator					
#1					
2					
3					
4					
5					
6					
7					
8					

B. Portable Equipment	Out of Place	Malfunction	Reload	Date			
Front End Loader							
Freight Box (w/soda ASH)							
Scott Air Packs (2)							
Fire Extinguisher							
# 1							
2							
3							
4							
5							
6							
7							
8							
9							

DYNECOL, INC.
6520 GEORGIA
DETROIT, MI 48211
SAMPLE & PROCESS CONTROL EVALUATION LOG

DATE	GENERATOR NAME	PRODUCT & VOLUME	MANIFEST # & EPA #	PHYSICAL APPEAR. (Color, clarity, phase sep., susp. solids, settled solids)	ODOR	COMPARISON WITH REF. SAMPLE (note any deviation)	pH	% ACID	SPECIFIC GRAVITY	CYANIDE (F006 or F019)	INSPECTOR INITIALS

DYNECOL, INC.
~~WASTE ACID SERVICES, INC~~.

9.10

6520 Georgia St.
Detroit, MI 48211
313-571-7140

Date: _____

Sample I.D. No.: _____

GENERATOR

Company Name _____ Phone _____

Address _____ City _____ State _____ Zip _____

Contact and Title _____

SUBMITTER OF SAMPLE *(if different from GENERATOR)*

Company Name _____ Phone _____

Address _____ City _____ State _____ Zip _____

Contact and Title _____

WASTE DESCRIPTION

Common Name _____ Volume Generated (gal./mo.) _____

DOT Shipping Name _____

DOT Hazard Class _____ DOT Shipping Code (UN/NA) _____

EPA Hazardous Waste No. _____

Description of Process Generating Waste _____

Handling Precautions _____

WASTE CHARACTERIZATION

Physical State @ 70°F *(circle one)*: Solid Slurry Liquid Powder

Specific Gravity @ 70°F _____ BOD _____ COD _____ TOC _____

Flash Point and Method _____ pH _____ % Acid or Alkali _____

Odor *(describe)* _____

Circle **yes (Y)** or **no (N)** to the presence of the following characteristics or contaminants:

Carcinogen	Y	N	Poison	Y	N	Asbestos	Y	N
Corrosive	Y	N	Radioactive	Y	N	Cyanide	Y	N
Explosive	Y	N	Reactive	Y	N	Organics	Y	N
Flammable	Y	N	Water Dispersion	Y	N	PCB's	Y	N
Oxidizer	Y	N	Water Solution	Y	N	Pesticides	Y	N
Reducer	Y	N				Sulfides	Y	N

WASTE COMPOSITION *(concentration in ppm or mg/l)*

Arsenic	_____	Cyanides	_____	Phenols	_____
Barium	_____	Fats, Oil, Grease	_____	Selenium	_____
Cadmium	_____	Iron	_____	Silver	_____
Cobalt	_____	Lead	_____	Sulfides	_____
Copper	_____	Mercury	_____	Zinc	_____
Chromium (+6)	_____	Molybdenum	_____		
Chromium (total)	_____	Nickel	_____		

Other Components	EPA Haz. Waste No.	Concentration (%)
1.		
2.		
3.		
4.		

ACTION

☐ Please send a 16 oz. sample in DOT approved container.

☐ Report completed by: *(Name, Title, Phone No.)* _____

Date	Ar	Cd	Cr	Cu	Fe	Pb	Hg	Ni	Se	Ag	Zn	Remar
01/06/87	-0.2	0.03	0.843	0.621	717.7	3.303	-0.2	0.566	-0.2	-0.03	15.78	
01/07/87	-0.2	0.034	0.491	0.315	402.7	1.936	-0.2	0.439	-0.2	-0.03	5.191	
01/08/87	-0.2	0.028	0.243	-0.024	472.5	-0.2	-0.2	0.321	-0.2	-0.03	3.113	
01/09/87	-0.2	0.035	0.275	0.076	621.5	-0.2	-0.2	0.366	-0.2	-0.03	2.186	
01/12/87	-0.2	0.041	0.089	0.05	793.2	0.674	-0.2	0.562	-0.2	-0.03	4.92	
01/14/87	-0.2	0.037	0.124	0.06	1130	13.26	-0.2	0.471	-0.2	-0.03	3.015	
01/15/87	-0.2	0.027	-0.03	-0.024	160.7	-0.2	-0.2	0.256	-0.2	-0.03	0.269	
01/17/87	-0.2	0.03	-0.03	0.047	158.6	0.315	-0.2	0.19	-0.2	-0.03	0.55	
01/19/87	-0.1	-0.02	0.076	0.158	0	0.596	-0.17	0.182	-0.23	-0.1	1.076	
01/20/87	-0.1	-0.02	-0.02	-0.02	0	-0.1	-0.17	0.273	-0.1	-0.1	0.104	
01/21/87	-0.1	-0.02	0.388	0.027	0	-0.1	-0.17	0.708	-0.1	-0.1	0.753	
01/22/87	-0.1	-0.02	0.234	-0.02	0	0.114	-0.17	0.177	-0.1	-0.1	2.017	
01/23/87	-0.1	-0.02	-0.02	-0.02	0	-0.1	-0.17	0.085	-0.1	-0.1	0.132	
01/24/87	-0.1	-0.02	0.029	-0.02	0	-0.1	-0.17	0.196	-0.1	-0.1	0.183	
01/26/87	-0.1	-0.02	0.333	-0.02	0	0.202	-0.17	0.329	-0.1	-0.1	1.239	
01/27/87	-0.1	-0.02	0.061	-0.02	0	0.101	-0.17	0.135	-0.1	-0.1	0.278	
01/28/87	-0.1	-0.02	0.502	-0.02	0	0.334	-0.17	0.807	-0.1	-0.1	0.875	
01/30/87	-0.15	-0.02	0.043	-0.02	4.586	-0.2	-0.1	0.313	-0.15	-0.06	0.391	
02/02/87	-0.1	-0.02	0.212	-0.02	0	0.714	-0.17	0.265	-0.1	-0.1	12.38	
02/03/87	-0.2	-0.02	0.036	-0.02	349.6	3.731	-0.1	0.123	-0.1	-0.1	1	
02/04/87	-0.2	-0.02	0.069	0.038	184.7	2.952	-0.1	0.103	-0.1	-0.1	1.138	
02/05/87	-0.2	-0.02	0.061	-0.02	61.52	0.589	-0.1	0.15	-0.1	-0.1	6.88	
02/06/87	-0.2	-0.02	0.052	0.038	54.52	0.925	-0.2	-0.04	-0.1	-0.1	18.54	
02/09/87	-0.2	-0.02	0.051	-0.02	345.8	0.232	-0.1	0.081	-0.1	-0.1	35.31	
02/10/87	-0.1	-0.02	0.09	-0.02	597.7	0.405	-0.1	0.163	-0.1	-0.1	7.476	
02/11/87	-0.1	-0.02	0.075	0.021	641	0.61	-0.1	0.662	-0.1	-0.1	2.36	
02/12/87	-0.1	-0.02	0.07	0.024	128	0.543	-0.1	0.187	-0.2	-0.1	3.964	
02/13/87	-0.1	-0.02	0.212	-0.02	245.5	0.288	-0.1	0.617	-0.1	-0.1	1.466	
02/17/87	-0.1	-0.02	0.273	0.161	279.2	0.388	-0.2	0.146	0.1	0.119	4.113	
02/18/87	-0.1	-0.02	0.232	0.082	110	7.897	-0.15	0.869	-0.1	-0.1	3.438	
02/19/87	-0.1	-0.02	0.228	0.059	303.2	1.844	-0.15	0.526	-0.1	-0.1	3.288	
02/20/87	0	0	0	0	0	0	0	0	0	0	0	Sampling
02/21/87	0	0	0	0	0	0	0	0	0	0	0	Sampling
02/23/87	0	0	0	0	0	0	0	0	0	0	0	Sampling
02/24/87	0	0	0	0	0	0	0	0	0	0	0	Sampling
02/25/87	0	0	0	0	0	0	0	0	0	0	0	Sampling
02/26/87	0	0	0	0	0	0	0	0	0	0	0	Sampling
02/27/87	0	0	0	0	0	0	0	0	0	0	0	Sampling
02/28/87	0	0	0	0	0	0	0	0	0	0	0	Sampling
03/02/87	0	0	0	0	0	0	0	0	0	0	0	Sampling
03/03/87	0	0	0	0	0	0	0	0	0	0	0	Sampling
03/04/87	-0.15	0.024	-0.02	-0.02	13	-0.1	-0.2	0.089	-0.15	-0.1	0.397	
03/05/87	-0.15	-0.02	-0.02	-0.02	124	0.307	-0.2	0.078	-0.15	-0.1	0.842	
03/06/87	0	0	0	0	0	0	0	0	0	0	0	Sampling
03/09/87	-0.15	-0.01	0.071	0.021	169.2	0.283	-0.15	0.203	-0.1	-0.1	0.253	
03/10/87	-0.15	-0.02	-0.02	0.041	223.5	-0.15	-0.15	0.301	-0.1	-0.1	0.633	
03/11/87	-0.15	-0.02	-0.02	0.075	39.33	-0.15	-0.15	0.159	-0.1	-0.1	8.965	
03/12/87	-0.15	-0.02	-0.02	-0.02	300	-0.1	-0.2	0.083	-0.15	-0.1	4.524	
03/13/87	-0.15	-0.02	-0.02	0.114	455.4	-0.1	-0.2	-0.04	-0.15	-0.1	2.13	
03/14/87	-0.5	0.026	0	0.039	51.96	-0.2	-0.25	-0.04	-0.25	-0.1	3.802	
03/15/87	-0.5	0.056	0	0.036	278.8	0.294	-0.25	0.115	-0.25	-0.1	19.48	
03/16/87	0	0	0	0	0	0	0	0	0	0	0	
03/17/87	-0.5	0.033	0	0.065	444.5	0.684	-0.25	0.705	-0.25	-0.1	25.3	
03/19/87	-0.5	0.021	0	0.031	93.53	-0.2	-0.25	-0.04	-0.25	-0.1	1.611	

03/20/87	-0.5	0.022	0.214	0.071	638.7	0.437	-0.25	1.094	-0.25	-0.1	3.014
03/21/87	-0.5	-0.02	-0.02	-0.02	482.1	-0.2	-0.25	0.077	-0.25	-0.1	0.87
03/23/87	-0.5	-0.02	-0.03	0.046	14.98	-0.2	-0.25	0.104	-0.25	-0.1	0.112
03/24/87	-0.5	0.024	-0.03	0.048	29.88	-0.2	-0.25	0.19	-0.25	-0.1	0.228
03/25/87	-0.5	-0.02	-0.03	0.046	104.7	0.363	-0.25	0.159	-0.25	-0.1	0.456
03/26/87	-0.5	0.027	-0.03	0.04	440.8	-0.2	-0.25	0.587	-0.2	-0.1	0.547
03/27/87	-0.5	-0.02	-0.03	0.066	136.8	-0.2	-0.25	0.296	-0.25	-0.1	0.156
03/30/87	-0.5	-0.02	0.031	0.085	17.19	-0.2	-0.25	0.274	-0.25	-0.1	2.111
03/31/87	-0.5	-0.02	-0.03	0.06	54.42	-0.2	-0.25	0.207	-0.25	-0.1	0.37
04/01/87	-0.5	-0.02	-0.03	0.084	35.93	-0.2	-0.25	0.192	-0.25	-0.1	0.581
04/02/87	-0.5	-0.02	0.036	0.109	25.43	-0.2	-0.25	0.304	-0.25	-0.1	0.299

DYNECOL, INC.
~~WASTE ACID SERVICES, INC.~~

6520 Georgia St.
Detroit, MI 48211
313-571-7140

Date: _____

Sample I.D. No.: _____

GENERATOR

Company Name _____ Phone _____

Address _____ City _____ State _____ Zip _____

Contact and Title _____

SUBMITTER OF SAMPLE *(if different from GENERATOR)*

Company Name _____ Phone _____

Address _____ City _____ State _____ Zip _____

Contact and Title _____

WASTE DESCRIPTION

Common Name _____ Volume Generated (gal./mo.) _____

DOT Shipping Name _____

DOT Hazard Class _____ DOT Shipping Code (UN/NA) _____

EPA Hazardous Waste No. _____

Description of Process Generating Waste _____

Handling Precautions _____

WASTE CHARACTERIZATION

Physical State @ 70°F *(circle one)*: Solid Slurry Liquid Powder

Specific Gravity @ 70°F _____ BOD _____ COD _____ TOC _____

Flash Point and Method _____ pH _____ % Acid or Alkali _____

Odor *(describe)* _____

Circle yes (Y) or no (N) to the presence of the following characteristics or contaminants:

Carcinogen	Y	N	Poison	Y	N	Asbestos	Y	N
Corrosive	Y	N	Radioactive	Y	N	Cyanide	Y	N
Explosive	Y	N	Reactive	Y	N	Organics	Y	N
Flammable	Y	N	Water Dispersion	Y	N	PCB's	Y	N
Oxidizer	Y	N	Water Solution	Y	N	Pesticides	Y	N
Reducer	Y	N				Sulfides	Y	N

WASTE COMPOSITION *(concentration in ppm or mg/l)*

Arsenic	_____	Cyanides	_____	Phenols	_____
Barium	_____	Fats, Oil, Grease	_____	Selenium	_____
Cadmium	_____	Iron	_____	Silver	_____
Cobalt	_____	Lead	_____	Sulfides	_____
Copper	_____	Mercury	_____	Zinc	_____
Chromium (+6)	_____	Molybdenum	_____		
Chromium (total)	_____	Nickel	_____		

Other Components	EPA Haz. Waste No.	Concentration (%)
1.		
2.		
3.		
4.		

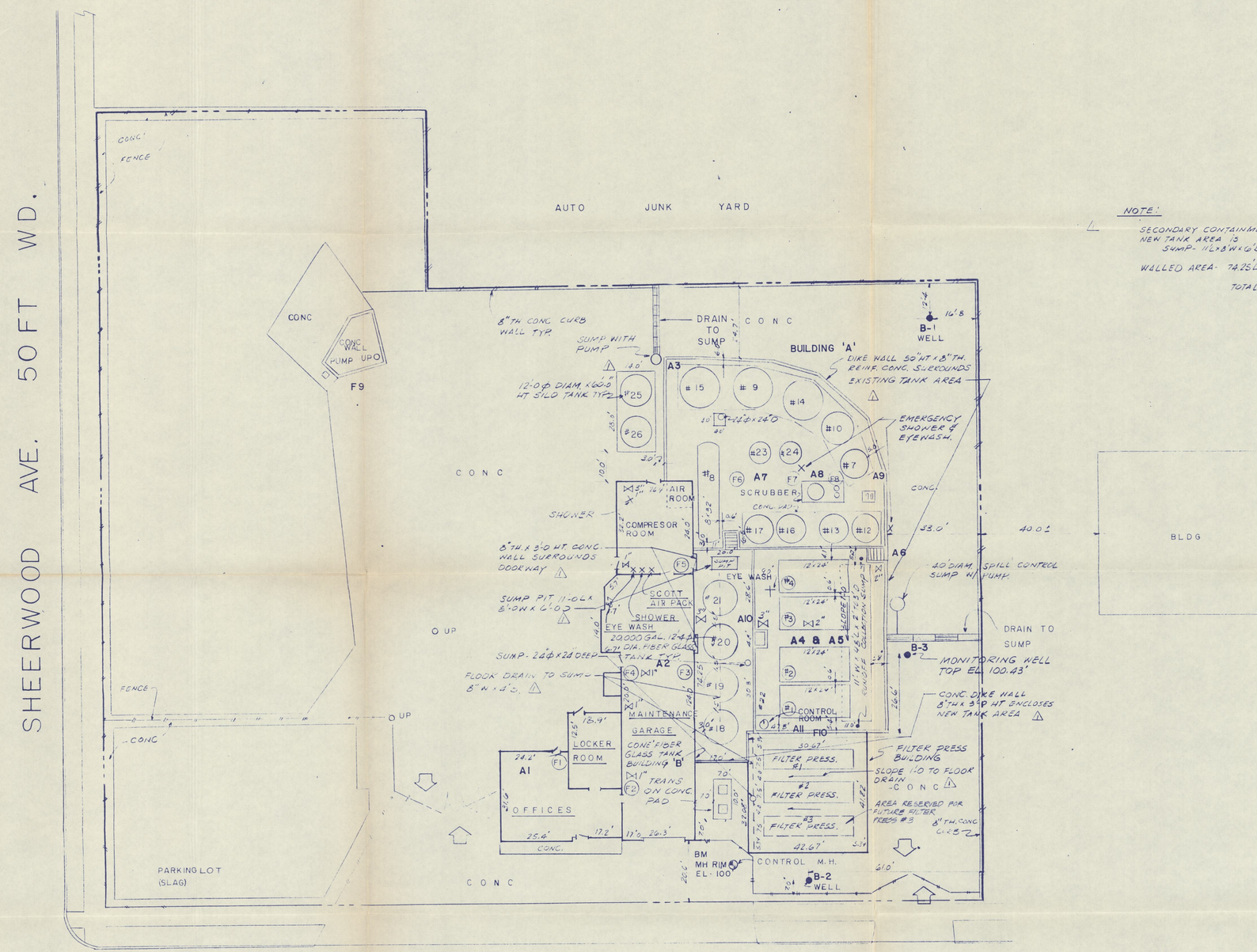
ACTION

☐ Please send a 16 oz. sample in DOT approved container.

☐ Report completed by: *(Name, Title, Phone No.)* _____

APPENDIX O

This appendix is reserved for future use.



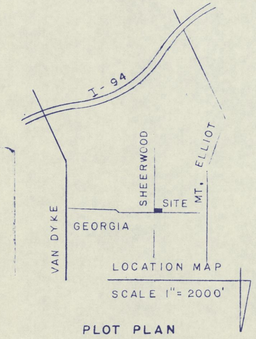
SITE PLAN
SCALE. 1" = 20'
NORTH

NOTE:
SECONDARY CONTAINMENT IN NEW TANK AREA IS
SUMP- 11L x 8W x 6'D = 3,950 GAL.
WALLED AREA- 74.25L x 17W x 3'D = 28,325 GAL.
TOTAL VOLUME = 32,275 GAL.

TANK NO.	VOLUME DIMENSION	USAGE
1	20,000 Gal. 12'D X 24'L	
2	20,000 Gal. 12'D X 24'L	
3	20,000 Gal. 12'D X 24'L	
4	20,000 Gal. 12'D X 24'L	
7	10,000 Gal. 10'D X 17'L	
8	12,000 Gal. 8'D X 32'L	
9	27,600 Gal. 14'D X 24'H	
10	12,000 Gal. 12'D X14'H	
12	25,800 Gal. 11'd X 35'H	
13	25,800 Gal. 11'D X 35'H	
14	14,000 Gal. 14'D X 12'H	
15	27,600 Gal. 14'd X 24'H	
16	25,800 Gal. 11'D X 35'H	
17	25,800 Gal. 11'D X 35'H	
23	6,000 Gal. 8'D X 16'H	
24	6,000 Gal. 8'D X 16'H	
22	975 Gal 4'D x 11'H	
25,26	5,000 CU FT 12'D x 60' H	
18-21	20,000 Gal 12'D x 22'H	

EMERGENCY EQUIPMENT SYMBOLS

A1-A11	ALARM ACTUATORS
F1-F10	FIRE EXTINGUISHERS
3"	WATERLINE
1"	WATERLINE



LOCATION MAP
SCALE 1" = 2000'

PLOT PLAN

Dynecol, Inc. - 1988 Act 64
License Reapplication

NO.	REVISION	DATE
1	REVISED & ADDED AS NOTED	04-03-86
	ISSUED FOR REVIEW & APPROVAL	02-07-86

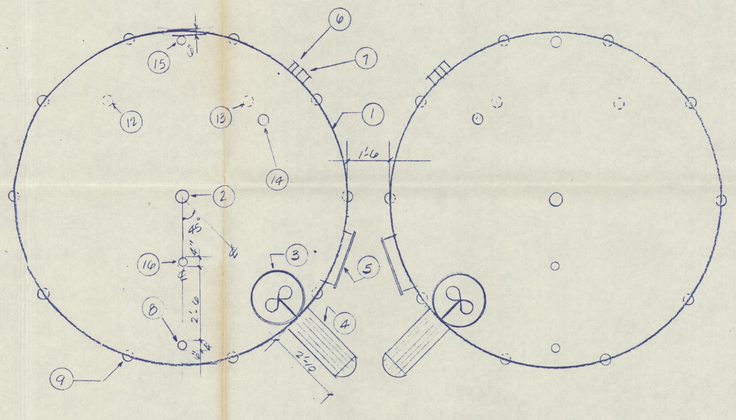
CONSULTING ENGINEERS
CHEMTEC RESEARCH ASSOCIATES, INC.
16241 WESTMORELAND
DETROIT, MICH. 48219

OWNER
DYNECOL, INC.
6520 GEORGIA ST.
DETROIT, MICH. 48211

TITLE
SITE PLAN

SCALE 1" = 40'-0	DATE	PROJECT NO.
DRAWN BY SH, HB, AQ	JAN. 27 1986	
DESIGNED BY HB, RB	JAN. 27 1986	SHEET NO.
CHECKED BY HB, RB	FEB. 7, 1986	SP-1 OF 1
APPROVED BY RB	FEB 7, 1986	

RECEIVED
OCT 10 1988
Waste Management Division



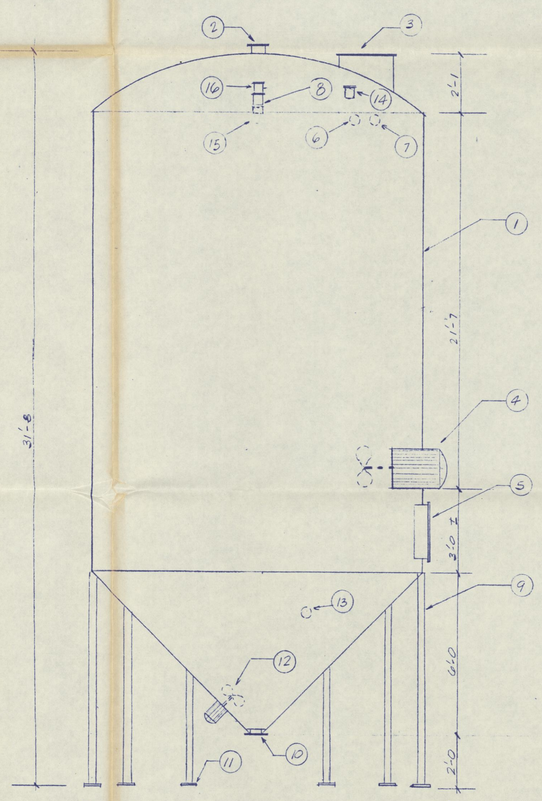
TANK A & C

TANK B & D

TOP PLAN VIEW - CONE FIBERGLASS TANK

3/8" = 1'-0

20,000 GALLON CAPACITY.



TANK A & C, IDENTICAL FOR B & D TANK

FRONT ELEVATION VIEW - CONE FIBERGLASS TANK

NOT TO SCALE

NOTE:

SUPPLIER OR FABRICATOR SHALL COORDINATE WITH ENGINEER FOR ANY DISCREPENCY.

ITEM NO.	DESCRIPTION OF ITEMS ON EACH TANK
1.	20,000 GALLON CONE FIBERGLASS TANK 12'-4" ϕ DIA.
2.	6" FLANGE, TANK VENT
3.	24" ϕ DIA MANWAY
4.	AGITATOR MOTOR WITH FLANGE
5.	24" ϕ DIA. MANWAY
6.	3" FLANGE, PH LOOP INLET
7.	4" FLANGE, TANK OVERFLOW
8.	4" FLANGE, WASTE INLET
9.	3" ϕ DIA. PIPE TANK LEG
10.	6" FLANGE, TANK OUTLET
11.	BASE PLATE
12.	AGITATOR MOTOR WITH FLANGE
13	PH LOOP OUTLET 3" ϕ DIA FLANGE
14	4" LEVEL CONTROL FLANGE
15	4" TRANSFER INLET FLANGE
16	3" FLANGE, LIME INLET

Dynecol, Inc. - 1988 Act 64
License Reapplication

RECEIVED
OCT 10 1988
Waste Management Division

NO.	REVISION	DATE

CONSULTING ENGINEERS

CHEMTEC RESEARCH ASSOCIATES, INC.

16241 WESTMORELAND
DETROIT, MICH. 48219

OWNER

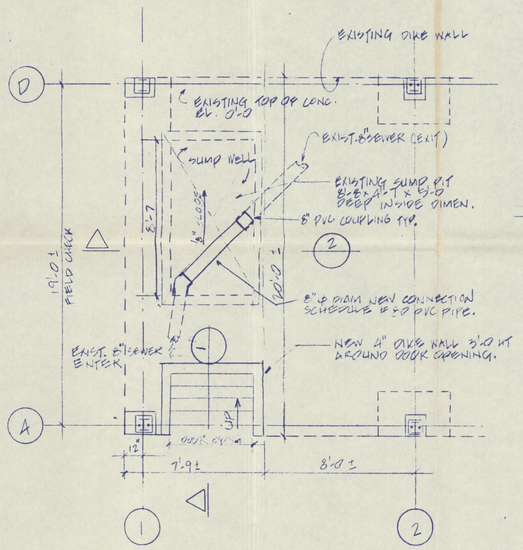
WASTE ACID SERVICES, INC.

6520 GEORGIA ST.
DETROIT, MICH. 48211

TITLE

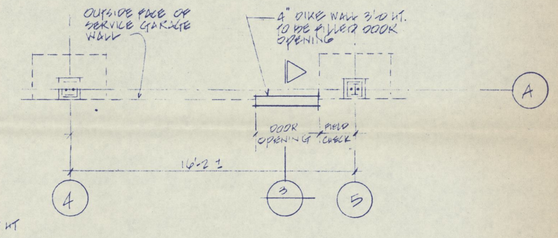
PLAN & ELEVATION
CONE FIBERGLASS TANK

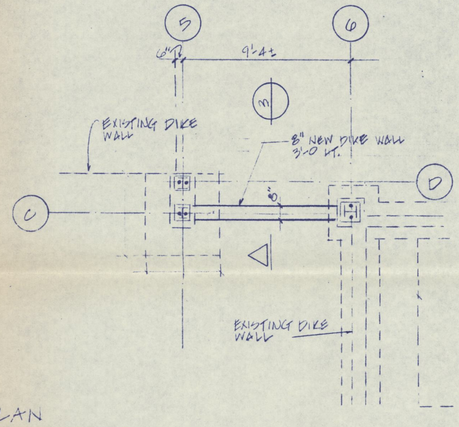
SCALE AS NOTED	DATE	PROJECT NO.
DRAWN BY HB	SEPT. 12, 85	
DESIGNED BY RB	SEPT. 11, 85	SHEET NO.
CHECKED BY RB	SEPT. 13, 85	1 OF 1
APPROVED BY RB	SEPT. 13, 85	



SUMP PIT & DIKE WALL PLAN

1/4" = 1'-0





NEW DIKE WALLS PLAN

1/4" = 1'-0

MATERAL SPECIFICATION:

MATERIAL:

Caroline 505 an epoxy based fiberglass reinforced lining system installed 1/8" thick.

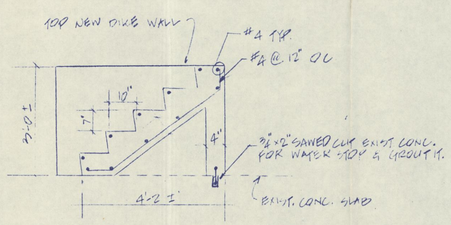
FILLING HOLE:

Hole in crock will be patched as follows.

1. Install a back up plate such as a hard piece of fiberglass sheeting.
2. Fill crock hole cavity with caroline 505 resin and powder filler.
3. After this has set up line this filler area, and exterior of unit with the caroline 505 lining system.

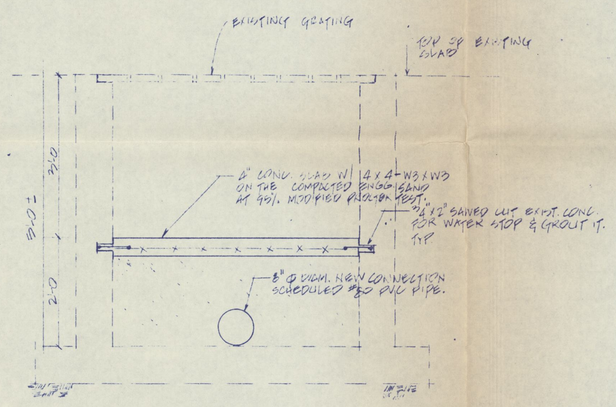
NOTES:

1. Refer sheet no. s-1 for general note.
2. Provide 3/4" x 2" sawed cut or chisel cut between existing concrete surface or existing brick wall and new concrete construction to have intalled water-stop as shown in the sections.
3. All dike walls and floor should be coated with CEILCOTE flakeline epoxy coating or equivalent.
4. 3'-0" height of existing service garage brick wall and new dike walls are capable to resist fluid pressure in the dike.
5. REFER SHT. NO S-1 FOR SUMP PIT & DIKE WALLS LOCATION.
6. TOTAL VOLUME OF DIKE SHALL BE 444.2 CUFT.



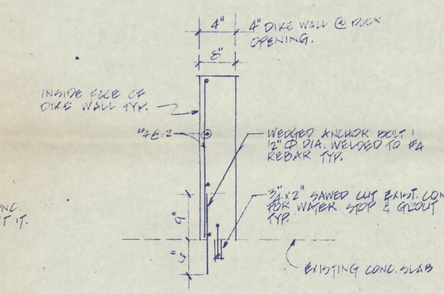
SECTION 1

3/4" = 1'-0



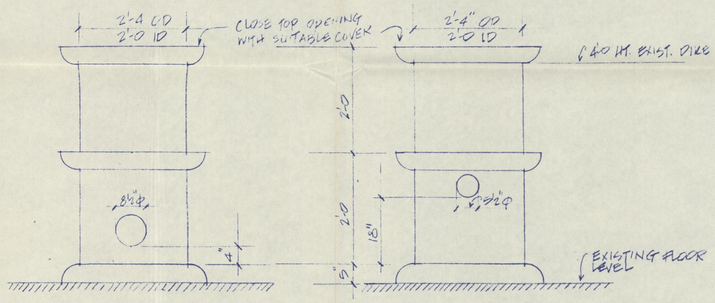
SECTION 2

3/4" = 1'-0



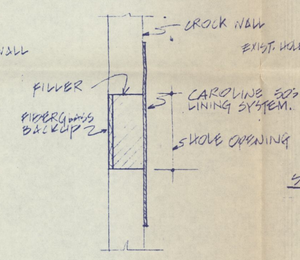
SECTION 3

3/4" = 1'-0

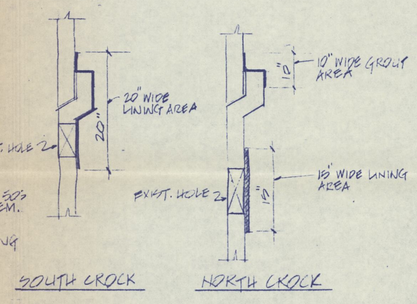


NORTH CROCK

SOUTH CROCK



CROCK HOLE DETAIL TYP.



SOUTH CROCK

NORTH CROCK

CROCK TYP. SECTION FOR JOINT & HOLE FILLER.

Dynecol, Inc. - 1988 Act 64
License Reapplication

NO.	REVISION	DATE

CONSULTING ENGINEERS

CHEMTEC RESEARCH ASSOCIATES, INC.

16241 WESTMORELAND
DETROIT, MICH. 48219

OWNER

DYNECOL, INC.

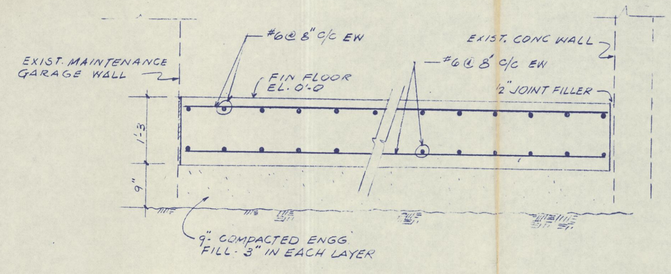
6520 GEORGIA ST.
DETROIT, MICH. 48211

TITLE

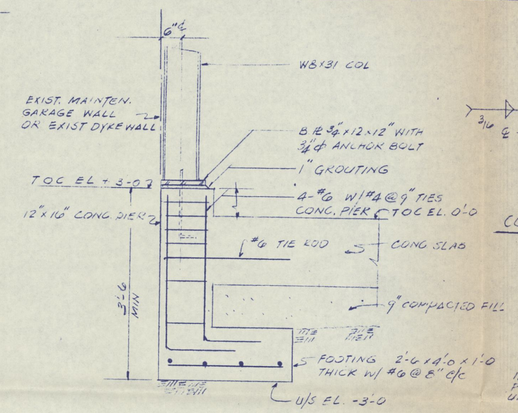
SUMP PIT AND NEW DIKE WALL PLANS & SECTIONS

SCALE As NOTED	DATE	PROJECT NO.
DRAWN BY HB	4-27-87	
DESIGNED BY HB	4-27-87	SHEET NO.
CHECKED BY HB KB	5-4-87	A-1 OF 1
APPROVED BY		

RECEIVED
OCT 1 0 1988
Waste Management Division



SECTION 1 / S-1
3/4" = 1'-0



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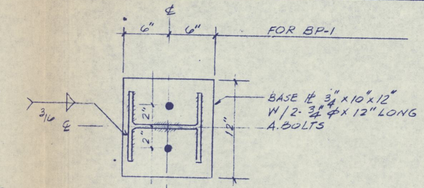
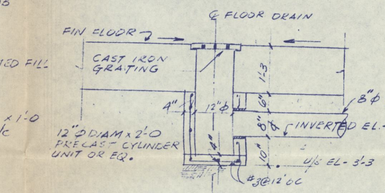
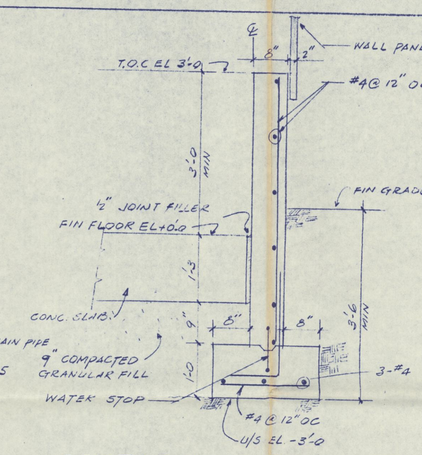
3/4" = 1'-0



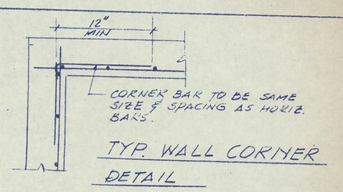
COL. BASE PL DETAIL TYP



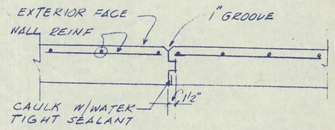
SECTION 6 / S-1 DRAIN DETAIL



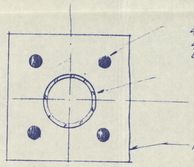
SECTION 5 / S-1
3/4" = 1'-0

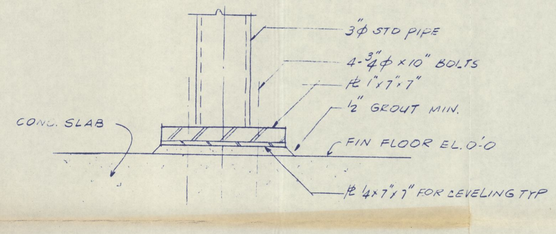


TYP WALL CORNER DETAIL

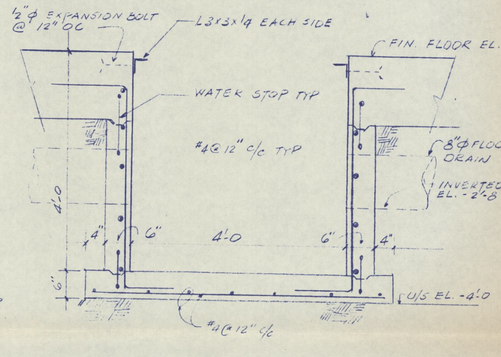


TYP. CONC. WALL CONSTRUCTION DETAIL

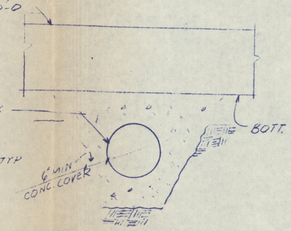




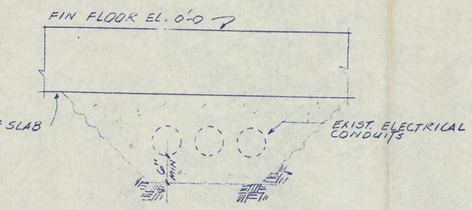
TANK LEG BASE PLATE DETAIL
3" = 1"



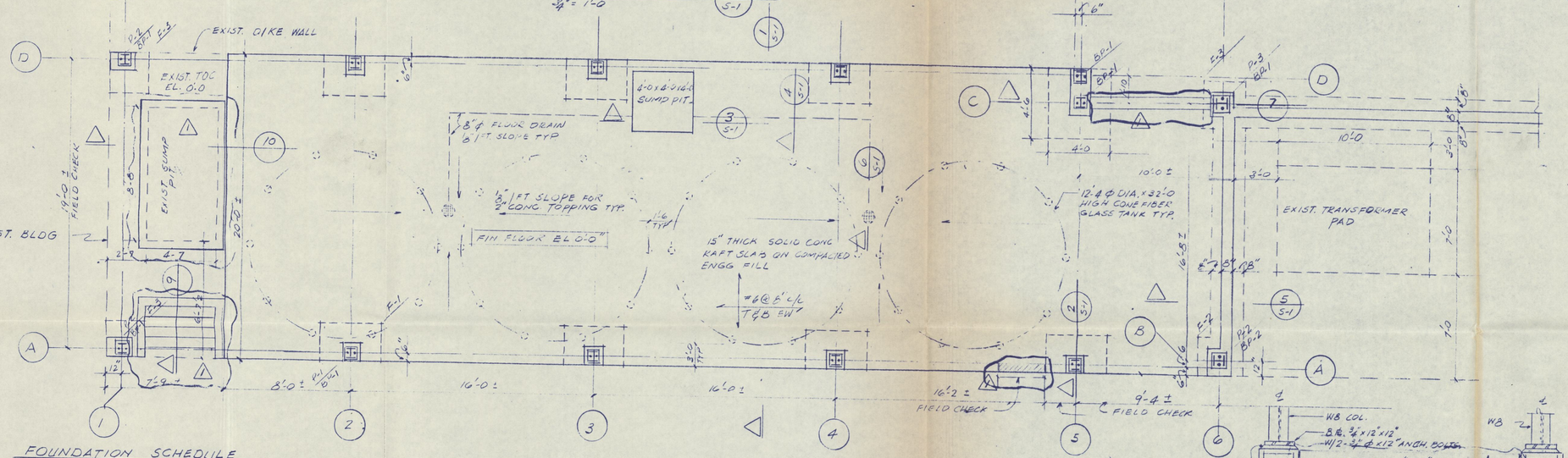
SECTION SUMP PIT 3 / S-1
3/4" = 1'-0



SECTION 4 / S-1
3/4" = 1'-0

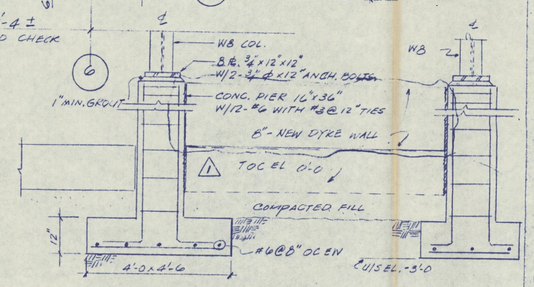


UNDERGROUND PIPE PROTECTION DET.



FOUNDATION PLAN
4" = 1'-0

NORTH



SECTION 7
1/2" = 1'-0

GENERAL NOTE:

1. Cone fiberglass tanks raft foundation is designed for soil pressure of 1000 psf and column footing is designed for soil pressure of 2000 psf at the depth indicated. Contact the engineer for correction action.
2. All conrete shall have a 28 day compressive strength of 3000 psi min.
3. Reinforcement steel yeild strength shall be grade of 60,000 psi unless noted otherwise.
4. Contractor shall verify location of foundation laylout with plant operator before casting footing and slab if plant is required to be shutdown.
5. The standards of ACI Building Code 318-83 and the standards of practice ACI 318-80 shall be followed for all detailing, fabrication and placement of all reinforcing steel and accessries.
6. All fill under slab foundation and footings shall be compacted to 95% of maximum density (Modified Proctor Test) at optimum moisture content.
7. Provide emporary bracing as required to insure the stability of existng and new structures.
8. Contractor shall coordinate with engineer during construction activities for any discripency.

FOUNDATION SCHEDULE

	MARK	SIZE	REINF.	REMARK
PIER	P-1	12"x16"	4-#6 W/#4@9" TIES	TOC EL 0'-6
	P-2	16"x20"	4-#6 W/#4@9" TIES	TOC EL 0'-6
	P-3	16"x16"	4-#6 W/#4@9" TIES	TOC EL 3'-0
BASE PL	BP-1	3/4"x10"x12"		2-3/4"φ x 12" A.B
	BP-2			
	BP-3			
FOOTING	F-1	2'-6 x 4'-0 x 1'-0	#6@8" OC EW	U/S EL -3'-0
	F-2	2'-4 x 2'-8 x 1'-0	#6@8" OC EW	U/S EL -3'-0
	F-3	2'-8 x 2'-8 x 1'-0	#6@8" OC EW	U/S EL -3'-0

Dynecol, Inc. - 1988 Act 64
License Reapplication

NO.	REVISION	DATE
1	SUMP PIT & NEW DIKE WALL REF. SHT. A-1	3-31-87
	ISSED FOR CONSTRUCTION	10-2-85
	ISSUED FOR REVIEW & APPROVAL	9-30-85

CONSULTING ENGINEERS
CHEMTEC RESEARCH ASSOCIATES, INC.
16241 WESTMORELAND
DETROIT, MICH. 48219

OWNER
DYNECOL, INC.
6520 GEORGIA ST.
DETROIT, MICH. 48211

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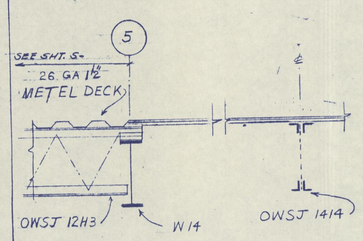
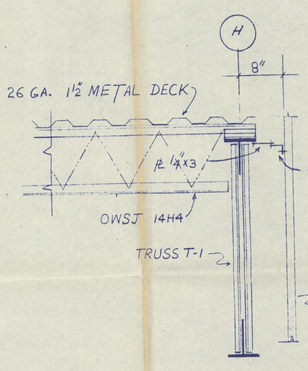
TITLE CONE FIBERGLASS TANKS
FOUNDATION PLAN
SECTIONS & DETAILS

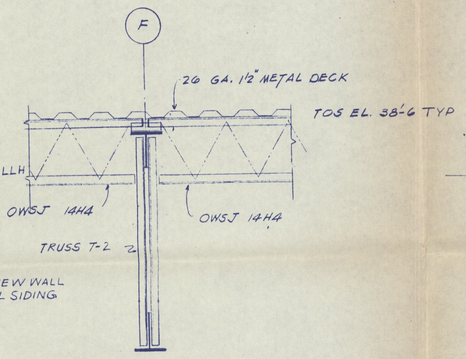
SCALE AS NOTED	DATE	PROJECT NO.
DRAWN BY HB	9/30/85	
DESIGNED BY HB	9/30/85	SHEET NO.
CHECKED BY HB, RB	9/30/85	S-1 OF
APPROVED BY		



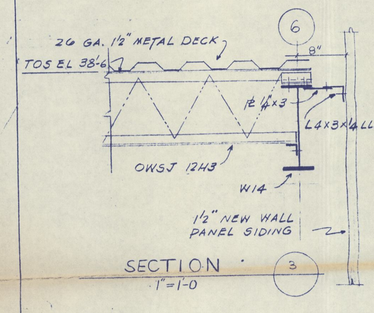
SECTION 6
3/4" = 1'-0



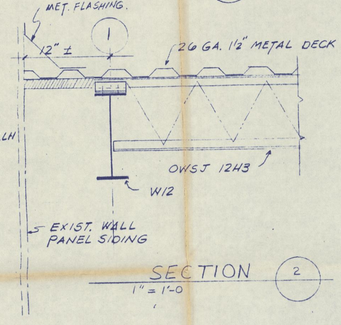
SECTION 5
3/4" = 1'-0



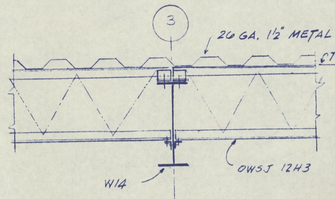
SECTION 4
3/4" = 1'-0



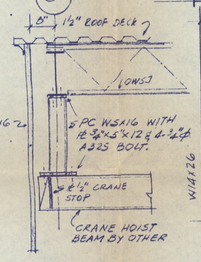
SECTION 3
1" = 1'-0



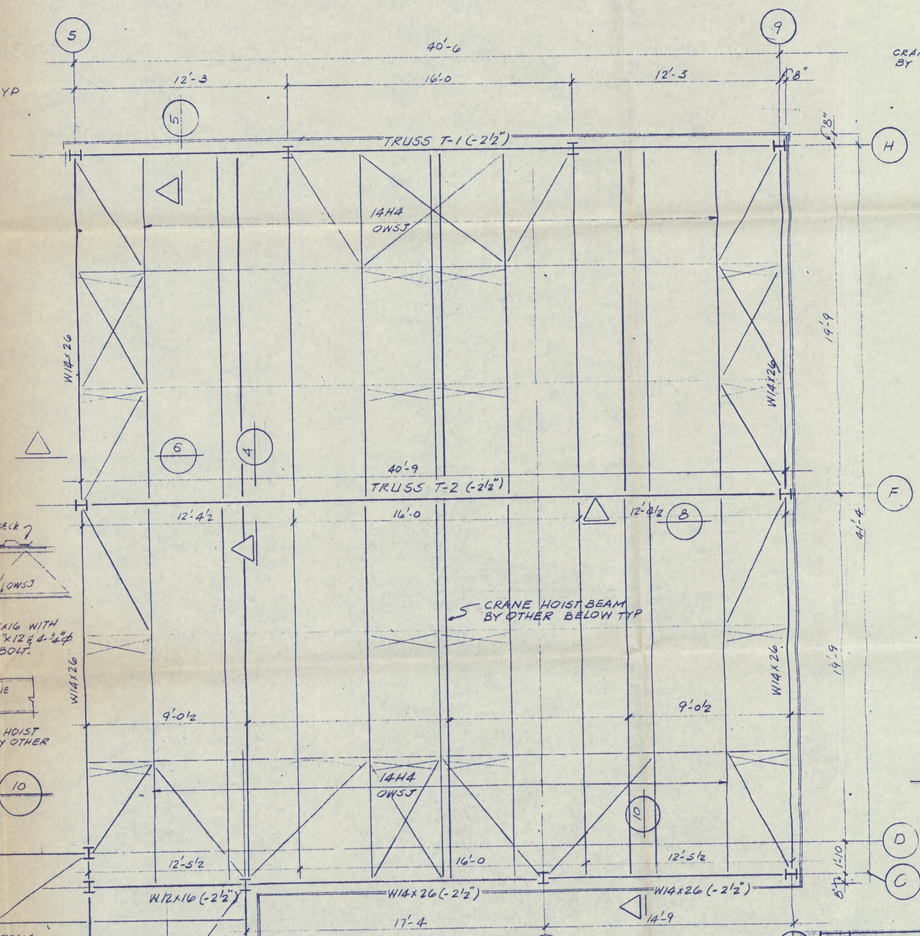
SECTION 2
1" = 1'-0

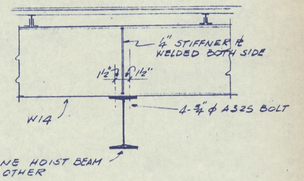


SECTION 1
1" = 1'-0

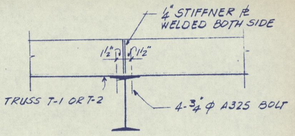


SECTION 10
1½" = 1'-0

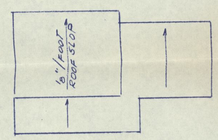




SECTION 7
3/4" = 1'-0

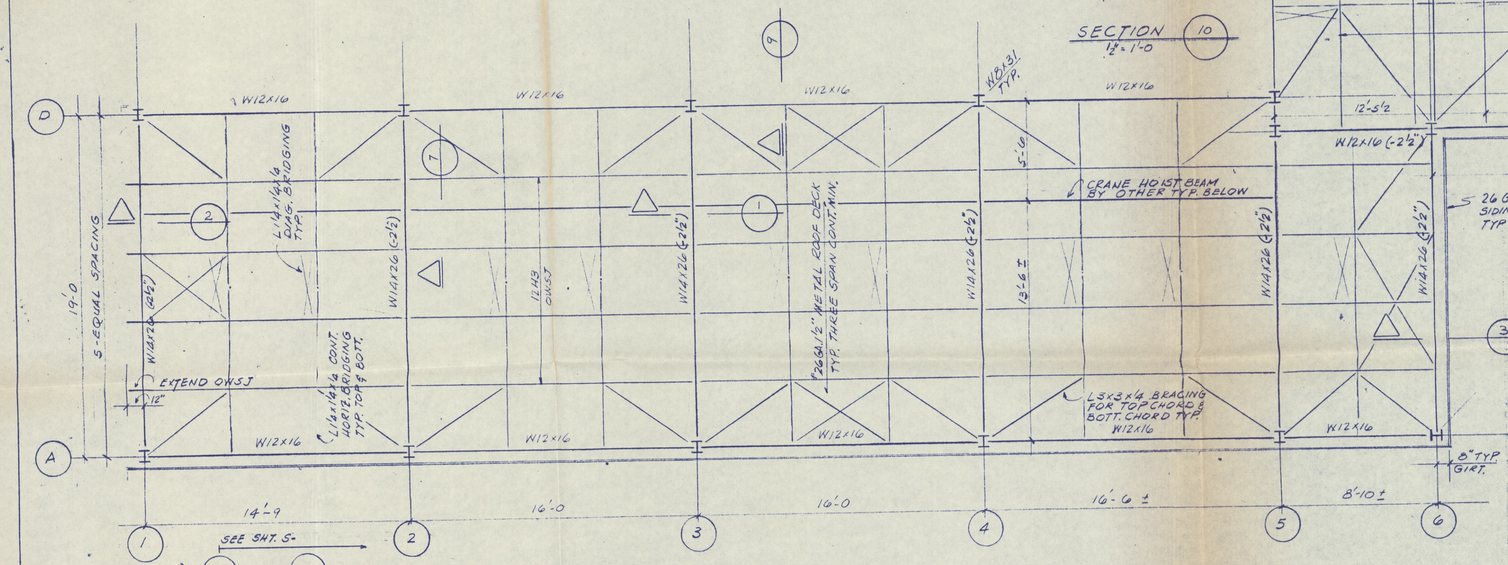


SECTION 8
3/4" = 1'-0



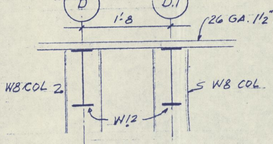
SCHEMATIC ROOF SLOPE PLAN

NORTH



ROOF FRAMING PLAN
4" = 1'-0

NORTH



SECTION 9
3/4" = 1'-0

GENERAL NOTES

STRUCTURAL STEEL NOTES:

1. Design live loads are as follows:
   Roof 30 psf
   Control Room 250 psf
   Filter press floor 100 psf
2. Design, fabrication and erection of strucutral steel shall be in accordance with current AISC Specification. All strucutural steel shall be ASTM A-36, unless noted otherwise.
3. Welding shall be in accordance with current "Code for welding in Building Construction".American Welding Society. Electrodes for welding shall be AWS 5.1 or A5.5,E70xx.
4. Verify all existing dimensions and elevations shown on drawings before commencing work.
5. Shop connection shall be welded and field connections shall be bolted 3/4" diameter ASTM A-325-F unless noted otherwise.
6. Provide temporary bracing as required to insure stability of the strucutre until the permanent bracing is in place.
7. Provide angles,clips,plates,bars and any misc. items if required for structural members.
8. Verify dimensions and location of filter press equipment with its drawing before proceeding with steel fabrication and erection.

OPEN WEB STEEL JOIST NOTES:

1. Design,fabrication and erection of OWSJ shall be in accordance with current SJI and AISC Specification. All OWSJ steel shall have yield strength of 50,000 psi, unless noted otherwise.
2. Live load deflection not to exceed 1/360 of the span. Provide 2½" joist seat for all joist unless noted otherwise.
3. All horizontal, 'V' bridging and cross bridging to be welded or bolted at intersections.
4. All bearing on steel for joist shall be at least 2½" min. beyond the face of support.

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License Reapplication

NO.	REVISION	DATE
	ISSUED FOR CONSTRUCTION	11-25-85
	ISSUED FOR REVIEW	10-21-85

CONSULTING ENGINEERS
CHEMTEC RESEARCH ASSOCIATES, INC.
16241 WESTMORELAND
DETROIT, MICH. 48219

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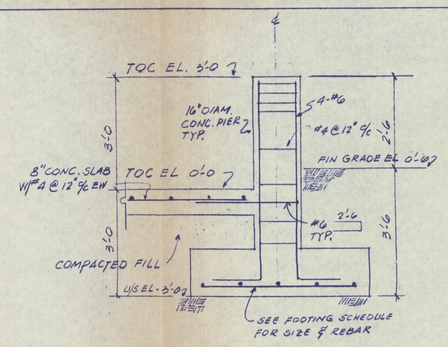
Waste Management Division

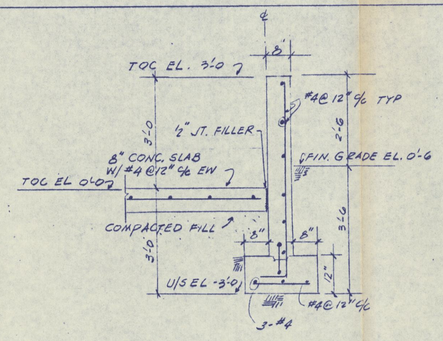
OWNER
WASTE ACID SERVICES, INC.
6520 GEORGIA ST.
DETROIT, MICH. 48211

TITLE CONE FIBERGLASS TANK & FILTER PRESS
ROOF FRAMING PLAN
SECTIONS & DETAILS

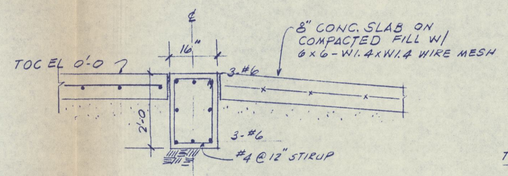
SCALE	AS NOTED	DATE	PROJECT NO.
DRAWN BY	HB	10-8-85	
DESIGNED BY	HB	10-8-85	SHEET NO.
CHECKED BY	HB RB	11-25-85	S-3 OF
APPROVED BY	RB	11-25-85	



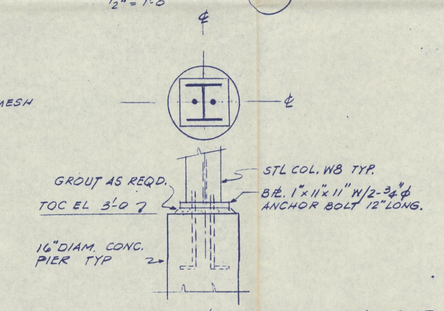
SECTION 1
1/2" = 1'-0



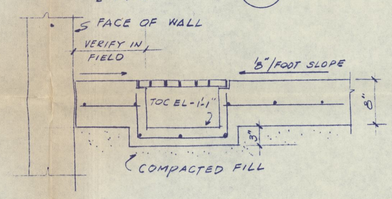
SECTION 2
1/2" = 1'-0



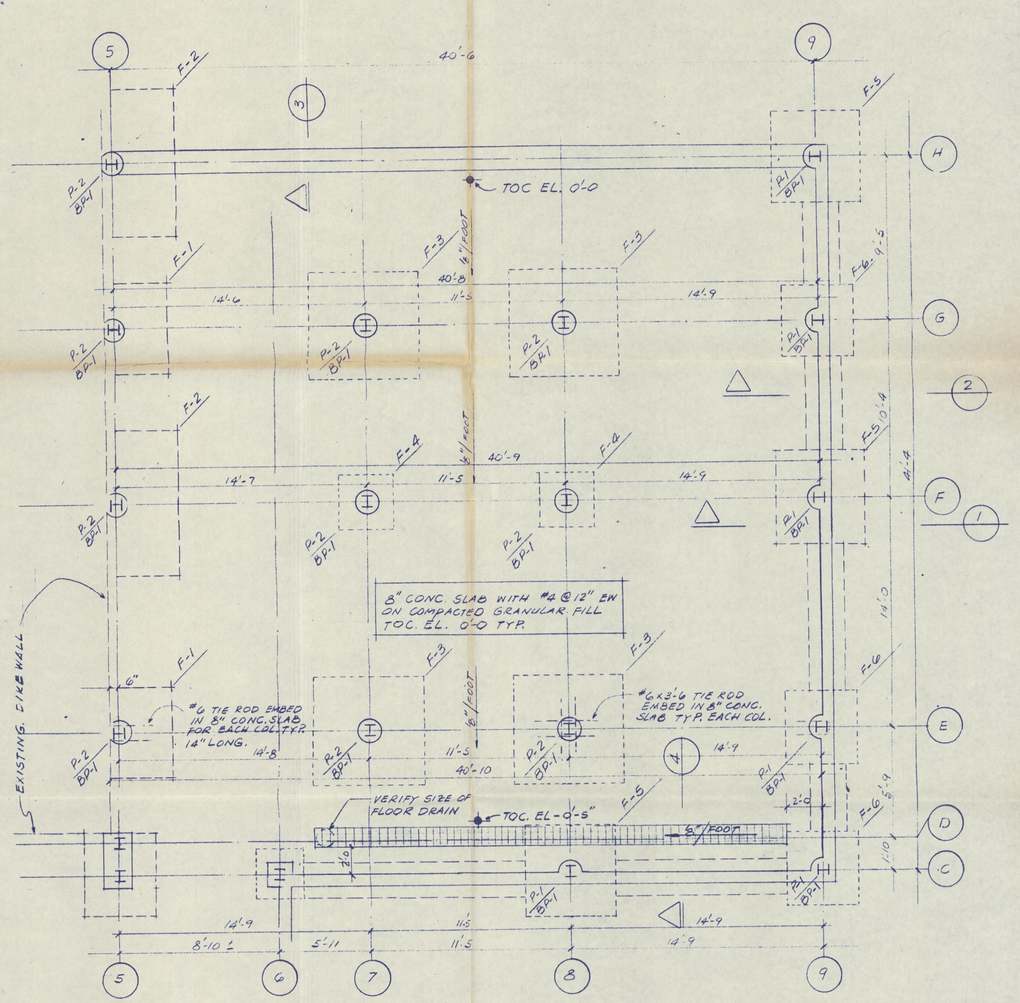
SECTION 3
1/2" = 1'-0



COL. BASE PLATE DETAIL TYP.



SECTION 4
1" = 1'-0



FOUNDATION PLAN
1/4" = 1'-0

NORTH

NOTE:

1. REFER SHEET S-1 FOR GENERAL NOTE, SECTION, & DETAIL CONNECTION WITH THIS DRAWING.

Dynecol, Inc. - 1988 Act 64
License Reapplication

PIER & FOOTING SCHEDULE

	MARK	SIZE	REINFORCEMENT	REMARK
PIER	P-1	16" DIAM.	4-#6 W/#4 @ 9" TIES	TOC EL. 3'-0
	P-2	16" DIAM.	4-#6 W/#4 @ 9" TIES	TOC EL 0'-0
BASE PL	BP-1	BPL. 1" x 11" x 11"		2-3/4" ϕ x 18" AB.
FOOTING	F-1	3'-0 x 3'-0 x 1'-0	6-#6 NS, 10-#6 EW	U/S EL -3'-0
	F-2	3'-6 x 3'-0 x 1'-4	7-#6 NS, 14-#6 EW.	U/S EL -3'-0
	F-3	6'-0 x 6'-0 x 1'-4	7-#6 EW @ BOTT.	U/S EL -3'-0
	F-4	3'-0 x 3'-0 x 1'-0	4-#6 EW @ BOTT.	U/S EL -3'-0
	F-5	5'-0 x 5'-0 x 1'-4	6-#6 EW @ BOTT.	U/S EL -3'-0
	F-6	4'-0 x 4'-0 x 1'-0	5-#6 EW @ BOTT.	U/S EL -3'-0

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Waste Management Division

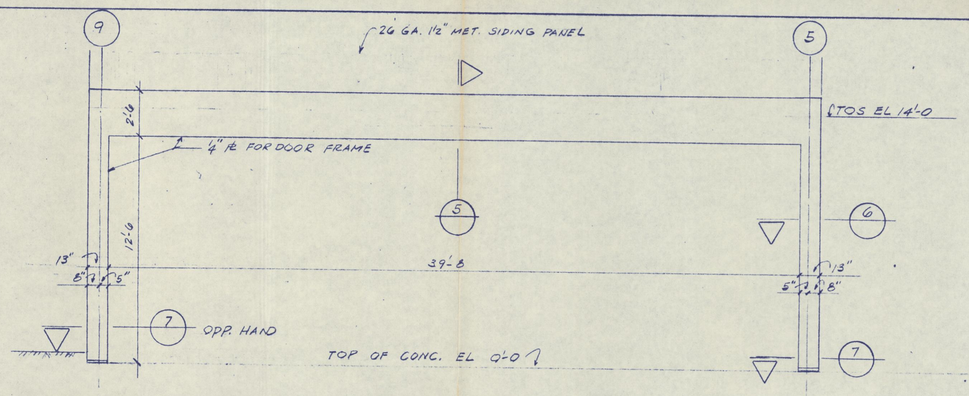
NO.	REVISION	DATE
	ISSUED FOR CONSTRUCTION	11-11-85

CONSULTING ENGINEERS
CHEMTEC RESEARCH ASSOCIATES, INC.
16241 WESTMORELAND
DETROIT, MICH. 48219

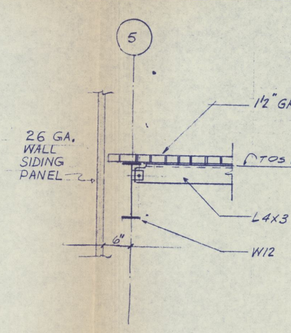
OWNER
WASTE ACID SERVICES, INC.
6520 GEORGIA ST.
DETROIT, MICH. 48211

TITLE FILTER PRESS
FOUNDATION PLAN SECTION & DETAIL

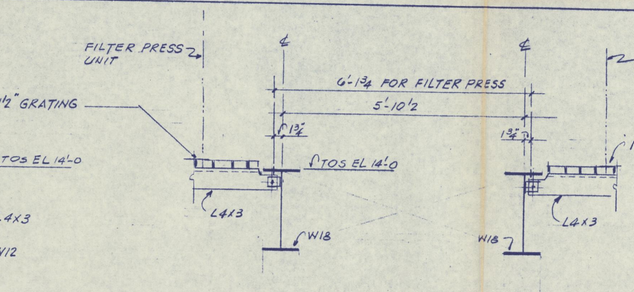
SCALE AS NOTED	DATE	PROJECT NO.
DRAWN BY HB	10-31-85	
DESIGNED BY HB	10-26-85	SHEET NO.
CHECKED BY HB RB	11-09-85	S-2 OF
APPROVED BY RB	11-11-85	



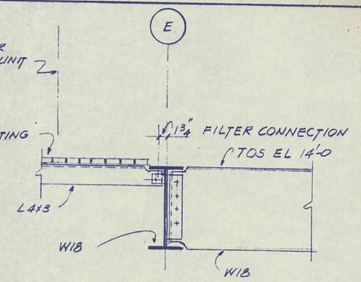
ELEVATION FOR DOOR ON LINE-H
¼" = 1'-0



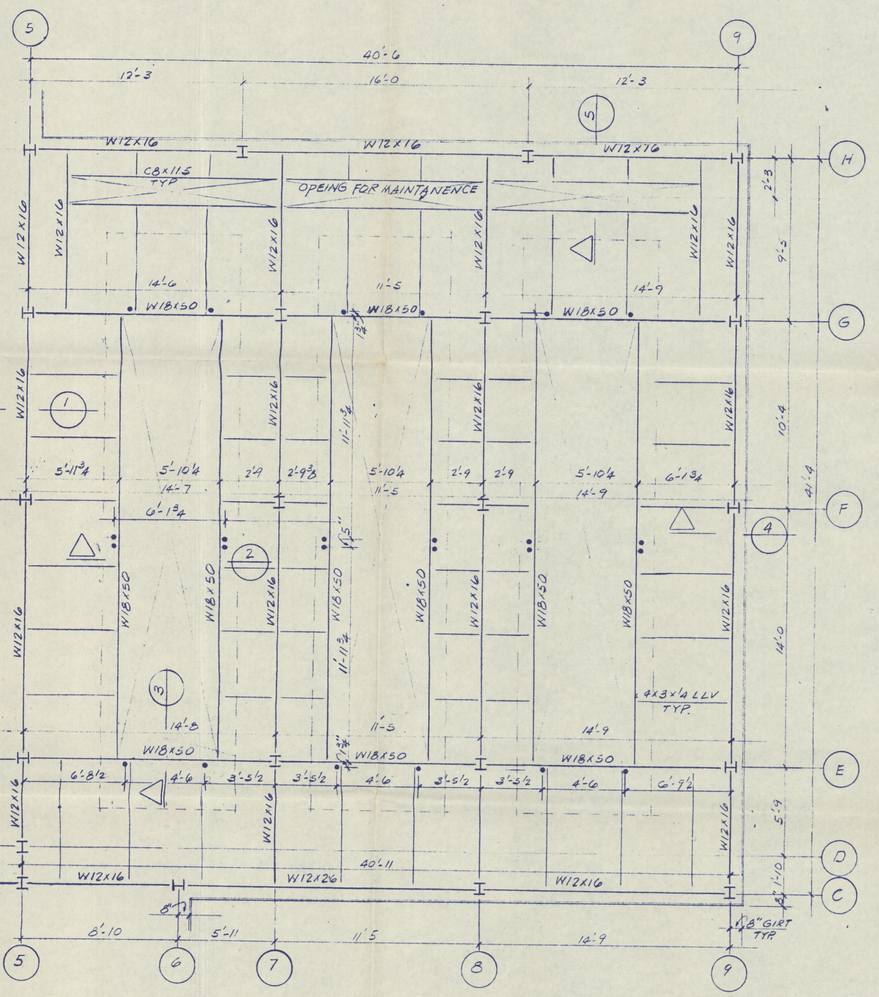
SECTION 1
¾" = 1'-0



SECTION 2
¾" = 1'-0

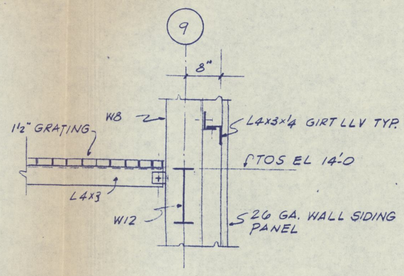


SECTION 3
¾" = 1'-0

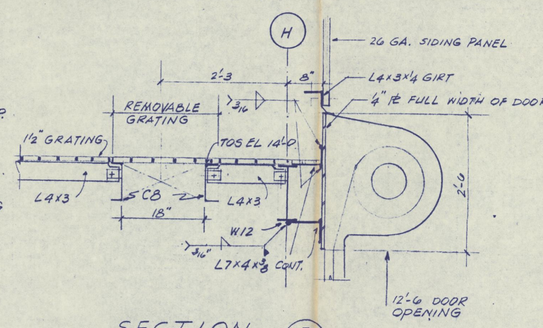


FLOOR FRAMING PLAN TOS EL. 14'-0
¼" = 1'-0

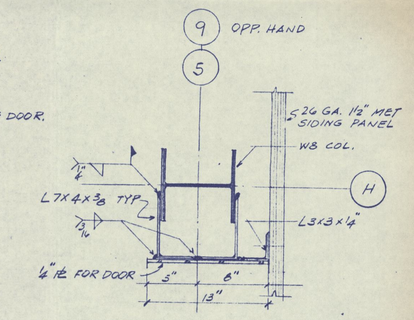
NORTH



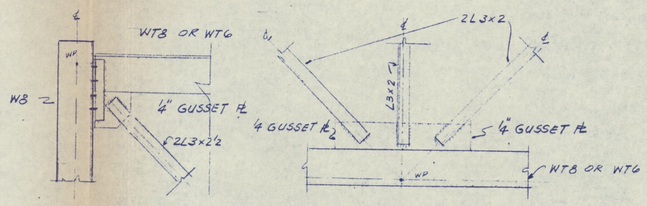
SECTION 4
¾" = 1'-0



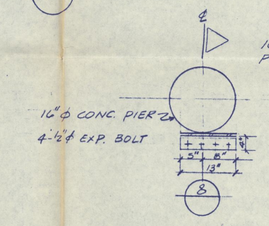
SECTION 5
¾" = 1'-0



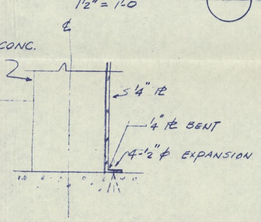
SECTION 6
1½" = 1'-0



TYPICAL TRUSS DETAILS

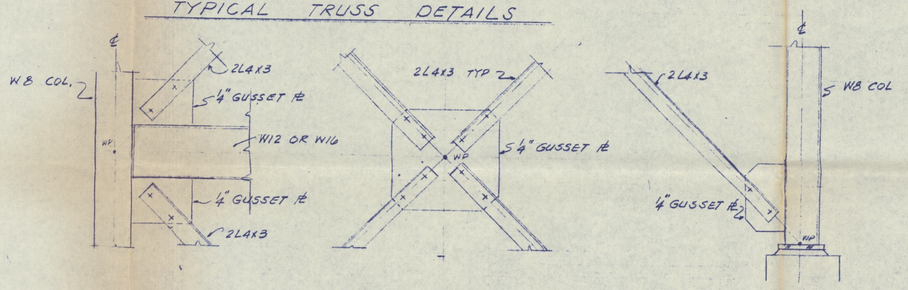


SECTION 7
¾" = 1'-0

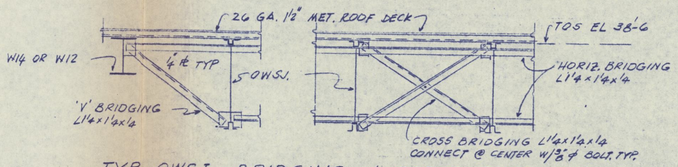


SECTION 8
¾" = 1'-0

NOTE:
1. REFER FOR GENERAL NOTE SHT. S-3.



TYPICAL BRACING DETAILS



TYP. OWSJ BRIDGING & CROSS BRIDGING DETAILS
(SEE ROOF PLAN FOR LOCATION & SIZE)

Dynecol, Inc. - 1988 Act 64
License Reapplication

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Waste Management Division

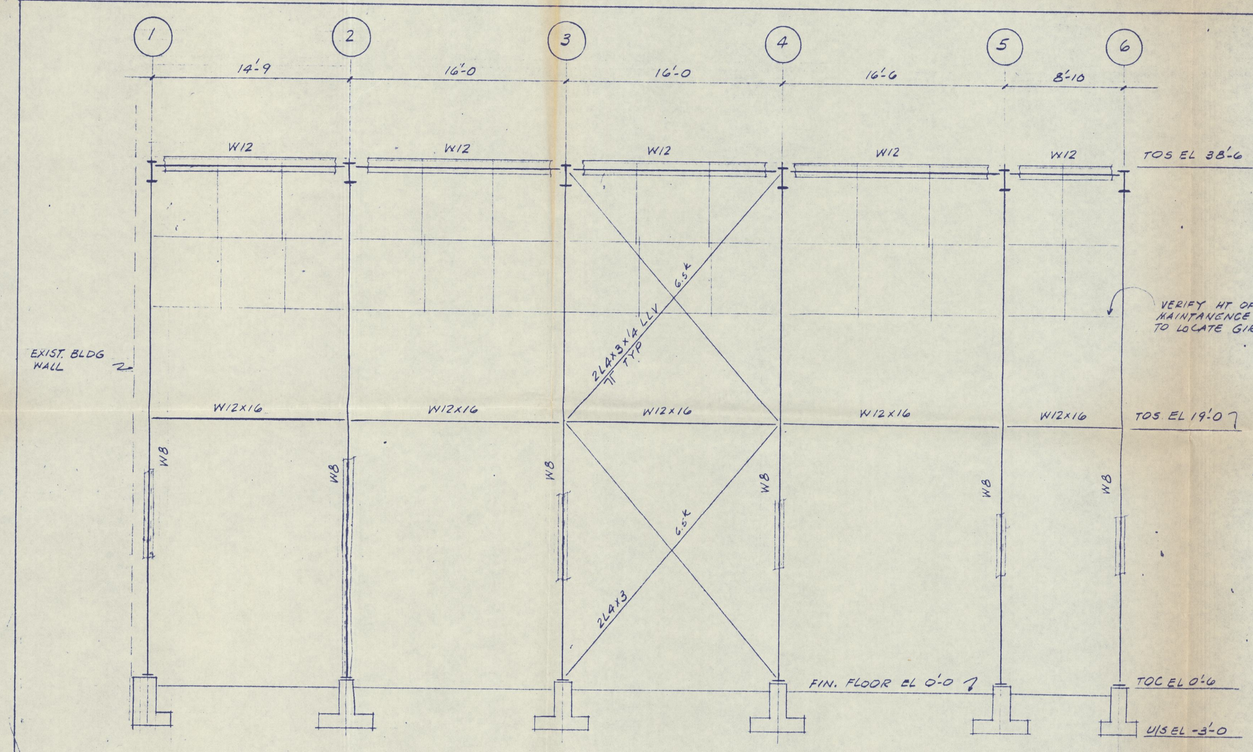
NO.	REVISION	DATE
	ISSUED FOR CONSTRUCTION	11-25-85
	ISSUED FOR REVIEW	10-21-85

CONSULTING ENGINEERS
CHEMTEC RESEARCH ASSOCIATES, INC.
16241 - WESTMORELAND
DETROIT, MICH. 48219

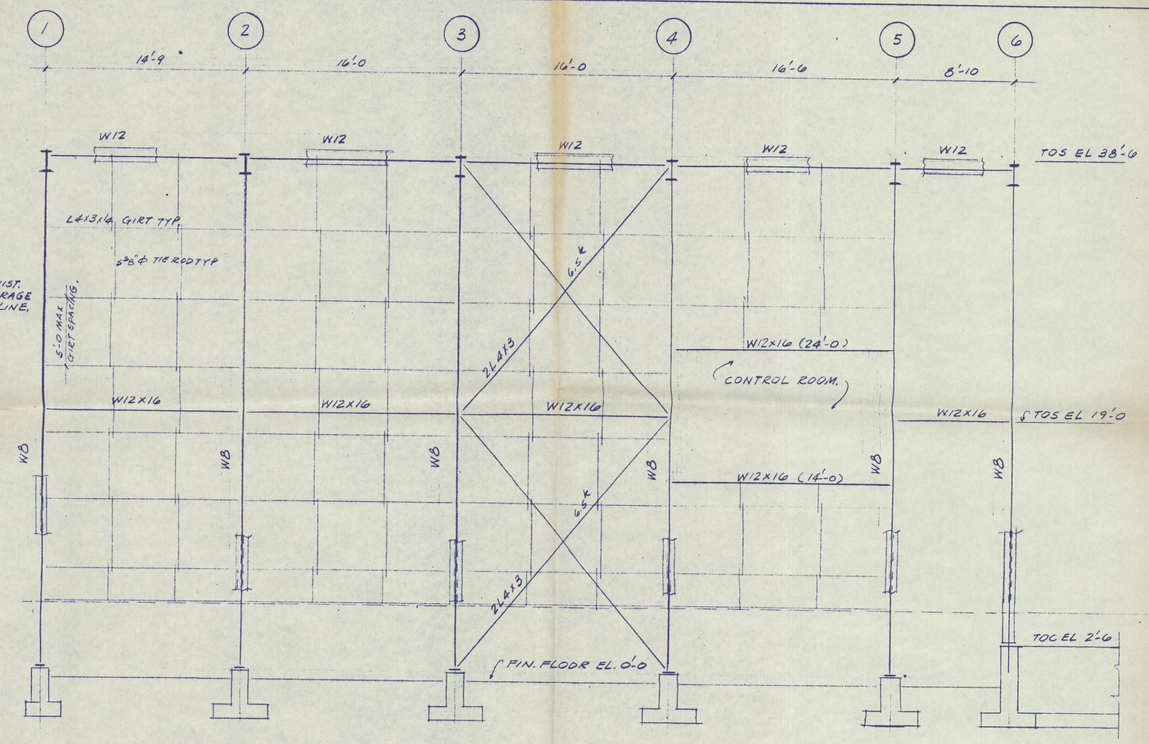
OWNER
WASTE ACID SERVICES, INC.
6520 GEORGIA ST.
DETROIT, MICH. 48211

TITLE FILTER PRESS
FLOOR FRAMING PLAN
SECTIONS & DETAILS

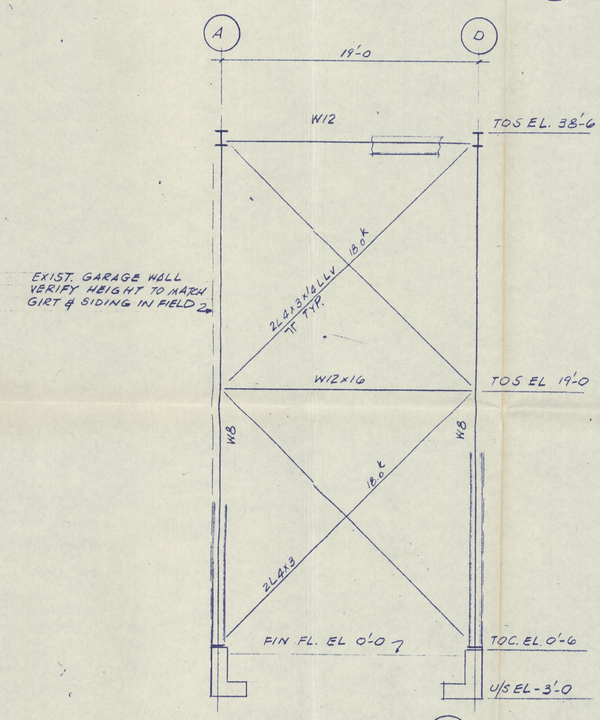
SCALE AS NOTED	DATE	PROJECT NO.
DRAWN BY HQ	10-12-85	
DESIGNED BY HQ	10-10-85	SHEET NO.
CHECKED BY		S-4 OF
APPROVED BY		



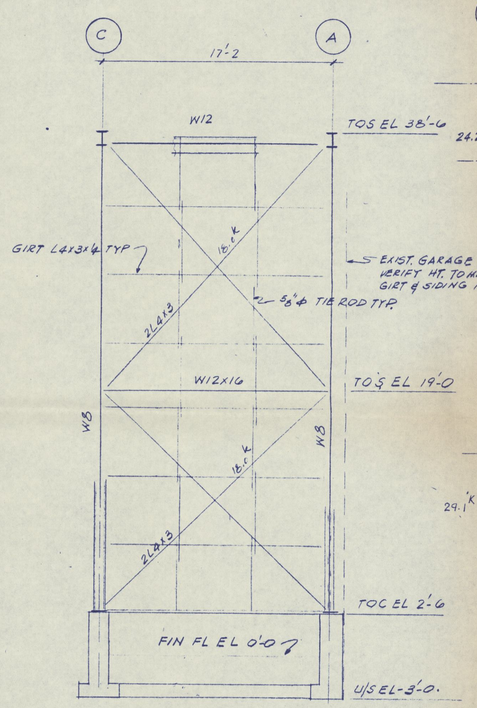
ELEVATION ON LINE (A)
3/16" = 1'-0



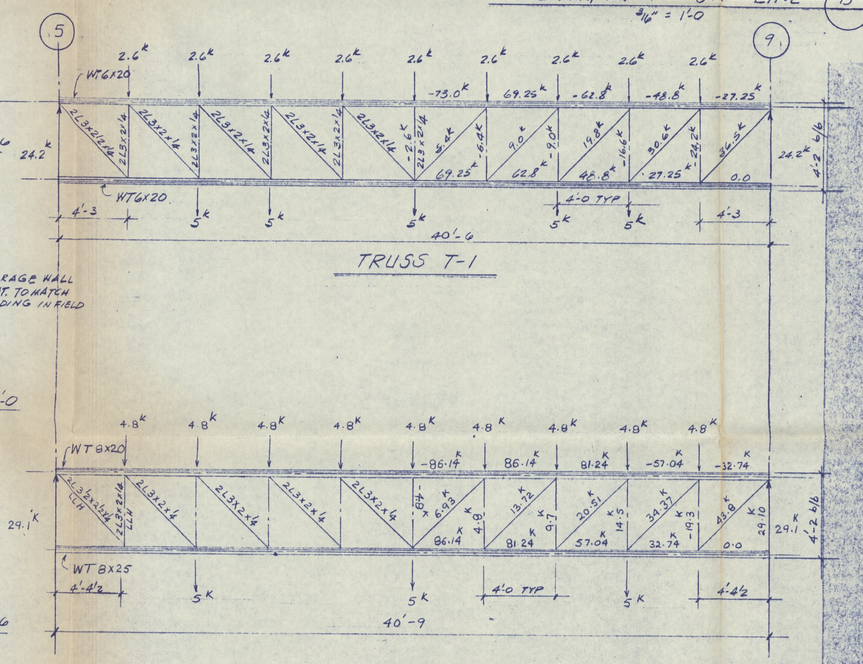
ELEVATION ON LINE (D)
3/16" = 1'-0



ELEVATION ON LINE (1)
3/16" = 1'-0



ELEVATION ON LINE (6)
3/16" = 1'-0



NOTES:

1. REFER SHT S-8 FOR GENERAL NOTES

Dynacol, Inc. - 1988 Act 64 License Reapplication

NO.	REVISION	DATE
	ISSUED FOR CONSTRUCTION	11-25-85
	ISSUED FOR REVIEW	11-21-85

CONSULTING ENGINEERS
CHEMTEC RESEARCH ASSOCIATES, INC.
16241 WESTMORELAND
DETROIT, MICH. 48219

OWNER
WASTE ACID SERVICES, INC.
6520 GEORGIA ST.
DETROIT, MICH. 48211

TITLE CONE FIBERGLASS TANKS
ELEVATIONS SECTIONS & DETAILS

SCALE AS NOTED	DATE	PROJECT NO.
DRAWN BY HB	10-17-85	
DESIGNED BY HB, SH	10-15-85	SHEET NO.
CHECKED BY HB, SH	11-26-85	5-5 OF
APPROVED BY RB	11-25-85	

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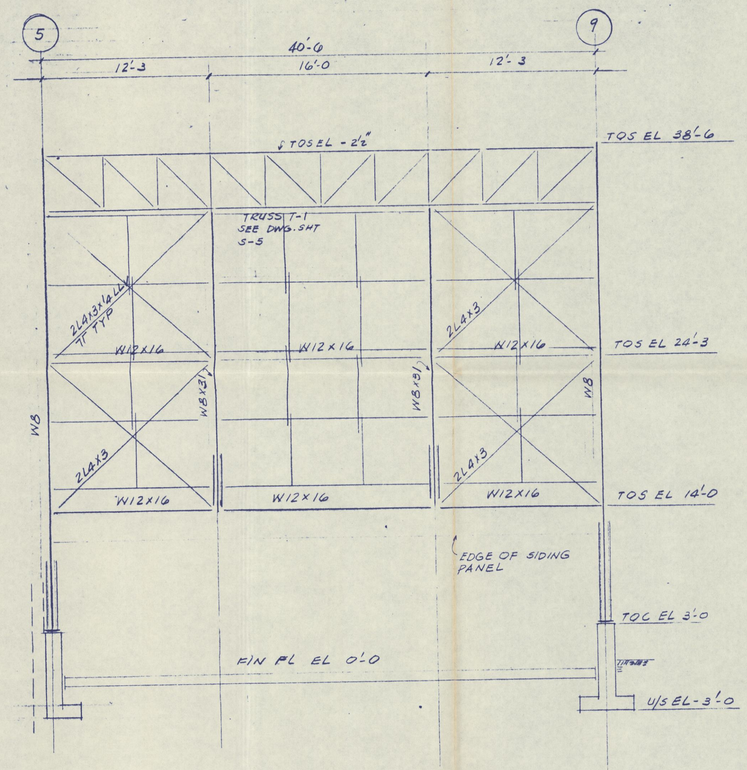
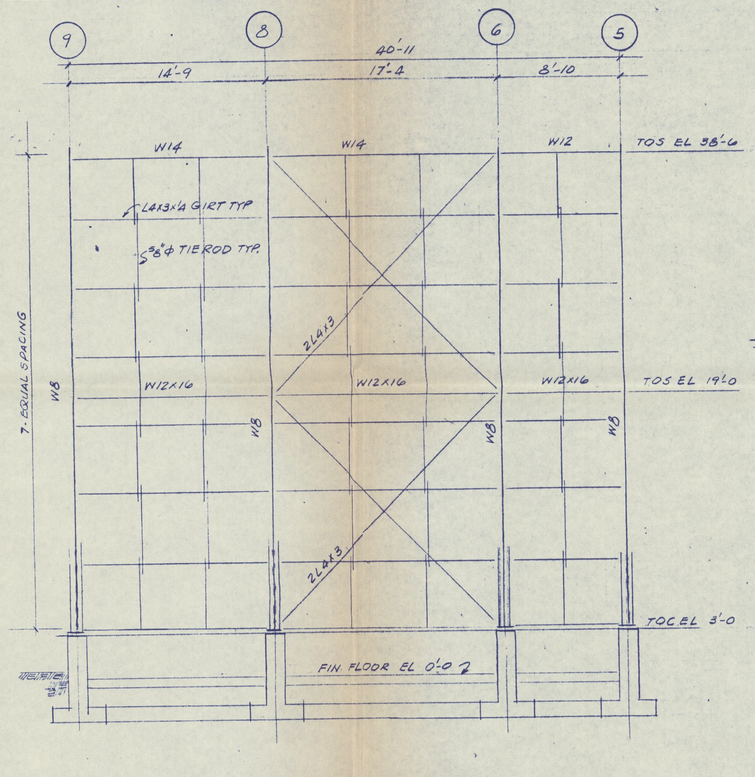
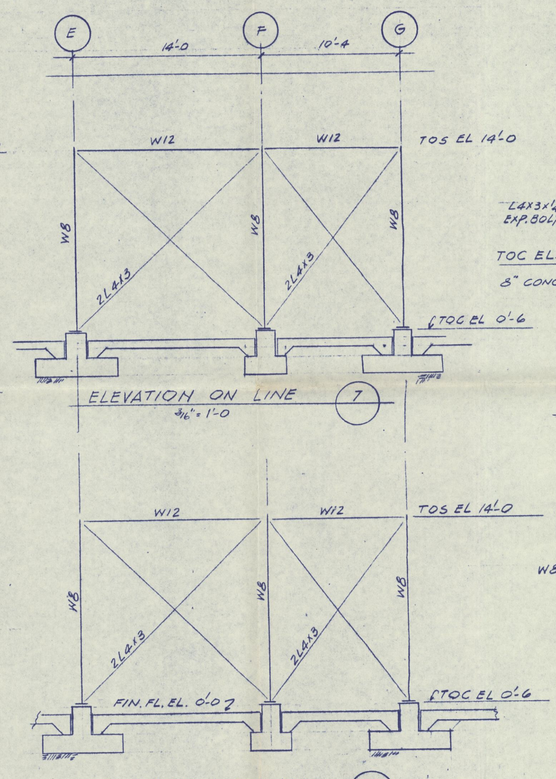
Waste Management Division



ELEVATION ON LINE (H)
3/16" = 1'-0

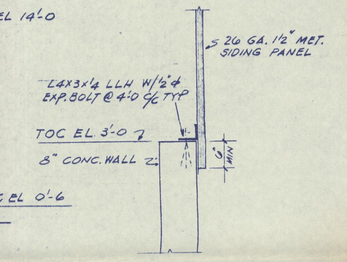


ELEVATION ON LINE (C)
3/16" = 1'-0

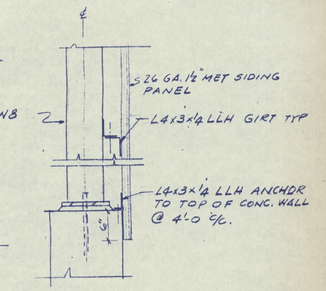


ELEVATION ON LINE (7)
3/16" = 1'-0

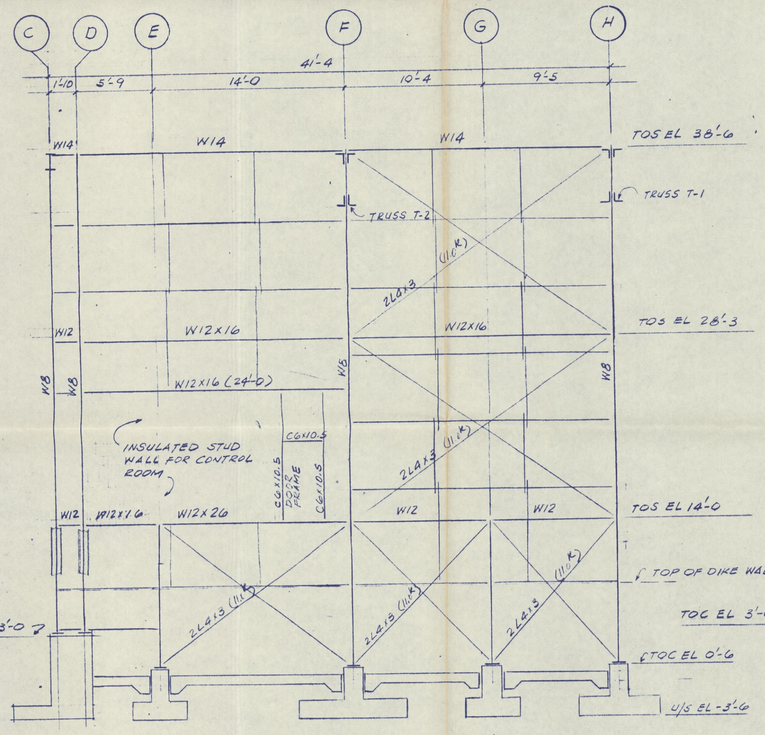
ELEVATION ON LINE (8)
3/16" = 1'-0



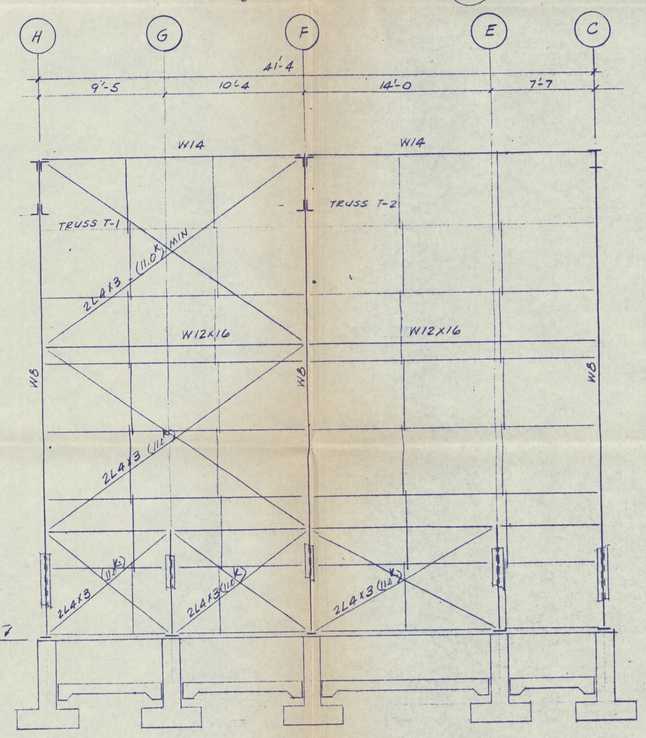
SECTION (4)
3/4" = 1'-0



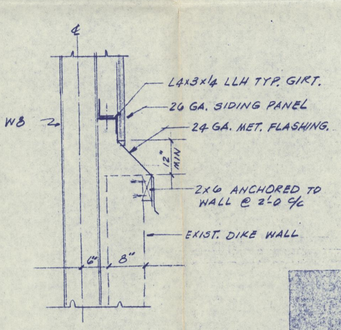
SECTION (3)
3/4" = 1'-0



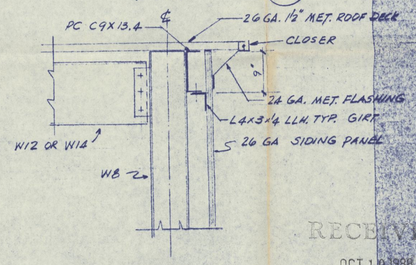
ELEVATION ON LINE (5)
3/16" = 1'-0



ELEVATION ON LINE (9)
3/16" = 1'-0



SECTION (1)
3/4" = 1'-0



SECTION (2)
3/4" = 1'-0

TYPICAL WALL SECTIONS

NOTE:

1. REFER SHT. S-3 FOR GENERAL NOTES.

Dynecol, Inc. - 1988 Act 64
License Reapplication

NO.	REVISION	DATE
	ISSUED FOR CONSTRUCTION	11-25-85
	ISSUED FOR REVIEW	11-21-85

CONSULTING ENGINEERS
CHEMTEC RESEARCH ASSOCIATES, INC.
6241 WESTMORELAND
DETROIT, MICH. 48219

OWNER
WASTE ACID SERVICES, INC.
6320 GEORGIA ST.
DETROIT, MICH. 48211

TITLE FILTER PRESS
ELEVATIONS SECTION & DETAILS

SCALE	AS NOTED	DATE	PROJECT NO.
DRAWN BY	HB	10-15-85	
DESIGNED BY	HB	10-14-85	SHEET NO.
CHECKED BY	HB, RB	11-24-85	S-6 OF
APPROVED BY	RB	11-25-85	

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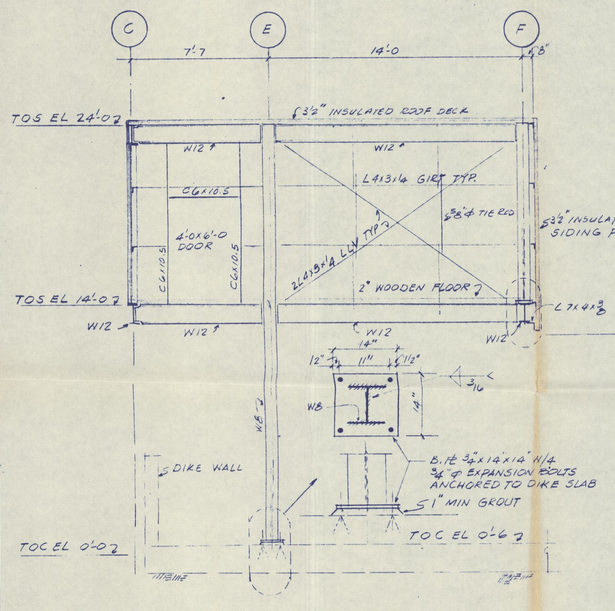
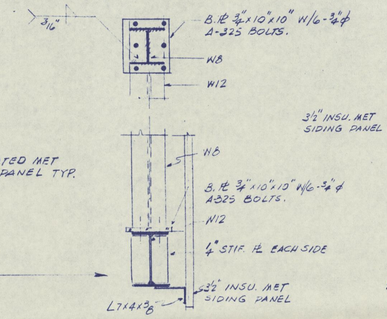
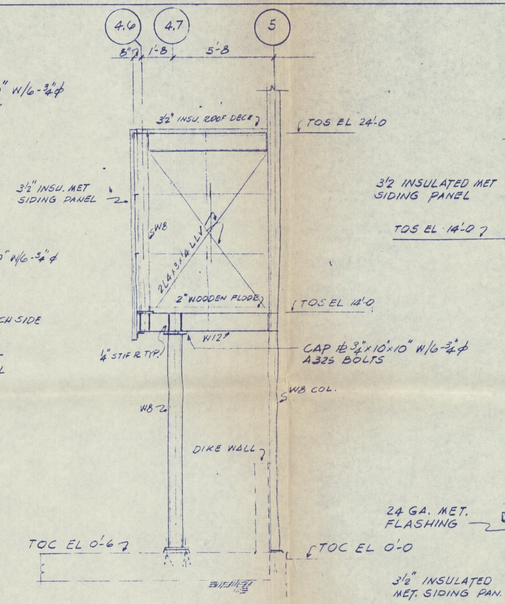
Waste Management
Division

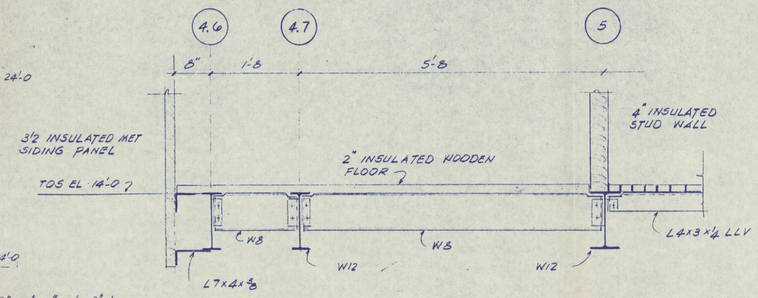


ELEVATION ON LINE 4.6
4" = 1'-0

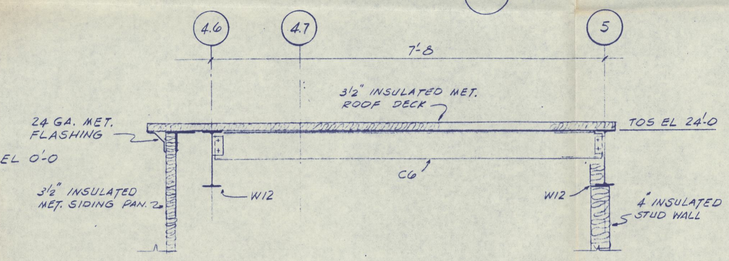




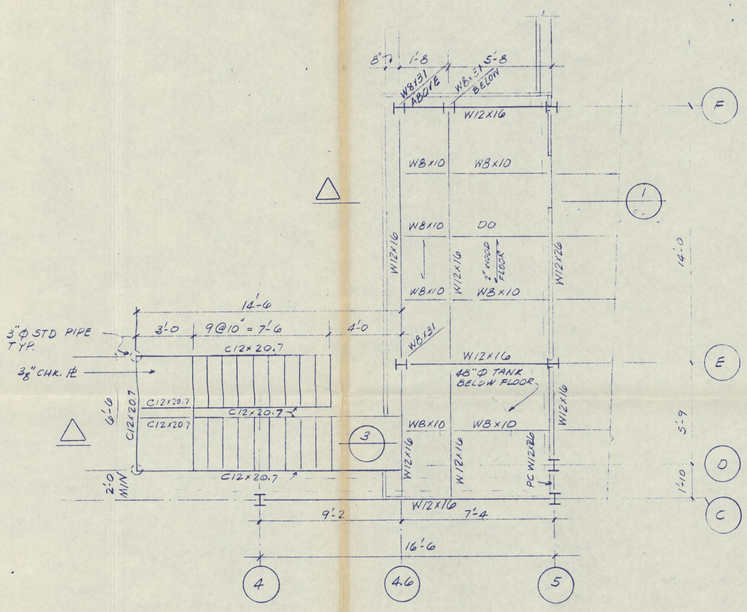
ELEVATION ON LINE - F
4" = 1'-0



SECTION 1

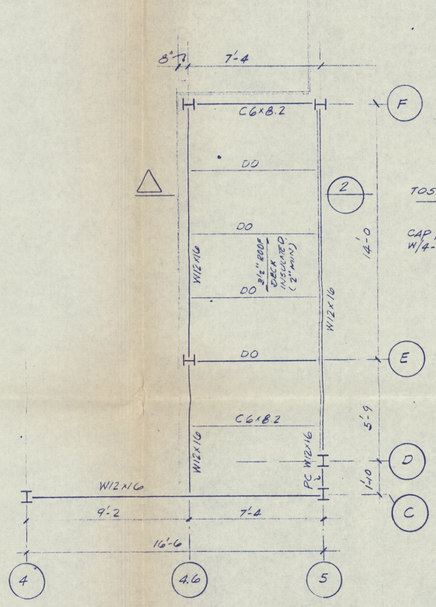


SECTION 2



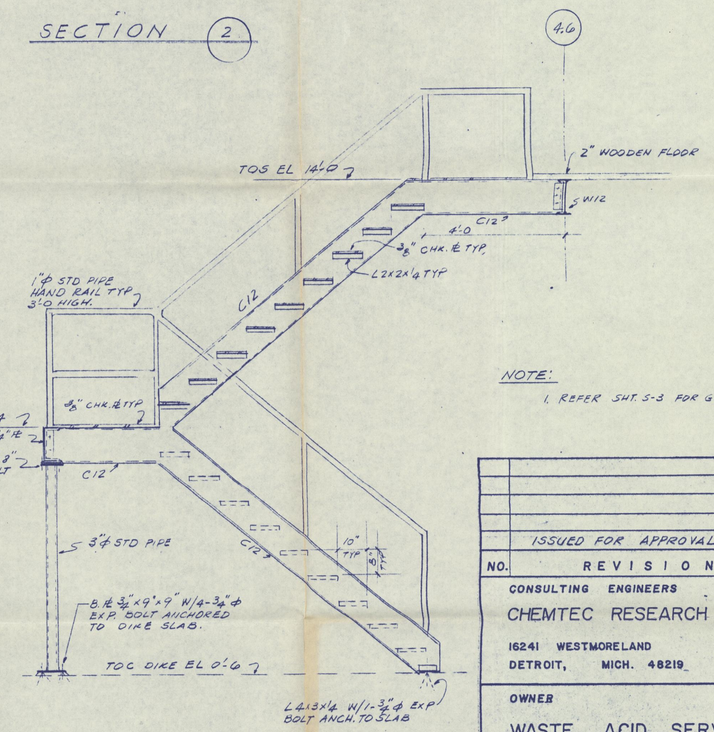
CONTROL ROOM FLOOR FRAMING PLAN TOS EL 14'-0
4" = 1'-0

NORTH



CONTROL ROOM ROOF FRAMING PLAN TOS EL 24'-0
4" = 1'-0

NORTH



SECTION 3
½" = 1'-0

NOTE:
1. REFER SHT. S-3 FOR GENERAL NOTES.

NO.	REVISION	DATE
	ISSUED FOR APPROVAL	11-25-85

CONSULTING ENGINEERS
CHEMTEC RESEARCH ASSOCIATES, INC.
16241 WESTMORELAND
DETROIT, MICH. 48219

OWNER
WASTE ACID SERVICES, INC.
6520 GEORGIA ST.
DETROIT, MICH. 48211

TITLE CONTROL ROOM
FLOOR AND ROOF FRAMING PLAN
SECTIONS & ELEVATIONS

SCALE AS NOTED	DATE	PROJECT NO.
DRAWN BY HB	11-18-85	
DESIGNED BY HB	11-15-85	SHEET NO.
CHECKED BY HB RB	11-24-85	S-7 OF
APPROVED BY RB	11-24-85	

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License Reapplication

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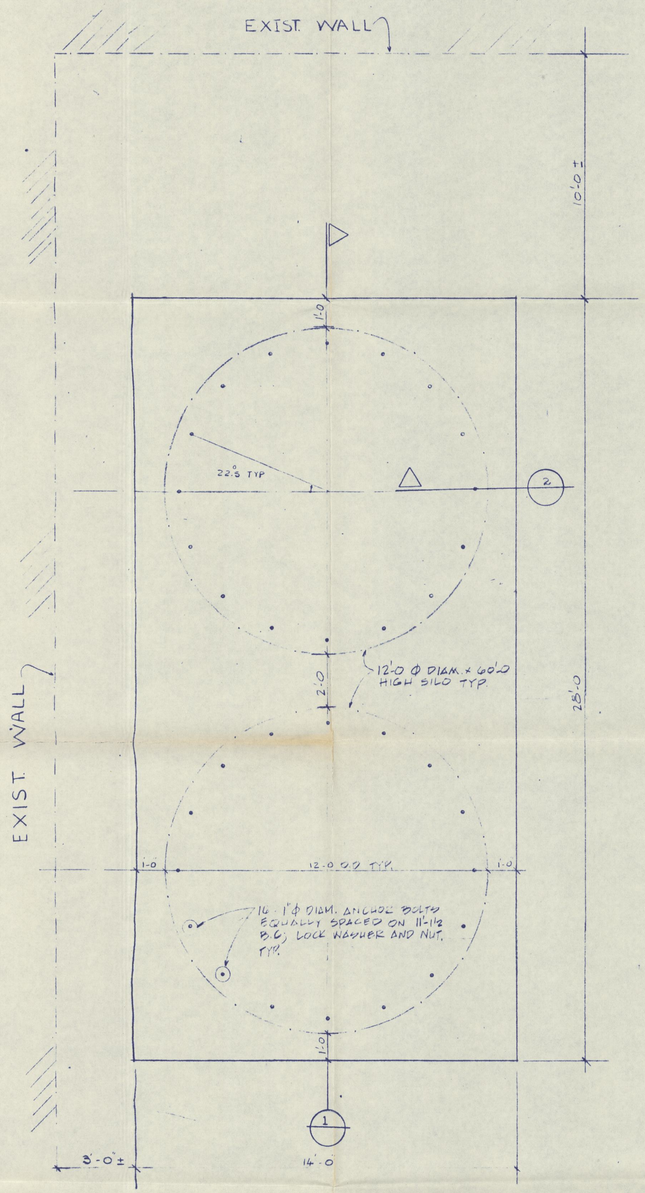
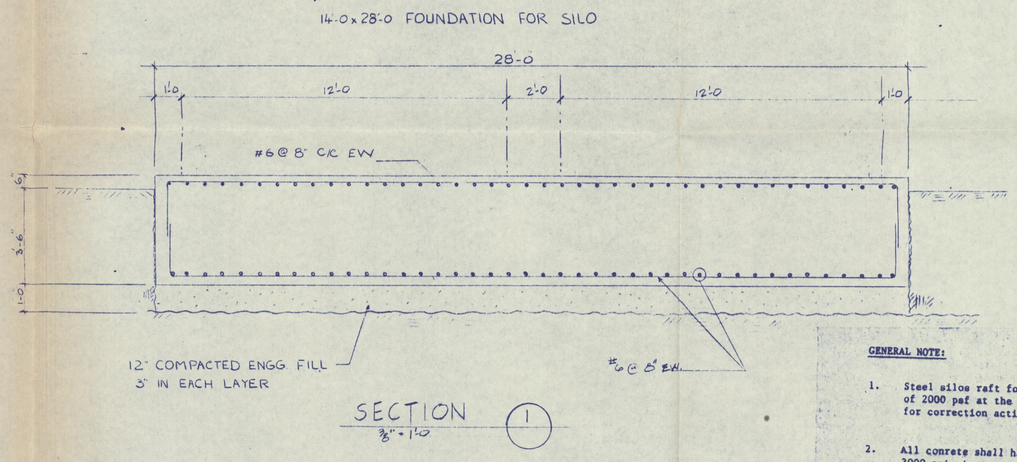
Waste Management Division



FOUDATION PLAN

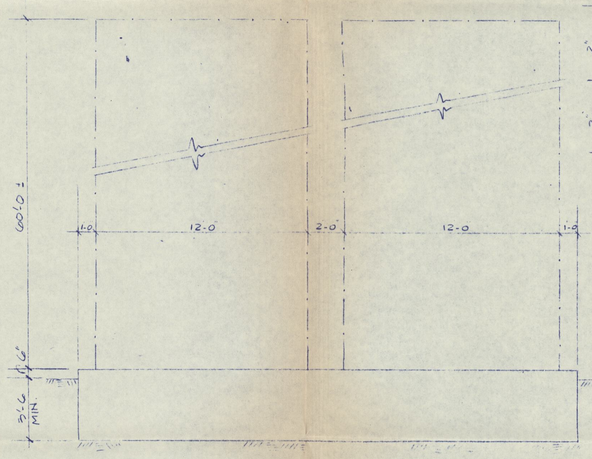
3/8" = 1'-0

NORTH.



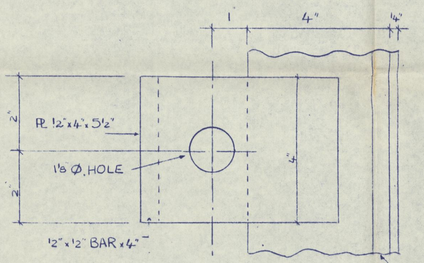
SECTION 1

3/8" = 1'-0



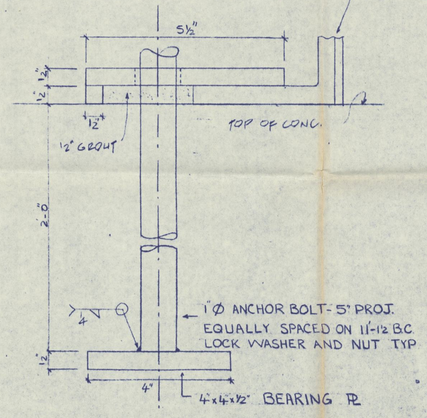
SILO TANK SECTIONAL ELEVATION

1/4" = 1'-0



PLAN VIEW

1/2" = 1"



SECTION 2

1/2" = 1"

GENERAL NOTE:

1. Steel silos raft foundation is designed for soil pressure of 2000 psf at the depth indicated. Contact the engineer for correction action.
2. All conrete shall have a 28 day compressive strength of 3000 psi min.
3. Reinforcement steel yeild strength shall be grade of 60,000 psi unless noted otherwise.
4. Contracter shall verify location of foundation laylout with plant operator before casting footing and slab if plant is required to be shutdown.
5. The standards of ACI Building Code 318-83 and the standards of practice ACI 318-80 shall be followed for all detailing,fabrication and placement of all reinforcing steel and accessories.
6. All fill under slab foundation and footings shall be compacted to 95% of maximum density (Modified Proctor Test) at optimum moisture content.
7. Provide temporary bracing as required to insure the stability of existing and new structures.
8. Contractor shall coordinate with engineer during construction activities for any discripency.

Dynecol, Inc. - 1988 Act 64
License Reapplication

NO.	REVISION	DATE
	ISSUED FOR CONSTRUCTION	12-05-85

CONSULTING ENGINEERS
CHEMTEC RESEARCH ASSOCIATES, INC.
16241 WESTMORELAND
DETROIT, MICH. 48219

OWNER
WASTE ACID SERVICES, INC.
6520 GEORGIA ST.
DETROIT, MICH. 48211

TITLE
SILO TANKS
FOUNDATION PLAN
SECTIONS & DETAILS

SCALE AS NOTED	DATE	PROJECT NO.
DRAWN BY SH, HB	11-22-85	
DESIGNED BY SH	11-7-85	SHEET NO.
CHECKED BY HD, RB	12-4-85	5 OF 8
APPROVED BY RB	12-4-85	

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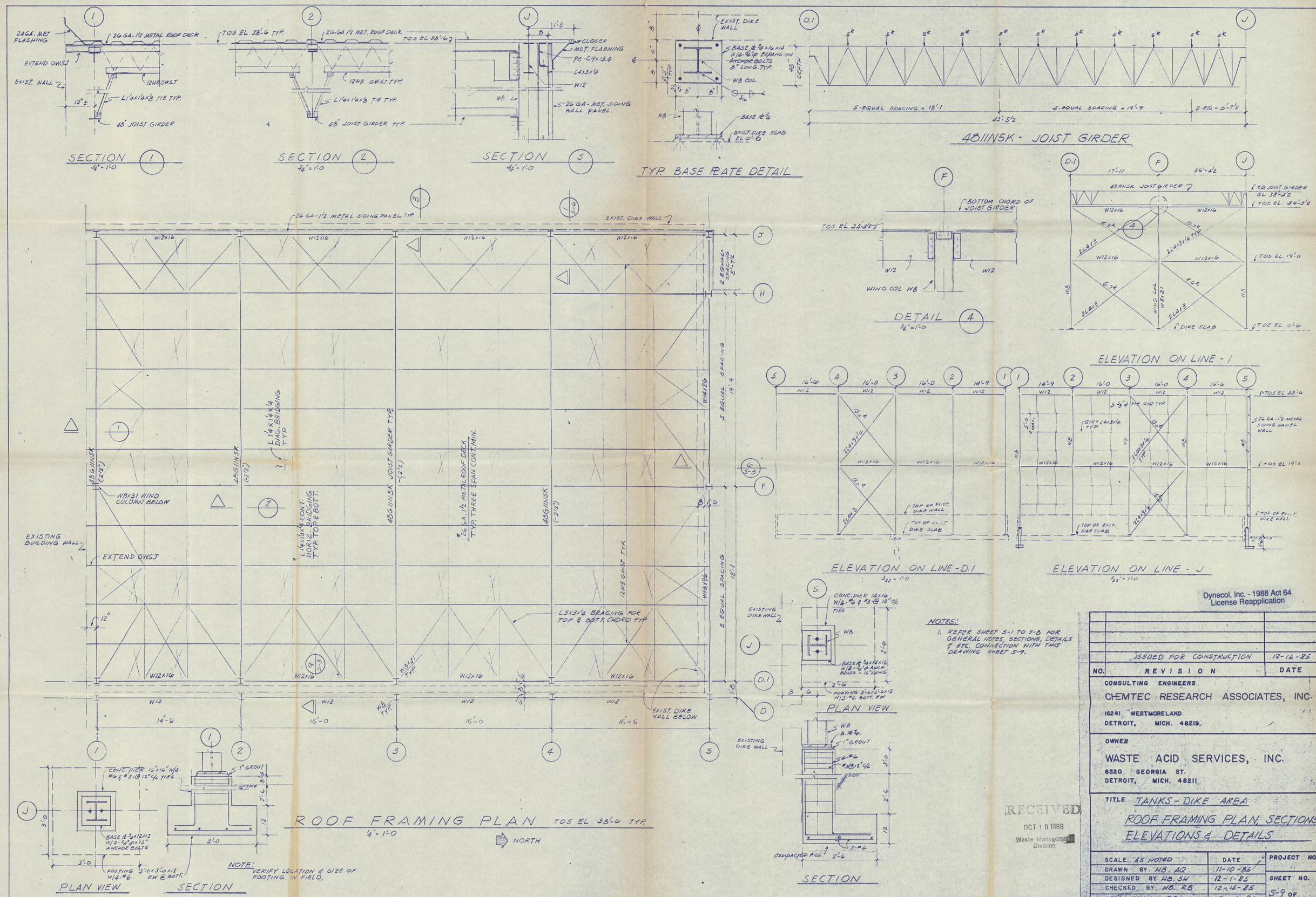
OCT 10 1988
Waste Management Division



Dynecol, Inc. - 1988 Act 64 License Reapplication

NOTES:

1. REFER SHEET S-1 TO S-8 FOR GENERAL NOTES, SECTIONS, DETAILS & ETC. CONJECTION WITH THIS DRAWING SHEET S-9.

NO.	REVISION	DATE
	ISSUED FOR CONSTRUCTION	12-16-85

CONSULTING ENGINEERS
CHEMTEC RESEARCH ASSOCIATES, INC.
16241 WESTMORELAND
DETROIT, MICH. 48219

OWNER
WASTE ACID SERVICES, INC.
6520 GEORGIA ST.
DETROIT, MICH. 48211

TITLE TANKS - DIKE AREA
ROOF FRAMING PLAN, SECTIONS, ELEVATIONS & DETAILS

SCALE AS NOTED	DATE	PROJECT NO.
DRAWN BY HB. AQ.	11-10-85	
DESIGNED BY HB. SH	12-1-85	SHEET NO.
CHECKED BY HB. RB	12-15-85	S-9 OF
APPROVED BY RB	12-16-85	

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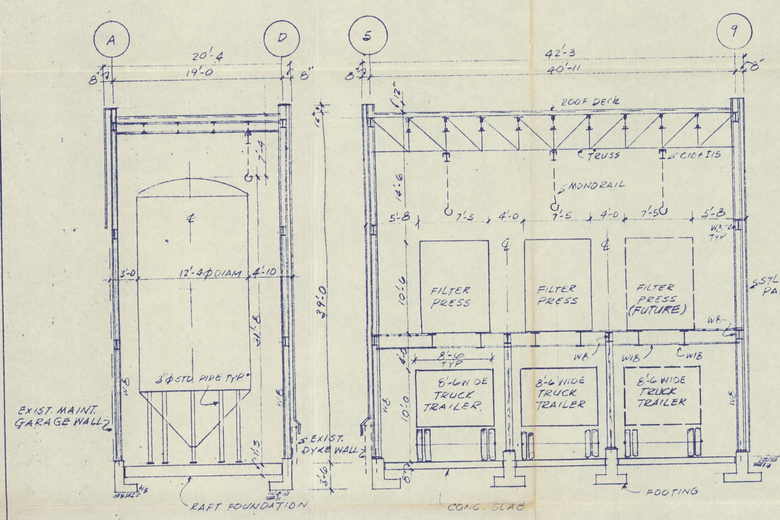
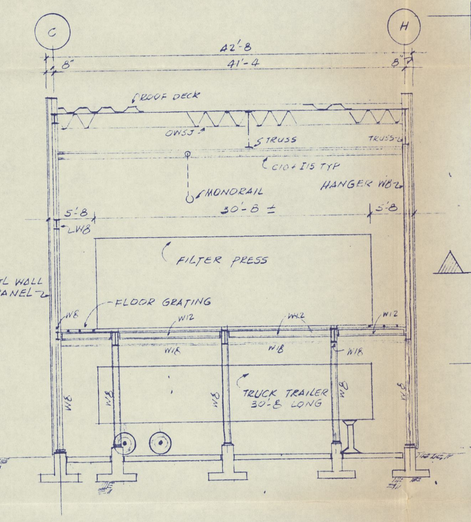
Waste Management Division

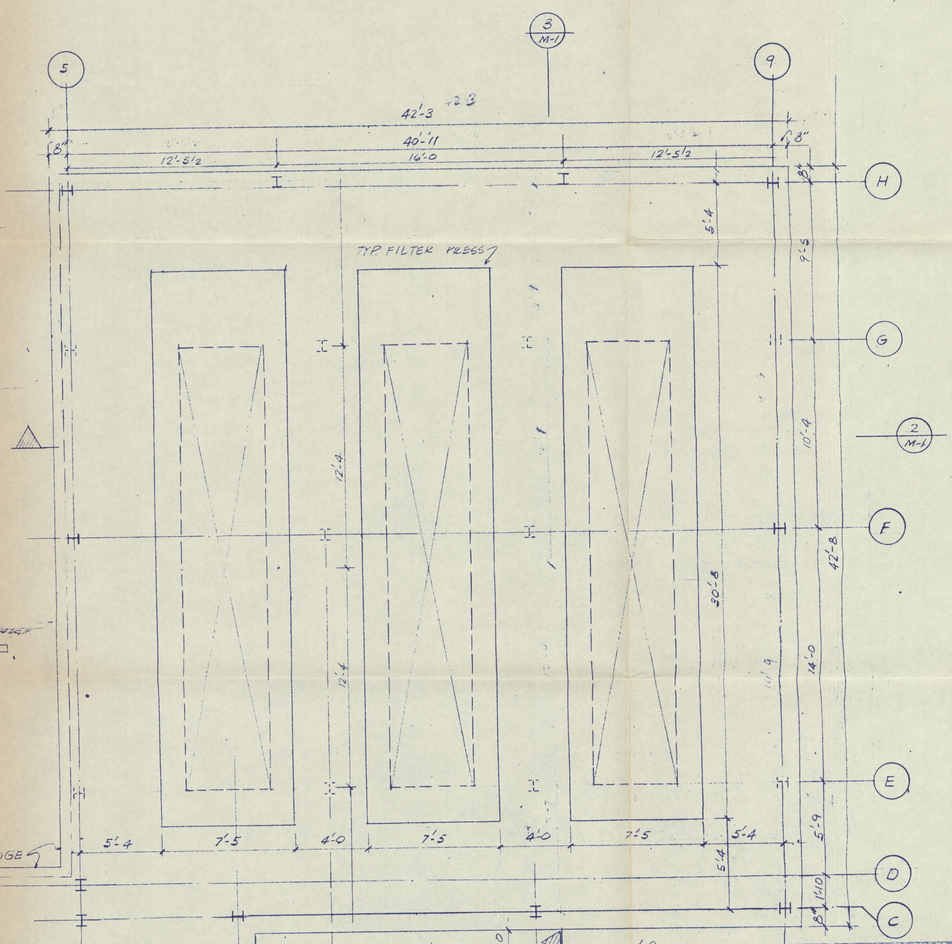


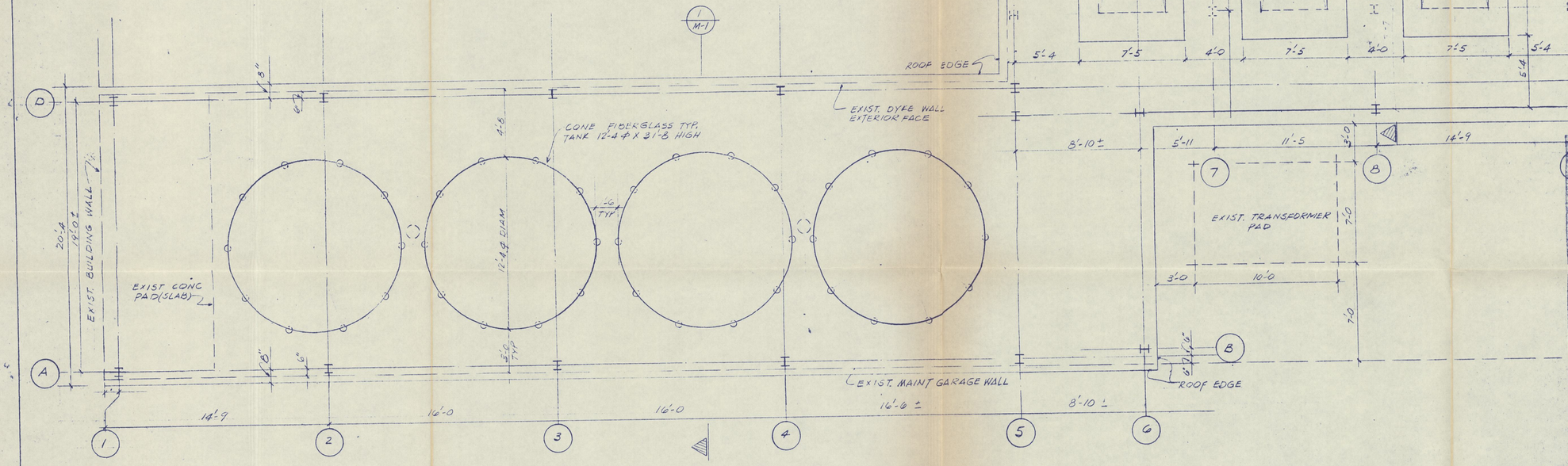
SECTION 1 (M-1)
8" = 1'-0

SECTION 2 (M-1)
8" = 1'-0



SECTION 3 (M-1)
8" = 1'-0





FIBERGLASS TANK & FILTER PRESS LAYOUT PLAN
.4" = 1'-0

NORTH

Dynecol, Inc. - 1988 Act 64
License Reapplication

NO.	REVISION	DATE
	ISSUED FOR REVIEW & APPROVAL	9-20-85

CONSULTING ENGINEERS
CHEMTEC RESEARCH ASSOCIATES, INC.
16241 WESTMORELAND
DETROIT, MICH. 48219

OWNER
WASTE ACID SERVICES, INC.
6520 GEORGIA ST.
DETROIT, MICH. 48211

TITLE:
FIBERGLASS TANK & FILTER PRESS LAYOUT PLAN AND SECTIONS

SCALE 1/4"=1'-0	DATE	PROJECT NO.
DRAWN BY HB	9-15-85	
DESIGNED BY HB	9-10-85	SHEET NO.
CHECKED BY HB RB	9-20-85	M-1 OF
APPROVED BY RB	9-20-85	

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Waste Management Division

SYSTEM DESIGN SCHEMATICS

INDUSTRIAL WASTE-WATER TREATMENT SYSTEM FOR

WASTE ACIDS SERVICES, INC.
6520 GEORGIA STREET
DETROIT, MI 48211

CHEMTRONIC SYSTEMS

FILTRATION SYSTEMS DIVISION

CHEMICAL CONTROLS FOR INDUSTRY
WATER POLLUTION CONTROL SYSTEMS
PROCESS CONTROL SYSTEMS

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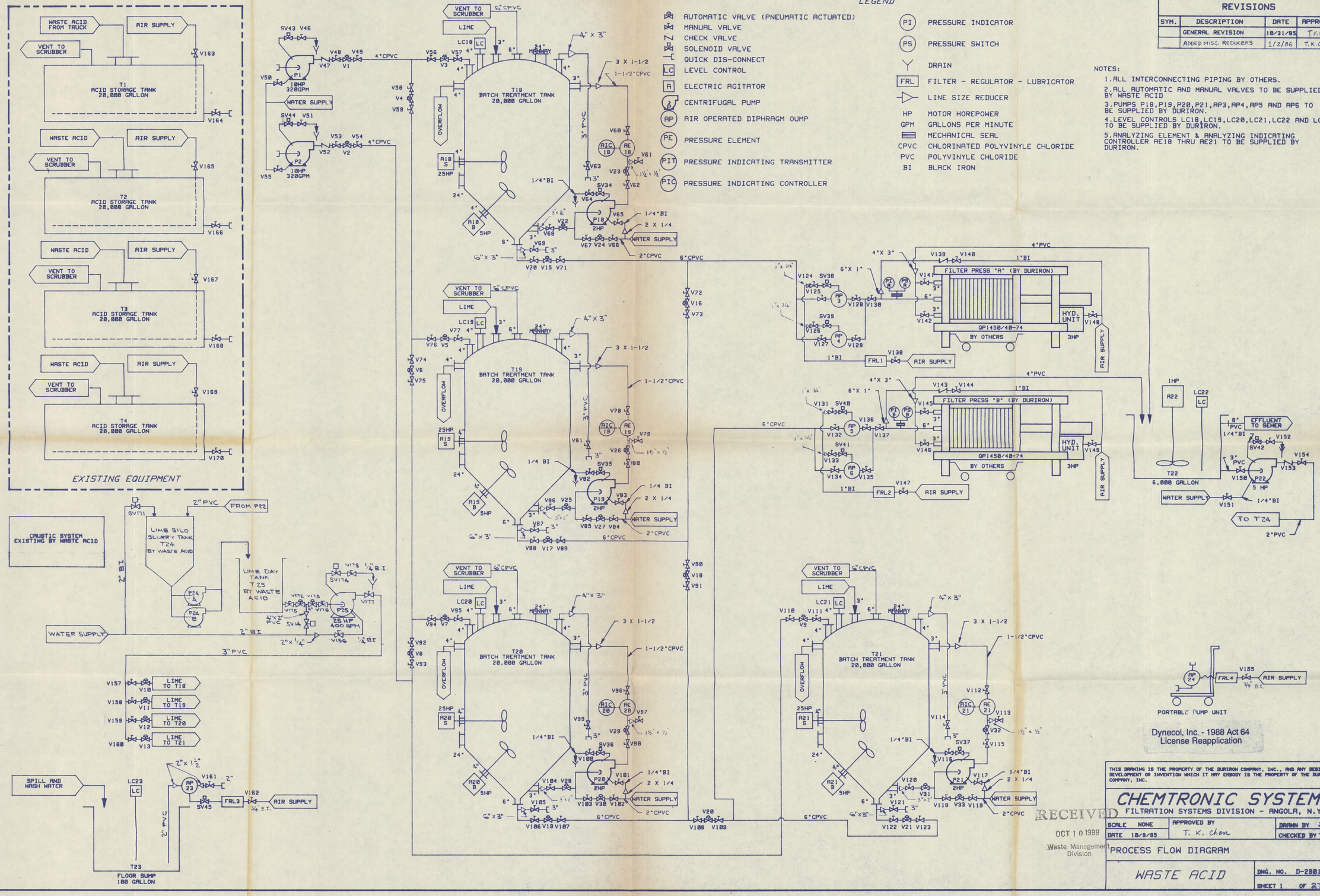
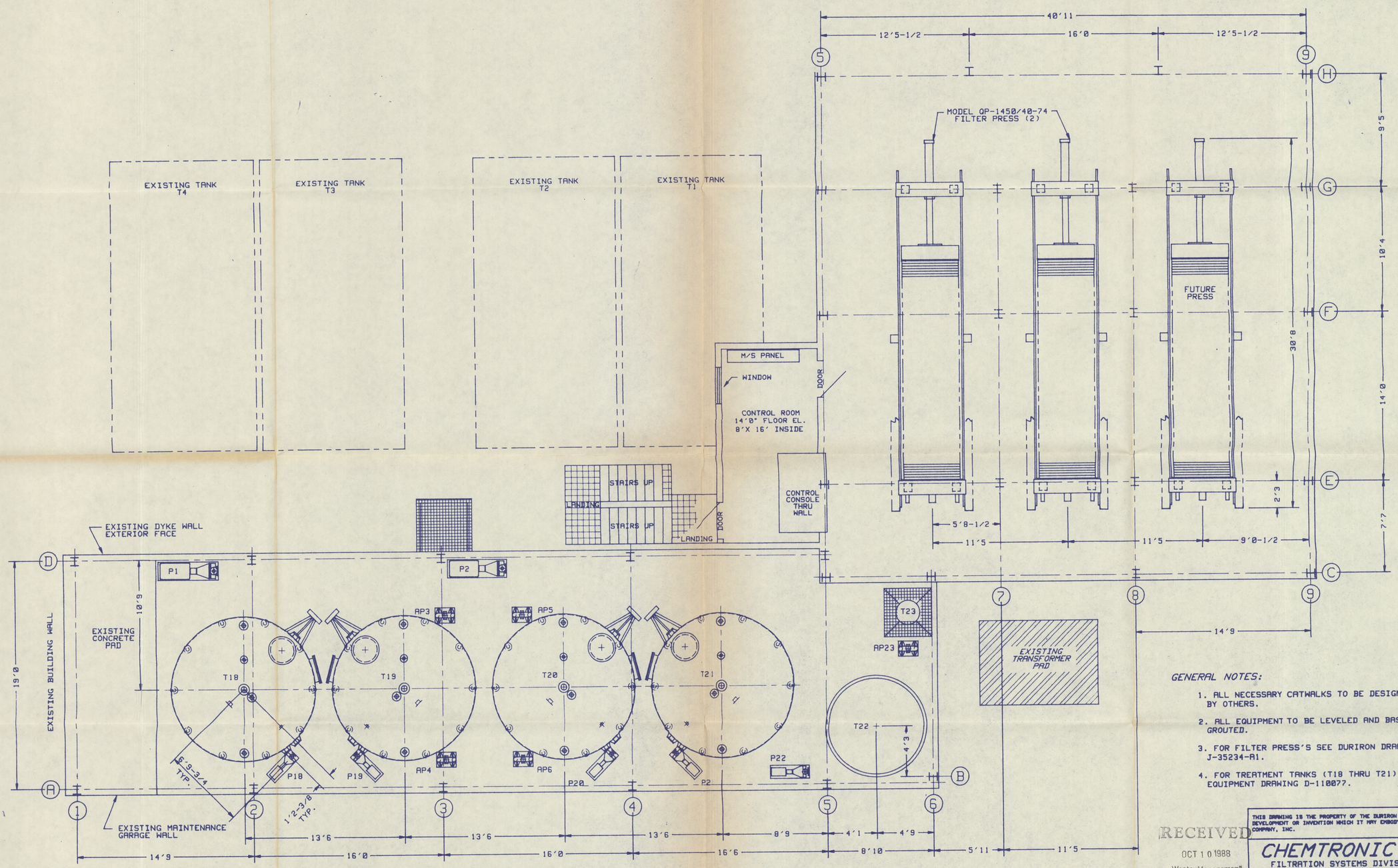
Waste Management
Division

9542 HARDPAN ROAD
ANGOLA, NEW YORK 14006



REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVED
	GENERAL REVISION	10/31/85	TKC
	ADDED MISC. REDUCERS	1/2/86	T.K.C.

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVED
NONE	REVISED PER APPROVAL PRINT DATED 10/24/85	10/31/85	TKC



GENERAL NOTES:

1. ALL NECESSARY CATWALKS TO BE DESIGNED AND BUILT BY OTHERS.
2. ALL EQUIPMENT TO BE LEVELED AND BASEPLATES GROUTED.
3. FOR FILTER PRESS'S SEE DURIRON DRAWING NUMBER J-35234-A1.
4. FOR TREATMENT TANKS (T18 THRU T21) SEE PROCESS EQUIPMENT DRAWING D-110077.

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CHEMTRONIC SYSTEMS
FILTRATION SYSTEMS DIVISION - ANGOLA, N.Y.

SCALE 1/4"=12"	APPROVED BY	DRAWN BY JDC
DATE 10/18/85		CHECKED BY TKC

EQUIPMENT LAYOUT PLAN

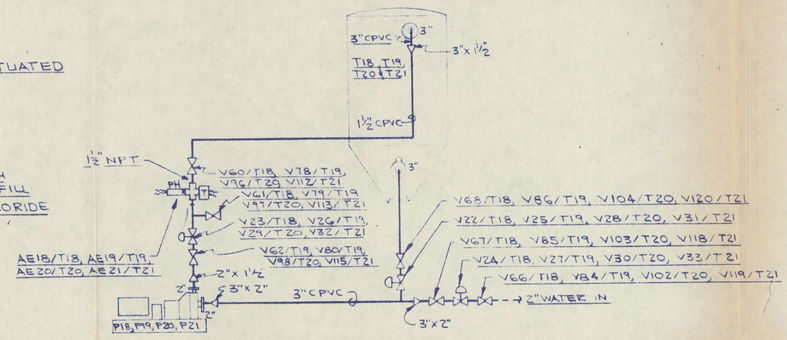
WASTE ACID

DWG. NO. D-29019-3
SHEET 2 OF 27

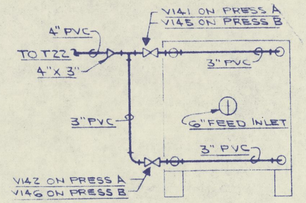
Dynecol, Inc. - 1988 Act 64 License Reapplication

SYMBOL LEGEND

- AUTOMATIC VALVE - PNEU. ACTUATED
- MANUAL VALVE
- CHECK VALVE
- LINE SIZE REDUCER
- QUICK DISCONNECT
- PI / PS — PRESS GAUGE & PRESS SWITCH MOUNTED TO MECH. SEAL, W/ FILL
- CPVC — CHLORINATED POLYVINYL CHLORIDE
- PVC — POLYVINYL CHLORIDE



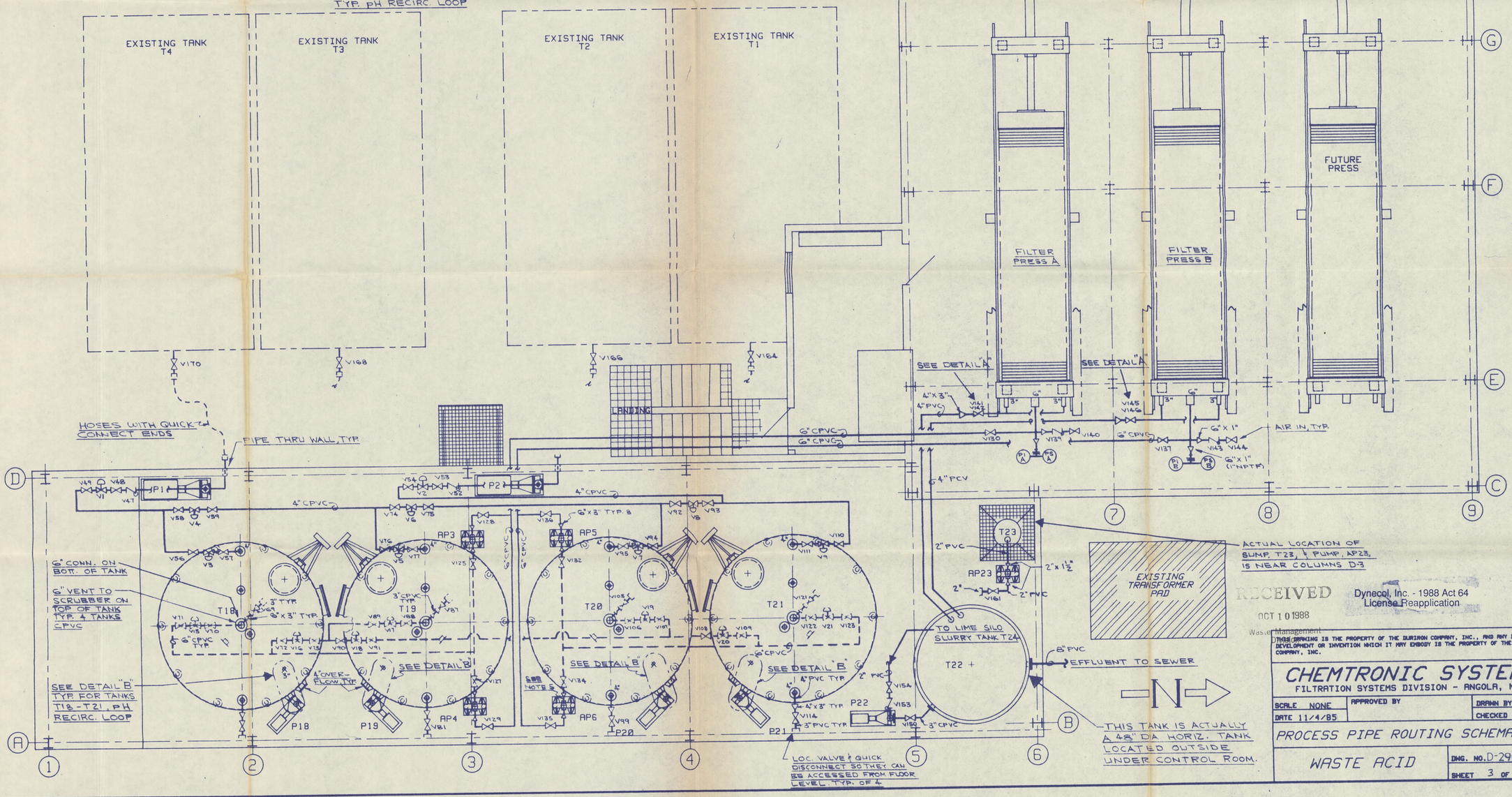
DETAIL "B"
TYP. PH RECIRC. LOOP



DETAIL "A"
PRESS OUTLET PIPING

GENERAL NOTES:
1. THIS DRAWING IS FOR SCHEMATIC PURPOSES ONLY; DO NOT USE AS A CONSTRUCTION DRAWING.
2. ALL MANUAL VALVES TO BE LOCATED FOR EASY ACCESSIBILITY FROM FLOOR OR CATWALK.
3. UNIONS/FLANGES TO BE INSTALLED WHERE NECESSARY TO ALLOW REMOVAL OF EQUIPMENT FOR REPAIR/REPLACEMENT.
4. ALL PIPING RUNS TO BE RUN IN A NEAT MANNER AND PROPERLY SUPPORTED BY INSTALLING CONTRACTOR.
5. IT IS RECOMMENDED THAT FLEXIBLE COUPLINGS BE INSTALLED ON SUCTION AND DISCHARGE SIDE OF AIR OPERATED DIAPHRAGM PUMPS.

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVED



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CHEMTRONIC SYSTEMS
FILTRATION SYSTEMS DIVISION - ANGOLA, N.Y.

SCALE NONE	APPROVED BY	DRAWN BY JDC
DATE 11/4/85		CHECKED BY TKC

PROCESS PIPE ROUTING SCHEMATIC

WASTE ACID

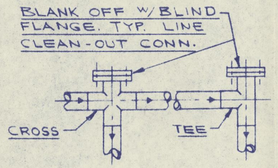
DWG. NO. D-29019-5
SHEET 3 OF 27

SYMBOL LEGEND

- AUTOMATIC VALVE
- MANUAL VALVE
- LINE SIZE REDUCER
- PVC POLYVINYL CHLORIDE (PIPE)

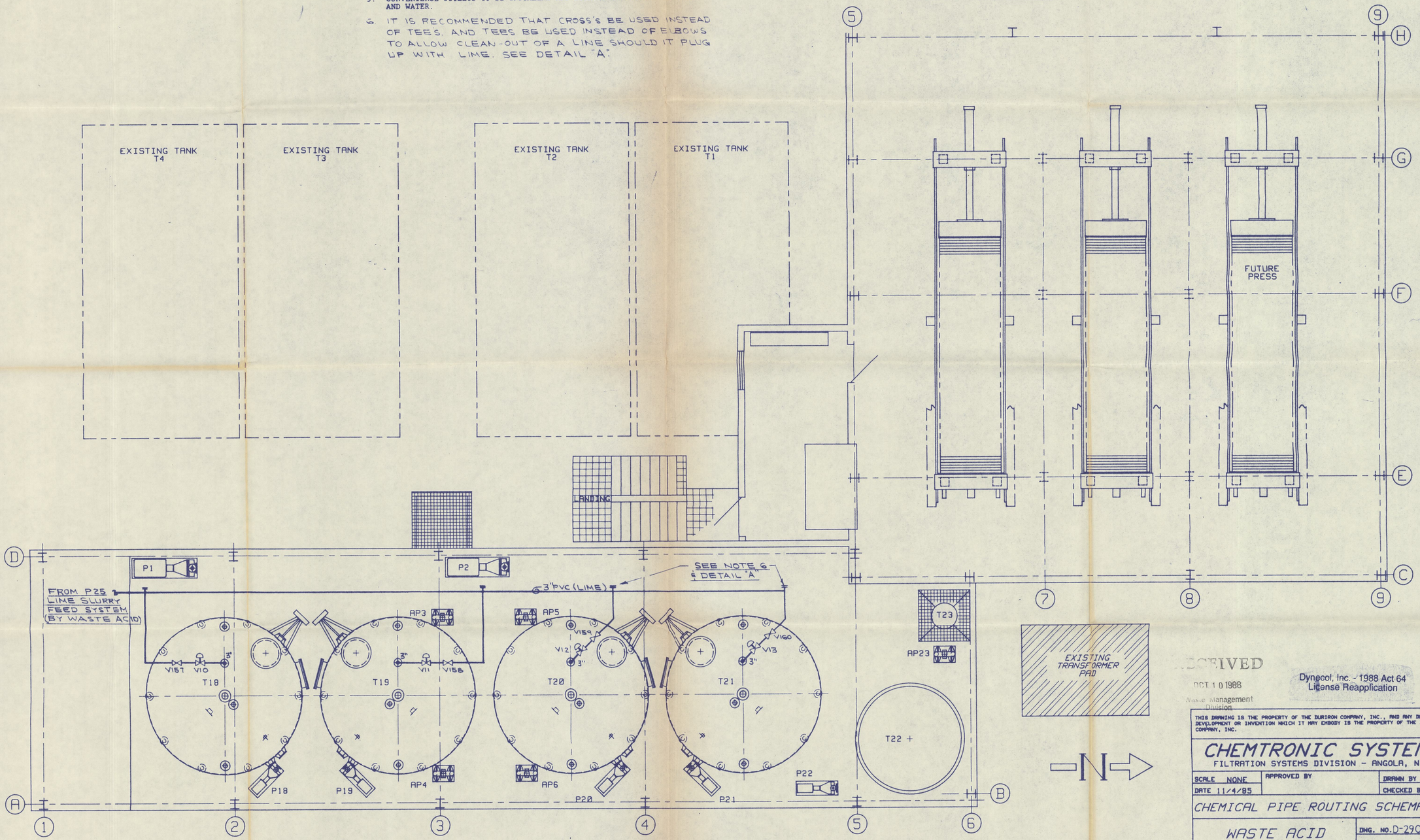
GENERAL NOTES:

1. THIS DRAWING IS FOR SCHEMATIC PURPOSES ONLY; DO NOT USE AS A CONSTRUCTION DRAWING.
2. ALL MANUAL VALVES TO BE LOCATED FOR EASY ACCESSIBILITY FROM FLOOR OR CATWALK.
3. UNIONS/FLANGES TO BE INSTALLED WHERE NECESSARY TO ALLOW REMOVAL OF EQUIPMENT FOR REPAIR/REPLACEMENT.
4. ALL PIPING RUNS TO BE RUN IN A NEAT MANNER AND PROPERLY SUPPORTED BY INSTALLING CONTRACTOR.
5. CONVENIENCE OUTLETS TO BE INSTALLED AND LOCATED THROUGHOUT FOR AIR AND WATER.
6. IT IS RECOMMENDED THAT CROSS'S BE USED INSTEAD OF TEES, AND TEES BE USED INSTEAD OF ELBOWS TO ALLOW CLEAN-OUT OF A LINE SHOULD IT PLUG UP WITH LIME. SEE DETAIL "A".



DETAIL "A"

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVED



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CHEMTRONIC SYSTEMS
FILTRATION SYSTEMS DIVISION - ANGOLA, N.Y.

SCALE NONE	APPROVED BY	DRAWN BY JDC
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CHEMICAL PIPE ROUTING SCHEMATIC

WASTE ACID

DWG. NO. D-29019-6

SHEET 4 OF 27

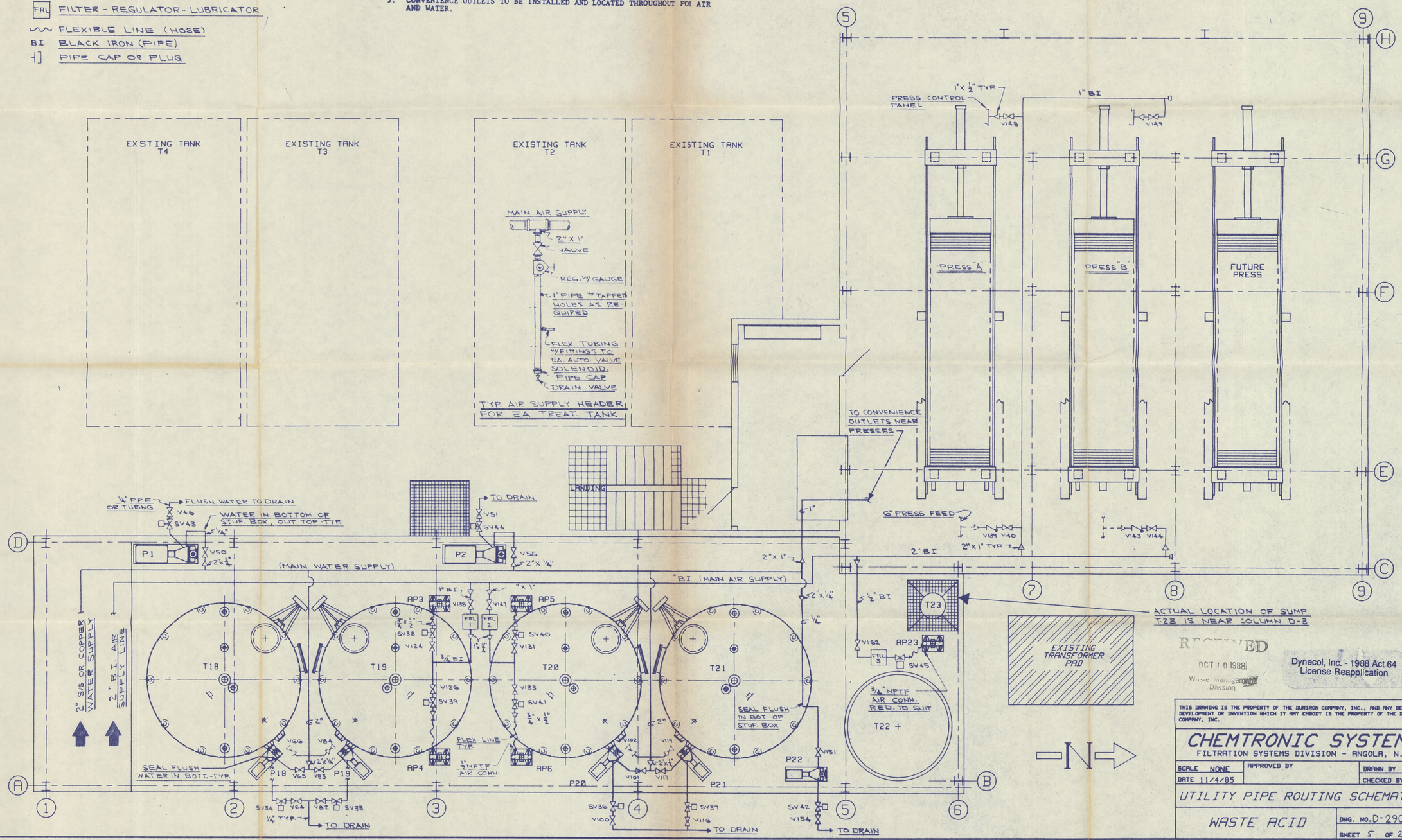
SYMBOL LEGEND

- SOLENOID VALVE, 2-WAY
- MANUAL VALVE
- VALVE SHOWN AS REFERENCE
- CHECK VALVE
- LINE SIZE REDUCER
- FRL — FILTER - REGULATOR - LUBRICATOR
- FLEXIBLE LINE (HOSE)
- BI — BLACK IRON (PIPE)
- PIPE CAP OR PLUG

GENERAL NOTES:

1. THIS DRAWING IS FOR SCHEMATIC PURPOSES ONLY; DO NOT USE AS A CONSTRUCTION DRAWING.
2. ALL MANUAL VALVES TO BE LOCATED FOR EASY ACCESSIBILITY FROM FLOOR OR CATWALK.
3. UNIONS/FLANGES TO BE INSTALLED WHERE NECESSARY TO ALLOW REMOVAL OF EQUIPMENT FOR REPAIR/REPLACEMENT.
4. ALL PIPING RUNS TO BE RUN IN A NEAT MANNER AND PROPERLY SUPPORTED BY INSTALLING CONTRACTOR.
5. CONVENIENCE OUTLETS TO BE INSTALLED AND LOCATED THROUGHOUT FOR AIR AND WATER.

REVISIONS			
SYM.	DESCRIPTION	DATE	APPROVED



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CHEMTRONIC SYSTEMS
FILTRATION SYSTEMS DIVISION - ANGOLA, N.Y.

SCALE NONE	APPROVED BY	DRAWN BY JDC
DATE 11/4/85		CHECKED BY

UTILITY PIPE ROUTING SCHEMATIC

WASTE ACID

DWG. NO. D-29019-7
SHEET 5 OF 27