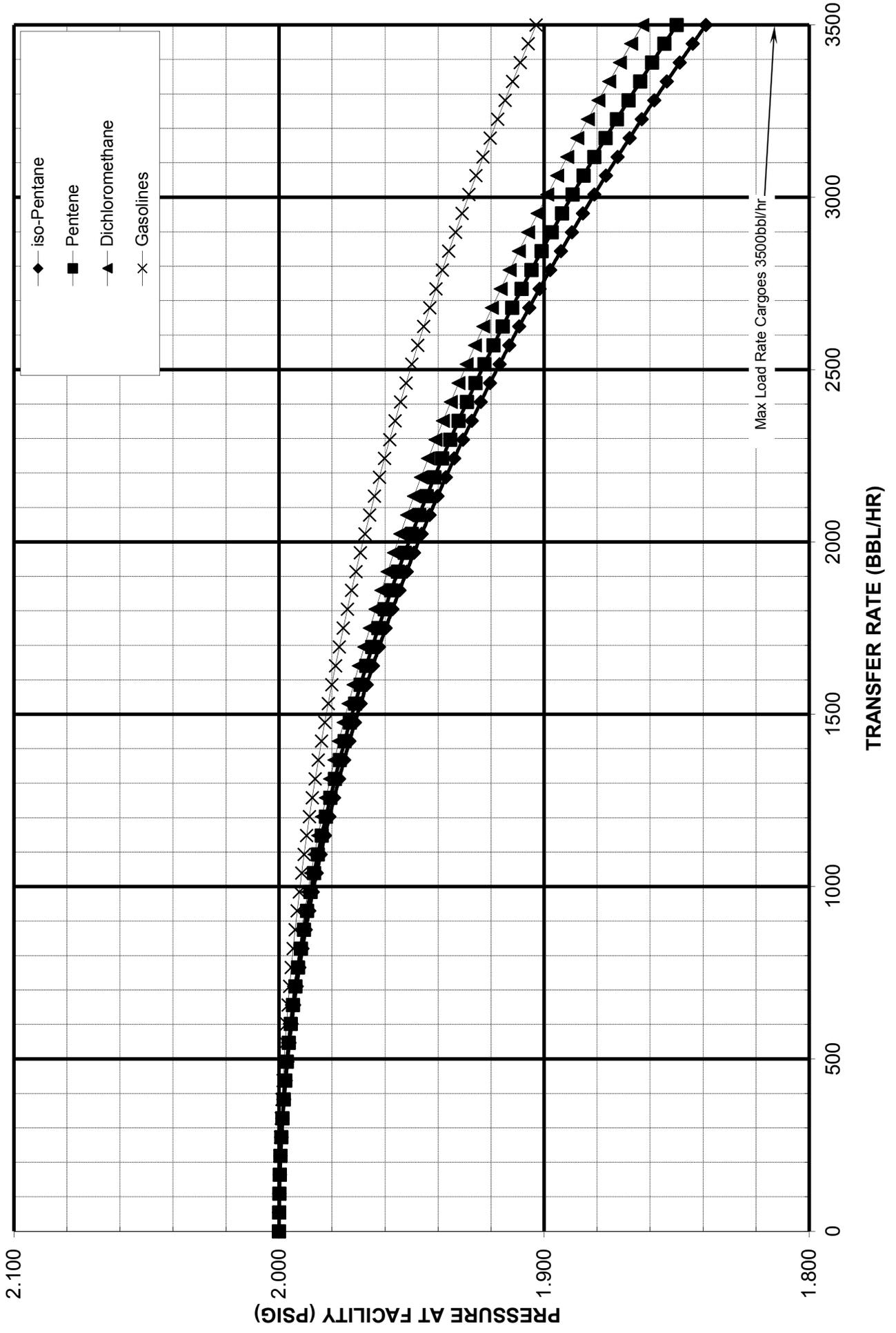
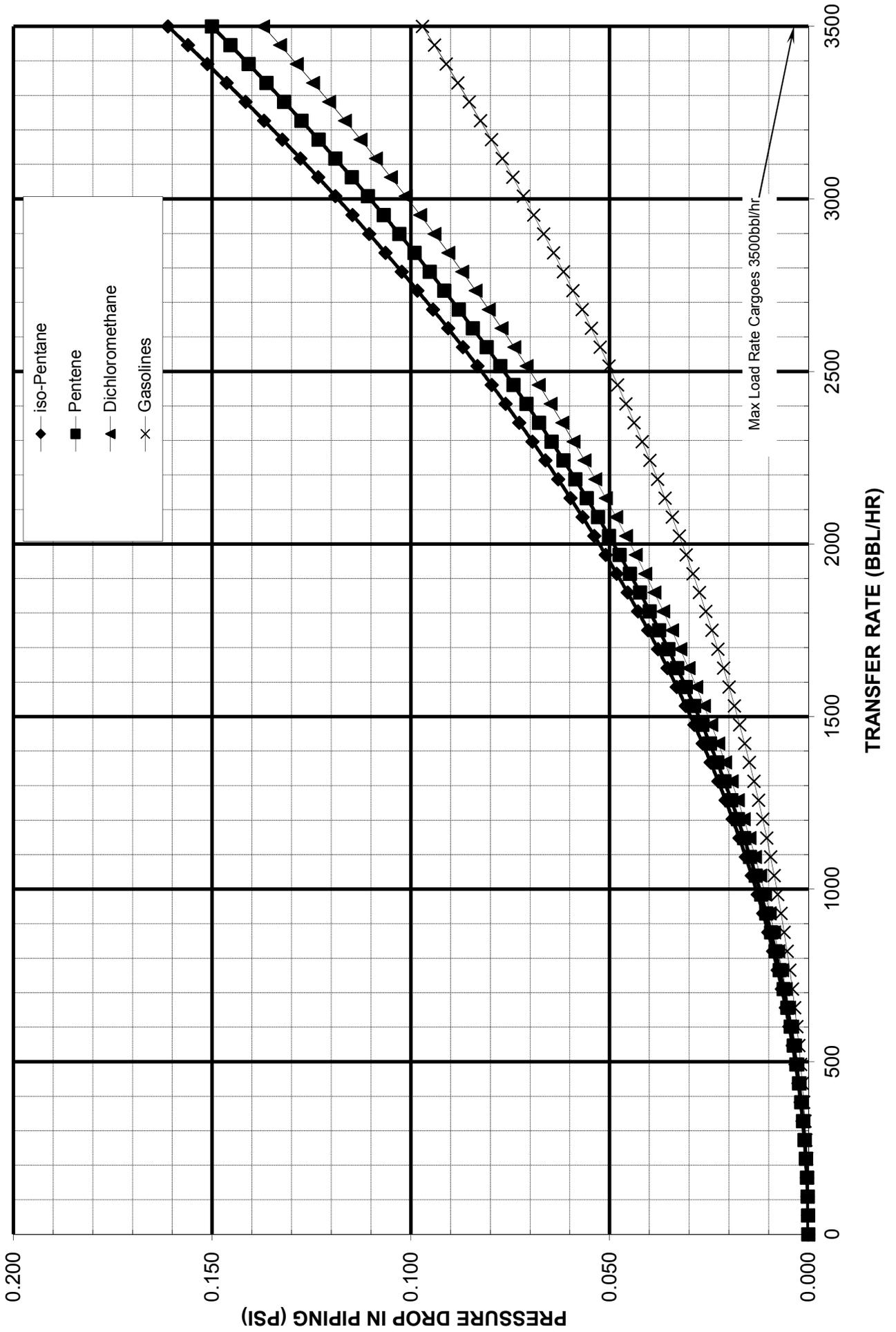


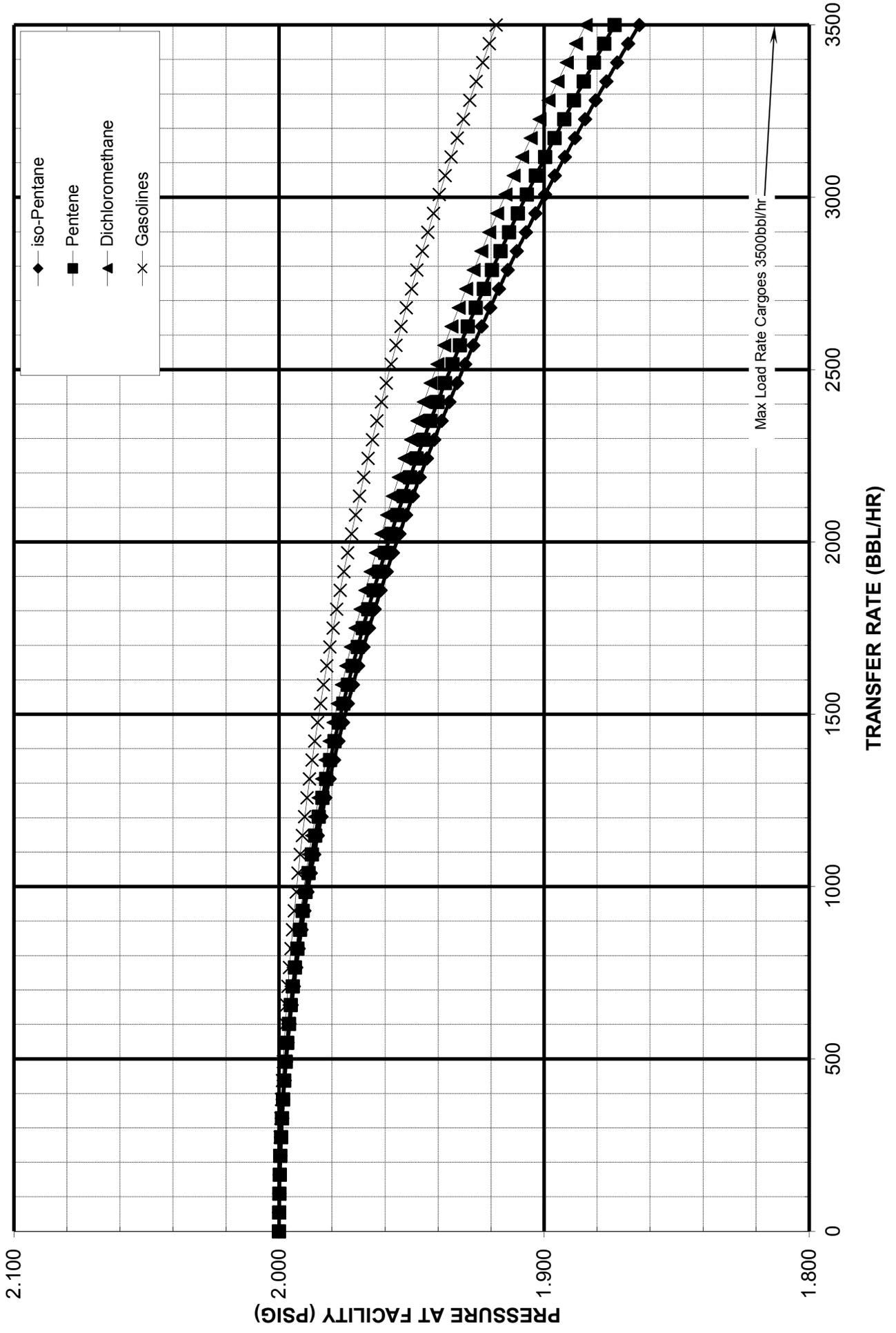
LIQUID TRANSFER RATE vs FACILITY PRESSURE FOR TANDEM LOADING
BASED ON PRESSURE DROP FROM CARGO TANK #3 TO FACILITY CONNECTION



LIQUID TRANSFER RATE vs PIPING PRESSURE DROP
CARGO TANK #3 TO FACILITY CONNECTION
TANDEM LOADING



LIQUID TRANSFER RATE vs FACILITY PRESSURE FOR SINGLE LOADING
BASED ON PRESSURE DROP FROM CARGO TANK #3 TO FACILITY CONNECTION



LIQUID TRANSFER RATE vs PIPING PRESSURE DROP
CARGO TANK #3 TO FACILITY CONNECTION
SINGLE LOADING

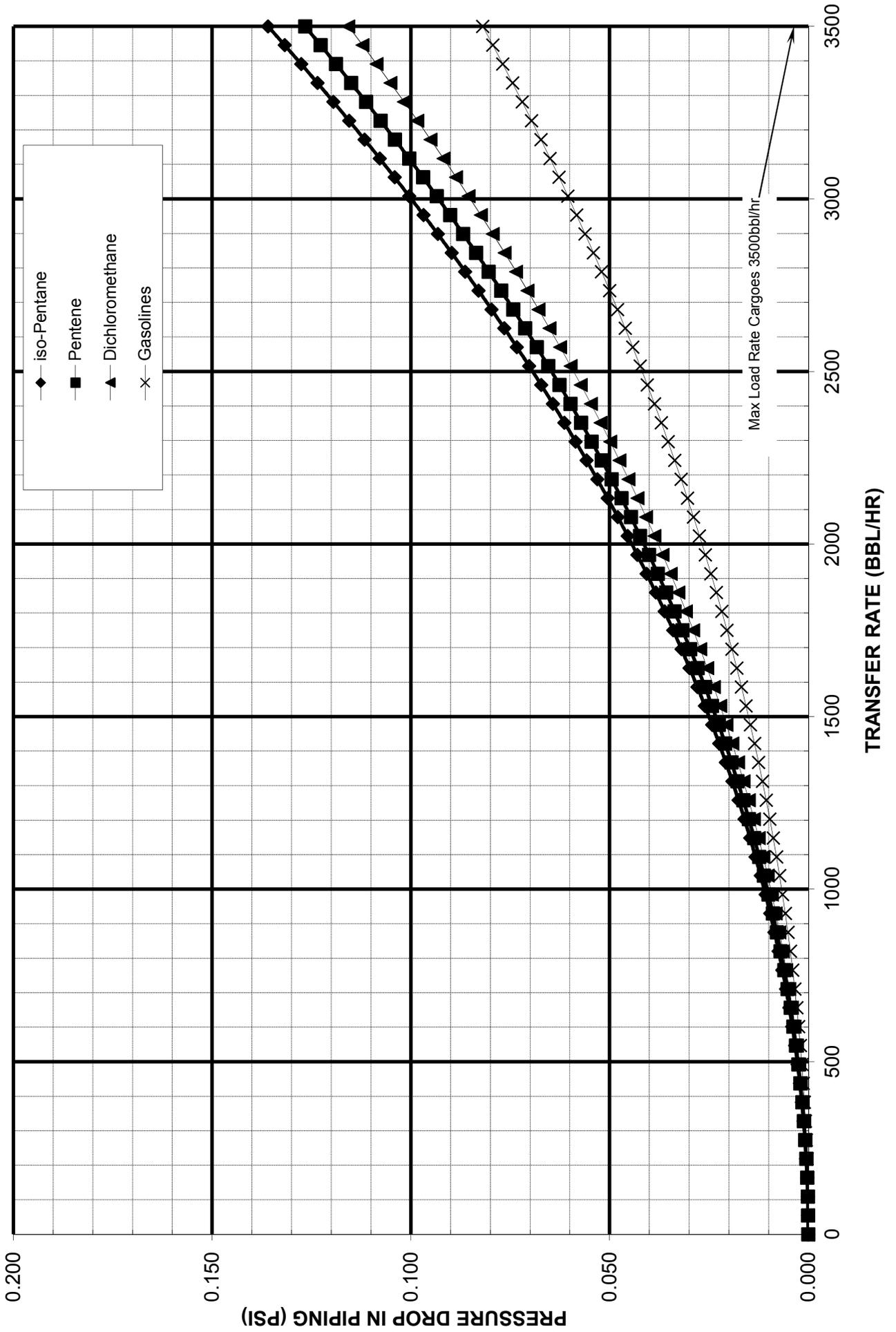


TABLE 1 - VAPOR CONTROL SYSTEM CALCULATIONS

CHRIS CODE	NAME	COMP GROUP	SUB CHAP	GRADE	HULL TYPE	VCS CAT	REST.	LIQ SG	VAPOR PRESS	VAPOR SG	VAPOR AIR WEIGHT DENSITY	VAPOR GROWTH RATE	VAPOR FLOW RATE (bbbl/h)	AIR EQUIV FLOW RATE (bbbl/hr)	PRESSURE DROP TO SHORE CONN IN VCS (LOADING)* (psid)	PRESSURE DROP TO SHORE CONN IN VCS (LOADING)* (psid)
1	ABX	Ammonium bisulfite solution (70% or less)	43	O	NA	III	N/A	0.880	0.330	4.480	0.086	1.007	3523	3642	0.017	0.024
2	ACN	Acrylonitrile	15	O	C	II	4	0.810	5.000	1.800	0.100	1.100	3850	4278	0.024	0.034
3	ADN	Adiponitrile	37	O	E	II	1	0.950	0.010	3.730	0.081	1.000	3501	3506	0.016	0.023
4	AEE	Aminoethylalanine	8	O	E	III	1	1.030	0.010	3.590	0.081	1.000	3501	3506	0.016	0.023
5	AHO	Anthracene oil (Coal tar fraction)	33	O	NA	II	N/A	1.030	0.010	3.590	0.081	1.000	3501	3506	0.016	0.023
6	AMH	Ammonium hydroxide (28% or less NH3)	6	O	NA	III	N/A	0.940	10.600	2.640	0.163	1.212	4242	6020	0.047	0.067
7	ATN	Acetonitrile	37	O	C	III	3	0.780	0.030	1.410	0.081	1.001	3502	3506	0.016	0.023
8	BAE	Butyraldehyde (all isomers)	19	O	C	III	1	0.790	8.000	2.480	0.136	1.160	4060	5280	0.036	0.051
9	BAR	Butyl acrylate (all isomers)	14	O	D	III	2	0.880	0.600	4.420	0.090	1.012	3542	3750	0.018	0.026
10	BHA	Benzene or hydrocarbon mixtures (containing Acetylene and 10% Benzene or more)	32	O	NA	III	1	0.880	0.800	4.000	0.092	1.250	4375	4674	0.028	0.040
11	BHB	Benzene or hydrocarbon mixtures (having 10% Benzene or more)	32	O	NA	III	1	0.880	0.800	4.000	0.092	1.250	4375	4674	0.028	0.040
12	BMN	Butyl Methacrylate	14	O	D	III	2	0.880	0.290	4.900	0.086	1.006	3520	3637	0.017	0.024
13	BNZ	Benzene	32	O	C	III	1	0.880	4.500	2.800	0.119	1.250	4375	5310	0.036	0.052
14	BTX	Benzene, Toluene, Xylene mixtures (10% Benzene or more)	32	O	B/C	III	1	0.840	7.300	2.800	0.143	1.250	4375	5815	0.044	0.062
15	CBT	Carbon tetrachloride	36	O	NA	III	N/A	1.590	5.400	5.490	0.195	1.108	3878	6025	0.047	0.067
16	CCH	Cyclohexanone	18	O	D	III	1	0.950	0.200	3.400	0.083	1.004	3514	3565	0.016	0.023
17	CCW	Cresote	21	O	E	III	1	0.950	0.200	3.400	0.083	1.004	3514	3565	0.016	0.023
18	CHA	Cyclohexylamine	7	O	D	III	1	0.870	0.620	3.420	0.088	1.012	3543	3698	0.018	0.025
19	CSS	Caustic soda solution	5	O	NA	III		1.540	0.029	1.370	0.081	1.001	3502	3506	0.016	0.023
20	DCM	Dichloromethane	36	O	NA	III	5	1.340	19.000	3.000	0.313	1.250	4375	8622	0.096	0.137
21	DEE	2,2'-Dichloroethyl ether	41	O	D	II	1	1.220	0.040	4.900	0.082	1.001	3503	3521	0.016	0.023
22	DEN	Diethylamine	7	O	C	III	3	0.710	1.000	2.500	0.088	1.020	3570	3725	0.018	0.026
23	DET	Diethylenetriamine	7	O	E	III	1	0.950	0.040	3.480	0.081	1.001	3503	3516	0.016	0.023
24	DIA	Diisopropylamine	7	O	C	II	3	0.720	3.700	3.500	0.124	1.074	3759	4665	0.028	0.040
25	DIP	Diisopropanolamine	8	O	E	III	1	0.980	0.010	4.590	0.081	1.000	3501	3507	0.016	0.023
26	DMB	Dimethylmethanamine	8	O	D	III	1	0.890	0.516	3.030	0.086	1.010	3536	3645	0.017	0.025
27	DMF	Dimethylformamide	10	O	D	III	1	0.950	0.300	2.510	0.083	1.006	3521	3570	0.016	0.024
28	DMX	Dichloropropane, Dichloropropane mixtures.	15	O	NA	II	1	0.892	9.200	1.550	0.105	1.184	4144	4718	0.029	0.041
29	DNA	Di-n-propylamine	7	O	C	II	3	0.740	1.450	3.500	0.098	1.029	3602	3966	0.020	0.029
30	DOL	Dodecyl phenol	21	O	E	I		0.930	0.000	9.040	0.081	1.000	3500	3503	0.016	0.023
31	DOT	Dodecyl dimethylamine, Tetradecyl dimethylamine mixture	7	O	E	III	N/A	0.990	0.010	13.450	0.081	1.000	3501	3516	0.016	0.023
32	DPB	1,1-Dichloropropane	36	O	C	III	3	1.040	1.800	3.000	0.098	1.036	3626	3991	0.021	0.029
33	DPC	1,3-Dichloropropane	36	O	C	III	3	1.040	1.800	3.000	0.098	1.036	3626	3991	0.021	0.029
34	DPP	1,2-Dichloropropane	36	O	C	III	3	1.160	2.500	3.890	0.115	1.050	3675	4383	0.025	0.035
35	DPU	1,3-Dichloropropane	15	O	D	II	4	1.230	5.500	3.840	0.154	1.110	3885	5371	0.037	0.053
36	DTI	2,4-Dichlorophenoxyacetic acid, trisopropanolamine salt solution.	43	O	NA	III	N/A	1.180	0.010	5.300	0.081	1.000	3501	3508	0.016	0.023
37	EAC	Ethyl acrylate	14	O	C	III	2	0.930	2.000	3.500	0.104	1.040	3640	4139	0.022	0.032
38	EAI	2-Ethylhexyl acrylate	14	O	E	III	2	0.890	0.015	6.350	0.081	1.000	3501	3512	0.016	0.023
39	EAN	Ethylamine solution (72% or less)	7	O	A	II	6	0.800	15.500	1.560	0.133	1.250	4375	5616	0.041	0.058
40	EBA	N-Ethylbutylamine	7	O	D	III	3	0.719	1.598	0.286	0.075	1.032	3612	3493	0.016	0.023
41	ECC	N-Ethylcyclohexylamine	7	O	D	III	1	0.850	0.585	4.400	0.090	1.012	3541	3743	0.018	0.026
42	EDA	Ethylenediamine	7	O	D	III	1	0.910	0.900	2.100	0.085	1.018	3563	3667	0.017	0.025
43	EDC	Ethylene dichloride	36	O	C	III	1	1.260	4.000	3.420	0.126	1.080	3780	4729	0.029	0.041
44	EGC	Ethylene glycol monoalkyl ethers	40	O	D/E	III	1	0.970	0.200	4.720	0.084	1.004	3514	3592	0.017	0.024
45	EGH	Ethylene glycol hexyl ether	40	O	E	III	N/A	0.930	0.170	3.100	0.083	1.003	3512	3511	0.016	0.023
46	EGP	Ethylene glycol propyl ether	40	O	E	III	1	0.908	0.025	3.600	0.081	1.001	3502	3511	0.016	0.023
47	EPA	2-Ethyl-3-propylacrolein	19	O	E	III	1	0.850	0.120	4.350	0.083	1.002	3508	3552	0.016	0.023

HULL/NAME: 5271/E2MS 101

TABLE 1 - VAPOR CONTROL SYSTEM CALCULATIONS

CHRIS CODE	NAME	COMP GROUP	SUB CHAP	GRADE	HULL TYPE	VCS CAT	REST.	LIQ SG	VAPOR PRESS	VAPOR SG	VAPOR AIR WEIGHT DENSITY	VAPOR GROWTH RATE	VAPOR FLOW RATE (bbbl/h)	AIR EQUIV FLOW RATE (bbbl/hr)	PRESSURE DROP TO PV VALVE IN VCS (LOADING) (psid)	PRESSURE DROP TO SHORE CONN IN VCS (LOADING)* (psid)
48	Ethylene cyanohydrin	20	O	E	III	1	No	1.040	0.010	2.450	0.081	1.000	3501	3505	0.016	0.023
49	Ethyl methacrylate	14	O	D/E	III	2	.50-70(a)	0.920	1.000	3.940	0.095	1.020	3570	3866	0.019	0.028
50	Furfural	19	O	E	III	1	.55-1(b)	1.200	0.150	3.310	0.082	1.003	3511	3548	0.016	0.023
51	Formaldehyde solution (37% to 50%)	19	O	D/E	III	1	.55-1(b)	1.130	0.150	1.030	0.081	1.003	3511	3514	0.016	0.023
52	Glutaraldehyde solution (50% or less)	19	O	NA	III	N/A	No	1.124	0.010	3.400	0.081	1.000	3501	3506	0.016	0.023
53	Hexamethylenediamine solution	7	O	E	III	1	.55-1(c)	1.210	10.500	1.260	0.094	1.210	4235	4562	0.027	0.038
54	Hexamethylenimine	7	O	C	III	1	.56-1(b), (c)	0.880	5.600	0.104	0.057	1.112	3892	3278	0.014	0.020
55	iso-Decyl acrylate	14	O	E	III	2	.50-70(a), .50-81(a), (b), .55-1(c)	0.890	0.010	7.300	0.081	1.000	3501	3510	0.016	0.023
56	iso-Propylamine	7	O	A	II	5	.55-1(c)	0.690	23.100	2.030	0.258	1.250	4375	7820	0.079	0.113
57	Isoprene	30	O	A	III	7	.50-70(a), .50-81(a), (b)	0.672	11.300	1.772	0.122	1.226	4291	5272	0.036	0.051
58	Kraft pulping liquors (free alkali content 3% or more) (including: Black, Green, or White liquor)	5	O	NA	III	N/A	.50-73, .56-1(a), (c), (g)	0.800	10.060	2.960	0.174	1.201	4204	6164	0.049	0.070
59	Methyl acrylate	14	O	C	III	2	.50-70(a), .50-81(a), (b)	0.950	4.100	3.000	0.119	1.082	3787	4606	0.027	0.039
60	Methylcyclopentadiene dimer	30	O	C	III	1	No	0.941	0.040	0.930	0.081	1.001	3503	3505	0.016	0.023
61	Methyl diethanolamine	8	O	E	III	1	.56-1(b), (c)	1.043	0.000	4.120	0.081	1.000	3500	3503	0.016	0.023
62	MEA	8	O	E	III	1	.55-1(c)	1.020	0.030	2.100	0.081	1.001	3502	3508	0.016	0.023
63	2-Methyl-5-ethylpyridine	9	O	E	III	1	.55-1(e)	0.920	0.160	4.180	0.083	1.003	3511	3566	0.016	0.023
64	MMM	14	O	C	III	2	.50-70(a), .50-81(a), (b)	0.940	2.020	3.260	0.104	1.040	3641	4135	0.022	0.031
65	MPL	8	O	E	III	1	.55-1(c)	0.960	0.080	2.590	0.081	1.002	3506	3521	0.016	0.023
66	Morpholine	7	O	D	III	1	.55-1(c)	1.000	0.800	3.000	0.088	1.016	3556	3721	0.018	0.026
67	2-Methylpyridine	9	O	D	III	3	.55-1(c)	0.940	2.065	3.200	0.102	1.041	3645	4101	0.022	0.031
68	Mesityl oxide	18	O	D	III	1	No	0.860	0.670	3.500	0.089	1.013	3547	3719	0.018	0.026
69	alpha-Methylstyrene	30	O	D	III	2	.50-70(a), .50-81(a), (b)	0.890	0.400	4.080	0.087	1.008	3528	3655	0.017	0.025
70	Coal tar naphtha solvent	33	O	D	III	1	.50-73	1.410	3.600	2.170	0.101	1.072	3752	4190	0.023	0.032
71	1- or 2-Nitropropane	42	O	D	III	1	.50-81	0.990	1.050	3.060	0.091	1.021	3574	3795	0.019	0.027
72	Propanolamine (iso-, n-)	8	O	E	III	1	.56-1(b), (c)	0.870	1.900	3.520	0.103	1.038	3633	4111	0.022	0.031
73	1,3-Pentadiene	30	O	A	III	7	.50-70(a), .50-81	0.680	17.060	2.360	0.221	1.250	4375	7246	0.068	0.097
74	Polyethylene polyamines	7	O	E	III	1	.55-1(e)	0.994	8.300	4.550	0.219	1.166	4081	6727	0.058	0.083
75	Perchloroethylene	36	O	NA	III	N/A	No	1.620	1.230	5.830	0.109	1.025	3586	4163	0.022	0.032
76	Pyridine	9	O	C	III	1	.55-1(e)	0.980	1.300	2.720	0.091	1.026	3591	3820	0.019	0.027
77	Sodium aluminate solution (45% or less)	5	O	NA	III	N/A	.50-73, .56-1(a), (b), (c)	0.850	0.010	0.010	0.081	1.000	3501	3502	0.016	0.023
78	Sodium chlorate solution (50% or less)	0	O	NA	III	N/A	.50-73	0.850	0.010	0.010	0.081	1.000	3501	3502	0.016	0.023
79	Sodium sulfide, hydrosulfide solution (H2S 15 ppm or less)	0	O	NA	III	1	.50-73, .55-1(b)	1.280	1.510	1.170	0.082	1.030	3606	3635	0.017	0.024
80	Sodium sulfide, hydrosulfide solution (H2S greater than 15 ppm but less than 200 ppm)	0	O	NA	III	N/A	.50-73, .55-1(b)	1.280	1.510	1.170	0.082	1.030	3606	3635	0.017	0.024
81	Sodium sulfide, hydrosulfidesolutions (H2S greater than 200ppm)	0	O	NA	II	N/A	.50-73, .55-1(b)	1.280	1.510	1.170	0.082	1.030	3606	3635	0.017	0.024
82	Styrene monomer	30	O	D	III	2	.50-70(a), .50-81(a), (b)	0.920	0.400	3.600	0.086	1.008	3528	3636	0.017	0.024
83	1,2,4-Trichlorobenzene	36	O	E	III	1	No	1.450	0.010	6.260	0.081	1.000	3501	3509	0.016	0.023
84	Trichloroethylene	36	O	NA	III	1	No	1.470	3.500	4.540	0.139	1.070	3745	4916	0.031	0.045
85	1,1,2-Trichloroethane	36	O	NA	III	1	.50-73, .56-1(a)	1.430	0.010	4.550	0.081	1.000	3501	3507	0.016	0.023
86	1,2,3-Trichloropropane	36	O	E	II	3	.50-73, .56-1(a)	1.390	0.150	5.600	0.084	1.003	3511	3583	0.017	0.024
87	Triethanolamine	8	O	E	III	1	.55-1(b)	1.130	0.010	5.140	0.081	1.000	3501	3508	0.016	0.023
88	1,1,2,2-Tetrachloroethane	36	O	NA	III	N/A	No	1.600	1.000	5.800	0.103	1.020	3570	4041	0.021	0.030
89	Triethylamine	7	O	C	II	3	.55-1(e)	0.730	2.500	3.490	0.110	1.050	3675	4292	0.024	0.034
90	Triethylenetetramine	7	O	E	III	1	.55-1(b)	0.980	0.010	5.040	0.081	1.000	3501	3508	0.016	0.023
91	Tetrahydrofuran	41	O	C	III	1	.50-70(b)	0.890	8.500	1.350	0.095	1.170	4095	4439	0.025	0.036
92	Triphenylborane (10% or less), caustic soda solution	5	O	NA	III	N/A	.56-1(a), (b), (c)	0.870	1.500	3.140	0.096	1.030	3605	3930	0.020	0.028
93	Tetraethylenepentamine	1	O	E	III	1	.55-1(c)	0.998	0.000	6.530	0.081	1.000	3500	3503	0.016	0.023
94	Urea, Ammonium nitrate solution (containing more than 2% NH3)	6	O	NA	III	N/A	.56-1(b)	1.000	0.010	6.800	0.081	1.000	3501	3509	0.016	0.023

OWNER: E-Squared Marine Service

DESCRIPTION: Double Skin Tank Barge, Rivers, Lakes, Bays and Sounds

SIZE: 200'-0"x35'-0"x12'-6"

HULL/NAME: 5271/E2MS 101

CONTRACT: 96273

BY: MEC

DATE: 22-Feb-2017

TABLE 1 - VAPOR CONTROL SYSTEM CALCULATIONS

CHRIS CODE	NAME	COMP GROUP	SUB CHAP	GRADE	HULL TYPE	VCS CAT	REST.	LIQ SG	VAPOR PRESS	VAPOR SG	VAPOR AIR WEIGHT DENSITY	VAPOR GROWTH RATE	VAPOR FLOW RATE (bbbl/h)	AIR EQUIV FLOW RATE (bbbl/hr)	PRESSURE DROP TO PV VALVE IN VCS (LOADING) (psid)	PRESSURE DROP TO SHORE CONN IN VCS (LOADING)* (psid)
95	VAM	Vinyl acetate	13	O	C	III	2	.50-70(a), .50-81(a), (b)	0.940	2.970	0.135	1.116	3906	5043	0.033	0.047
96	VNT	Vinyltoluene	13	O	D	III	2	.50-70(a), .50-81, .56-(a), (b), (c), (g)	0.900	4.080	0.083	1.002	3508	3549	0.016	0.023
97	ACP	Acetophenone	18	D	E	NA	1	NA	1.030	0.600	0.090	1.012	3542	3734	0.018	0.026
98	ACT	Acetone	18	D	C	NA	1	NA	0.790	10.000	0.128	1.200	4200	5286	0.036	0.052
99	BAL	Benzyl alcohol	21	D	E	NA	1	NA	1.050	0.100	0.082	1.002	3507	3538	0.016	0.023
100	BAN	Butyl alcohol (n-)	0	D	D	NA	1	NA	0.810	0.500	0.085	1.010	3535	3619	0.017	0.024
101	BAS	Butyl alcohol (sec-)	0	D	C	NA	1	NA	0.810	1.300	0.091	1.026	3591	3805	0.019	0.027
102	BAT	Butyl alcohol (tert-)	0	D	C	NA	1	NA	0.780	2.800	0.102	1.056	3696	4153	0.022	0.032
103	BAX	Butyl acetate (all isomers)	34	D	D	NA	1	NA	0.870	0.600	0.089	1.012	3542	3726	0.018	0.026
104	BPH	Butyl benzyl phthalate	34	D	E	NA	1	NA	1.120	0.010	0.081	1.000	3501	3513	0.016	0.023
105	BUE	Butyl toluene	32	D	D	NA	1	NA	0.850	0.100	0.083	1.002	3507	3551	0.016	0.023
106	CHN	Cyclohexanol	20	D	E	NA	1	NA	0.940	0.200	0.083	1.004	3514	3568	0.016	0.023
107	CHX	Cyclohexane	31	D	C	NA	1	NA	0.780	4.500	0.121	1.090	4672	4722	0.028	0.040
108	CJS	Caprolactam solutions	22	D	E	NA	1	NA	1.060	0.700	0.090	1.014	3549	3756	0.018	0.026
109	CMP	p-Cymene	32	D	D	NA	1	NA	0.860	0.460	0.089	1.009	3532	3702	0.018	0.025
110	CPD	1,3-Cyclopentadiene dimer (molten)	30	D	D/E	NA	2	NA	0.690	0.250	0.085	1.005	3518	3610	0.017	0.024
111	DAA	Diacetone alcohol	20	D	E	NA	1	NA	0.940	0.100	0.082	1.002	3507	3540	0.016	0.023
112	DAX	Decyl alcohol (all isomers)	20	D	E	NA	1	NA	0.830	5.800	0.135	1.116	3906	5043	0.033	0.047
113	DBL	Diisobutylene	30	D	C	NA	1	NA	0.720	2.200	0.112	1.044	3654	4296	0.024	0.034
114	DCE	Decene	30	D	D	NA	1	NA	0.740	0.120	0.083	1.002	3508	3563	0.016	0.023
115	DDB	Dodecylbenzene, see Alkyl(C9+)benzenes	32	D	E	NA	1	NA	0.860	4.700	0.244	1.094	3829	6662	0.057	0.082
116	DDO	Diphenyl, Diphenyl ether mixtures	33	D	E	NA	1	NA	1.070	0.010	0.081	1.000	3501	3508	0.016	0.023
117	DEB	Diethylbenzene	32	D	D	NA	1	NA	0.870	0.080	0.082	1.002	3506	3538	0.016	0.023
118	DEG	Diethylene glycol	40	D	E	NA	1	NA	1.120	0.010	0.081	1.000	3501	3506	0.016	0.023
119	DIK	Diisobutyl ketone	18	D	D	NA	1	NA	0.810	0.480	0.090	1.010	3534	3724	0.018	0.026
120	DOP	Diocetyl phthalate	34	D	E	NA	1	NA	0.990	0.010	0.081	1.000	3501	3516	0.016	0.023
121	DPG	Dipropylene glycol	40	D	E	NA	1	NA	1.030	0.070	0.082	1.001	3505	3533	0.016	0.023
122	EAL	Ethyl alcohol	20	D	C	NA	1	NA	0.790	3.500	0.091	1.070	3745	3970	0.020	0.029
123	EBT	Ethyl butanol	20	D	D	NA	1	NA	0.830	0.140	0.082	1.003	3510	3547	0.016	0.023
124	EGL	Ethylene glycol	20	D	E	NA	1	NA	1.130	0.010	0.081	1.000	3501	3505	0.016	0.023
125	EGY	Ethylene glycol diacetate	34	D	E	NA	1	NA	1.130	0.010	0.081	1.000	3501	3503	0.016	0.023
126	EHX	2-Ethylhexanol	20	D	E	NA	1	NA	0.830	0.015	0.081	1.000	3501	3509	0.016	0.023
127	ETA	Ethyl acetate	32	D	C	NA	1	NA	0.900	4.500	0.124	1.090	3815	4728	0.029	0.041
128	ETB	Ethylbenzene	34	D	C	NA	1	NA	0.870	0.600	0.088	1.012	3542	3706	0.018	0.025
129	ETG	Ethoxy triglycol (crude)	40	D	E	NA	1	NA	1.020	0.010	0.081	1.000	3501	3509	0.016	0.023
130	FAL	Furfuryl alcohol	20	D	E	NA	1	NA	1.290	0.100	0.082	1.002	3507	3534	0.016	0.023
131	GAT	Gasolines: Automotive (containing not over 4.23 grams lead per gallon)	33	D	C	NA	1	NA	0.760	12.500	0.222	1.250	4375	7253	0.068	0.097
132	GCR	Glycerine	20	D	E	NA	1	NA	1.260	0.010	0.081	1.000	3501	3506	0.016	0.023
133	HMX	Heptane (all isomers), see Alkanes (C6-C9) (all isomers)	31	D	C	NA	1	NA	0.680	2.500	0.110	1.050	3675	4283	0.024	0.034
134	HPX	Heptene (all isomers)	30	D	C	NA	2	NA	0.700	2.900	0.114	1.058	3703	4392	0.025	0.036
135	HXG	Hexylene glycol	20	D	E	NA	1	NA	0.920	0.010	0.081	1.000	3501	3507	0.016	0.023
136	HXN	Hexanol	20	D	D	NA	1	NA	0.820	1.000	0.093	1.020	3570	3826	0.019	0.027
137	IAC	iso-Propyl acetate	34	D	C	NA	1	NA	0.880	3.100	0.118	1.062	3717	4486	0.026	0.037
138	IAL	Butyl alcohol (iso-)	20	D	D	NA	1	NA	0.810	0.900	0.088	1.018	3563	3712	0.018	0.025
139	IDA	iso-Decaldehyde	19	D	E	NA	1	NA	0.830	0.060	0.082	1.001	3504	3534	0.016	0.023
140	IPA	iso-Propyl alcohol	20	D	C	NA	1	NA	0.790	3.000	0.096	1.060	3710	4045	0.021	0.030
141	IPH	Isophorone	18	D	E	NA	1	NA	0.930	0.010	0.081	1.000	3501	3507	0.016	0.023
142	KRS	Kerosene	33	D	D	NA	1	NA	0.810	0.150	0.083	1.003	3511	3566	0.016	0.023
143	MAC	Methylamyl acetate	34	D	D	NA	1	NA	0.860	0.340	0.087	1.007	3524	3663	0.017	0.025
144	MAL	Methyl alcohol	20	D	C	NA	1	NA	0.790	7.000	0.100	1.140	3990	4074	0.021	0.031
145	MBE	Methyl tert-butyl ether	41	D	C	NA	1	NA	0.740	0.040	0.081	1.001	3503	3514	0.016	0.023

OWNER: E-Squared Marine Service

DESCRIPTION: Double Skin Tank Barge, Rivers, Lakes, Bays and Sounds

SIZE: 200'-0"x35'-0"x12'-6"

HULL/NAME: 5271/E2MS 101

CONTRACT: 96273

BY: MEC

DATE: 22-Feb-2017

TABLE 1 - VAPOR CONTROL SYSTEM CALCULATIONS

CHRIS CODE	NAME	COMP GROUP	SUB CHAP	GRADE	HULL TYPE	VCS CAT	REST.	LIQ SG	VAPOR PRESS	VAPOR SG	VAPOR AIR WEIGHT DENSITY	VAPOR GROWTH RATE	VAPOR FLOW RATE (bbbl/h)	AIR EQUIV FLOW RATE (bbbl/hr)	PRESSURE DROP TO PV VALVE IN VCS (LOADING) (psid)	PRESSURE DROP TO SHORE CONN IN VCS (LOADING) (psid)
146	MEK	18	D	C	NA	1	NA	0.800	4.500	2.500	0.113	1.090	3815	4505	0.026	0.037
147	MIK	18	D	C	NA	1	NA	0.800	1.200	3.450	0.095	1.024	3584	3881	0.019	0.028
148	MNS	33	D	D	NA	1	NA	0.750	0.200	4.300	0.084	1.004	3514	3584	0.017	0.024
149	MIT	34	D	D	NA	1	NA	0.920	6.100	2.600	0.127	1.122	3927	4920	0.031	0.045
150	NNP	21	D	E	NA	1	NA	0.940	0.010	7.590	0.081	1.000	3501	3510	0.016	0.023
151	NSS	33	D	D	NA	1	NA	0.780	0.200	0.010	0.080	1.004	3514	3496	0.016	0.023
152	NSV	33	D	D	NA	1	NA	0.870	0.200	3.500	0.083	1.004	3514	3568	0.016	0.023
153	NVM	33	D	C	NA	1	NA	0.770	0.190	0.010	0.080	1.004	3513	3497	0.016	0.023
154	ODS	33	D	D/E	NA	1	NA	0.900	5.800	2.970	0.135	1.116	3906	5043	0.033	0.047
155	OIL	33	D	C/D	NA	1	NA	0.950	5.800	2.970	0.135	1.116	3906	5043	0.033	0.047
156	OSX	33	D	E	NA	1	NA	0.950	0.149	2.970	0.082	1.003	3510	3543	0.016	0.023
157	OTW	33	D	D/E	NA	1	NA	0.880	0.560	8.000	0.099	1.011	3539	3925	0.020	0.028
158	PAL	20	D	C	NA	1	NA	0.800	1.200	2.070	0.087	1.024	3584	3718	0.018	0.026
159	PAT	34	D	C	NA	1	NA	0.870	1.900	3.520	0.103	1.038	3633	4111	0.022	0.031
160	PBY	32	D	D	NA	1	NA	0.860	0.600	4.200	0.090	1.012	3542	3737	0.018	0.026
161	PLB	30	D	E	NA	1	NA	0.910	0.010	0.010	0.081	1.000	3501	3502	0.016	0.023
163	PTE	31	D	A	III	5	NA	0.637	24.945	2.500	0.343	1.250	4375	9018	0.105	0.150
162	PTY	30	D	A	III	5	NA	0.620	27.000	2.480	0.368	1.250	4375	9345	0.113	0.161
164	TCP	34	D	E	NA	1	NA	1.170	0.010	12.700	0.081	1.000	3501	3515	0.016	0.023
165	TEB	32	D	E	NA	1	NA	0.860	0.050	5.600	0.082	1.001	3504	3530	0.016	0.023
166	TEG	40	D	E	NA	1	NA	1.120	0.010	5.170	0.081	1.000	3501	3508	0.016	0.023
167	THN	32	D	E	NA	1	NA	0.980	0.040	4.550	0.082	1.001	3503	3520	0.016	0.023
168	TOL	32	D	C	NA	1	NA	0.870	1.500	3.140	0.096	1.030	3605	3930	0.020	0.028
169	TTG	40	D	E	NA	1	NA	1.130	0.010	6.700	0.081	1.000	3501	3509	0.016	0.023
Max Vapor Density Cargo	PTY iso-Pentane	30	D	A	III	5	NA	0.620	27.000	2.480	0.368	1.250	4375	9345	0.113	0.161
Max Pressure Drop Cargo	PTY iso-Pentane	30	D	A	III	5	NA	0.620	27.000	2.480	0.368	1.250	4375	9345	0.113	0.161

Vapor Control System List of Cargoes

for: E2MS 101, O.N. TBD, Trinity Marine, Ashland City, TN Hull , 5271

Chem Code	Chemical Name	VCS Category
ACT	Acetone	1
ATN	Acetonitrile	3
ACP	Acetophenone	1
ACN	Acrylonitrile	4
ADN	Adiponitrile	1
APU	Alcohol(C12-C16) poly(1-6)ethoxylates	1
AEB	Alcohol(C6-C17)(secondary) poly(7-12)ethoxylates	1
AEE	Aminoethylethanolamine	1
AEC	Amyl acetate (all isomers)	1
AAI	Amyl alcohol (iso-, n-, sec-, primary)	1
BNZ	Benzene	1
BHB	Benzene or hydrocarbon mixtures (having 10% Benzene or more)	1
BHA	Benzene or hydrocarbon mixtures (containing Acetylene and 10% Benzene or more)	1
BTX	Benzene, Toluene, Xylene mixtures (10% Benzene or more)	1
BAL	Benzyl alcohol	1
BFX	Brake fluid base mixtures (containing Poly(2-8)alkylene(C2-C3) glycols, Polyalkylene(C2-C10) glycol monoalkyl(C1-C4) ethers, and their borate esters)	1
BAX	Butyl acetate (all isomers)	1
BAR	Butyl acrylate (all isomers)	2
IAL	Butyl alcohol (iso-)	1
BAN	Butyl alcohol (n-)	1
BAS	Butyl alcohol (sec-)	1
BAT	Butyl alcohol (tert-)	1
BPH	Butyl benzyl phthalate	1
BMH	Butyl methacrylate	2
BUE	Butyl toluene	1
BAE	Butyraldehyde (all isomers)	1
CLS	Caprolactam solutions	1
CRB	Chlorobenzene	1
CRF	Chloroform	3
NCT	Coal tar naphtha solvent	1
CCW	Creosote	1
CRS	Cresols (all isomers)	1
CRX	Cresylic acid tar	1
CTA	Crotonaldehyde	4
CHG	Crude hydrocarbon feedstock (containing Butyraldehydes and Ethylpropyl acrolein)	1
CHX	Cyclohexane	1
CHN	Cyclohexanol	1
CCH	Cyclohexanone	1
CYX	Cyclohexanone, Cyclohexanol mixture	1
CHA	Cyclohexylamine	1
CPD	1,3-Cyclopentadiene dimer (molten)	2
CSB	Cyclopentadiene, Styrene, Benzene mixture	1
CMP	p-Cymene	1
IDA	iso-Decaldehyde	1
DAL	n-Decaldehyde	1
DCE	Decene	1

Chem Code	Chemical Name	VCS Category
IAI	iso-Decyl acrylate	2
DAX	Decyl alcohol (all isomers)	1
DBZ	n-Decylbenzene, see Alkyl(C9+)benzenes	1
DAA	Diacetone alcohol	1
DPA	ortho-Dibutyl phthalate	1
DBX	Dichlorobenzene (all isomers)	3
DCH	1,1-Dichloroethane	1
DEE	2,2'-Dichloroethyl ether	1
DCM	Dichloromethane	5
DPB	1,1-Dichloropropane	3
DPP	1,2-Dichloropropane	3
DPC	1,3-Dichloropropane	3
DPU	1,3-Dichloropropene	4
DMX	Dichloropropene, Dichloropropane mixtures	1
DEA	Diethanolamine	1
DEN	Diethylamine	3
DEB	Diethylbenzene	1
DEG	Diethylene glycol	1
DET	Diethylenetriamine	1
DBU	Diisobutylamine	3
DBL	Diisobutylene	1
DIK	Diisobutyl ketone	1
DIP	Diisopropanolamine	1
DIA	Diisopropylamine	3
DIX	Diisopropylbenzene (all isomers)	1
DAC	N,N-Dimethylacetamide	3
DMB	Dimethylethanolamine	1
DMF	Dimethylformamide	1
DTL	Dimethyl phthalate	1
DOP	Dioctyl phthalate	1
DPN	Dipentene	1
DIL	Diphenyl	1
DDO	Diphenyl, Diphenyl ether mixtures	1
DPE	Diphenyl ether	1
DNA	Di-n-propylamine	3
DPG	Dipropylene glycol	1
DFF	Distillates: Flashed feed stocks	1
DSR	Distillates: Straight run	1
DOZ	Dodecene (all isomers)	1
DDB	Dodecylbenzene, see Alkyl(C9+)benzenes	1
MEA	Ethanolamine	1
EEA	2-Ethoxyethyl acetate	1
ETG	Ethoxy triglycol (crude)	1
ETA	Ethyl acetate	1
EAA	Ethyl acetoacetate	1
EAC	Ethyl acrylate	2
EAL	Ethyl alcohol	1
EAN	Ethylamine solution (72% or less)	6
ETB	Ethylbenzene	1
EBT	Ethyl butanol	1
EBA	N-Ethylbutylamine	3
EBE	Ethyl tert-butyl ether	1
EBR	Ethyl butyrate	1

Chem Code	Chemical Name	VCS Category
ECY	Ethyl cyclohexane	1
ECC	N-Ethylcyclohexylamine	1
ETC	Ethylene cyanohydrin	1
EDA	Ethylenediamine	1
EDC	Ethylene dichloride	1
EGL	Ethylene glycol	1
EMA	Ethylene glycol butyl ether acetate	1
EGY	Ethylene glycol diacetate	1
EGC	Ethylene glycol monoalkyl ethers	1
EPE	Ethylene glycol phenyl ether	1
EGP	Ethylene glycol propyl ether	1
EEP	Ethyl-3-ethoxypropionate	1
EHX	2-Ethylhexanol	1
EAI	2-Ethylhexyl acrylate	2
ETM	Ethyl methacrylate	2
EPR	Ethyl propionate	1
EPA	2-Ethyl-3-propylacrolein	1
ETE	Ethyl toluene	1
FMS	Formaldehyde solution (37% to 50%)	1
FAM	Formamide	1
FFA	Furfural	1
FAL	Furfuryl alcohol	1
GAK	Gasoline blending stocks: Alkylates	1
GRF	Gasoline blending stocks: Reformates	1
GAT	Gasolines: Automotive (containing not over 4.23 grams lead per gallon)	1
GAV	Gasolines: Aviation (containing not over 4.86 grams of lead per gallon)	1
GCS	Gasolines: Casinghead (natural)	1
GPL	Gasolines: Polymer	1
GSR	Gasolines: Straight run	1
GCR	Glycerine	1
HMX	Heptane (all isomers), see Alkanes (C6-C9) (all isomers)	1
HEP	Heptanoic acid	1
HTX	Heptanol (all isomers)	1
HPX	Heptene (all isomers)	2
HPE	Heptyl acetate	1
HMC	Hexamethylenediamine solution	1
HMI	Hexamethyleneimine	1
HXS	Hexane (all isomers), see Alkanes (C6-C9)	1
HXO	Hexanoic acid	1
HXN	Hexanol	1
HEX	Hexene (all isomers)	2
HXG	Hexylene glycol	1
HFN	Hydrocarbon 5-9	1
IPH	Isophorone	1
IPR	Isoprene	7
JPF	Jet fuel: JP-4	1
JPV	Jet fuel: JP-5 (kerosene, heavy)	1
KRS	Kerosene	1
MSO	Mesityl oxide	1
MTT	Methyl acetate	1
MAM	Methyl acrylate	2
MAL	Methyl alcohol	1
MAC	Methylamyl acetate	1

Chem Code	Chemical Name	VCS Category
MAA	Methylamyl alcohol	1
MAK	Methyl amyl ketone	1
MBE	Methyl tert-butyl ether	1
MBK	Methyl butyl ketone	1
MBU	Methyl butyrate	1
MCK	Methylcyclopentadiene dimer	1
MDE	Methyl diethanolamine	1
MEK	Methyl ethyl ketone	1
MEP	2-Methyl-5-ethylpyridine	1
MHK	Methyl heptyl ketone	1
MIK	Methyl isobutyl ketone	1
MMM	Methyl methacrylate	2
MNA	Methyl naphthalene (molten)	1
MPR	2-Methylpyridine	3
MSR	alpha-Methylstyrene	2
MNS	Mineral spirits	1
MPL	Morpholine	1
MRE	Myrcene	1
NAG	Naphtha: Heavy	1
PTN	Naphtha: Petroleum	1
NSV	Naphtha: Solvent	1
NSS	Naphtha: Stoddard solvent	1
NVM	Naphtha: Varnish makers and painters (75%)	1
NPM	1- or 2-Nitropropane	1
NAX	Nonane (all isomers), see Alkanes (C6-C9)	1
NON	Nonene (all isomers)	2
NNS	Nonyl alcohol (all isomers)	1
NNP	Nonyl phenol	1
NPE	Nonyl phenol poly(4+)ethoxylates	1
OAX	Octane (all isomers), see Alkanes (C6-C9)	1
OAY	Octanoic acid (all isomers)	1
OCX	Octanol (all isomers)	1
OTX	Octene (all isomers)	2
OTW	Oil, fuel: No. 2	1
OTD	Oil, fuel: No. 2-D	1
OFR	Oil, fuel: No. 4	1
OFV	Oil, fuel: No. 5	1
OSX	Oil, fuel: No. 6	1
OIL	Oil, misc: Crude	1
ODS	Oil, misc: Diesel	1
OGP	Oil, misc: Gas, high pour	1
OLB	Oil, misc: Lubricating	1
ORL	Oil, misc: Residual	1
OTB	Oil, misc: Turbine	1
PDE	1,3-Pentadiene	7
PTY	Pentane (all isomers)	5
PTX	Pentene (all isomers)	5
PPE	n-Pentyl propionate	1
PIO	alpha-Pinene	1
PIP	beta-Pinene	1
PAG	Poly(2-8)alkylene glycol monoalkyl(C1-C6) ether	1
PAF	Poly(2-8)alkylene glycol monoalkyl(C1-C6) ether acetate	1
PLB	Polybutene	1

Chem Code	Chemical Name	VCS Category
PEB	Polyethylene polyamines	1
PGC	Polypropylene glycol	1
MPA	iso-Propanolamine	1
PAX	Propanolamine (iso-, n-)	1
IAC	iso-Propyl acetate	1
PAT	n-Propyl acetate	1
IPA	iso-Propyl alcohol	1
PAL	n-Propyl alcohol	1
IPP	iso-Propylamine	5
PBY	Propylbenzene (all isomers)	1
IPX	iso-Propylcyclohexane	1
PPG	Propylene glycol	1
PGN	Propylene glycol methyl ether acetate	1
PTT	Propylene tetramer	1
PRD	Pyridine	1
SSH	Sodium sulfide, hydrosulfide solution (H2S 15 ppm or less)	1
STX	Styrene (crude)	2
STY	Styrene monomer	2
SFL	Sulfolane	1
TTG	Tetraethylene glycol	1
TTP	Tetraethylenepentamine	1
THF	Tetrahydrofuran	1
THN	Tetrahydronaphthalene	1
TOL	Toluene	1
TCB	1,2,4-Trichlorobenzene	1
TCM	1,1,2-Trichloroethane	1
TCL	Trichloroethylene	1
TCN	1,2,3-Trichloropropane	3
TCP	Tricresyl phosphate (less than 1% of the ortho isomer)	1
TEA	Triethanolamine	1
TEN	Triethylamine	3
TEB	Triethylbenzene	1
TEG	Triethylene glycol	1
TET	Triethylenetetramine	1
TPS	Triethyl phosphate	1
TRE	Trimethylbenzene (all isomers)	1
TRP	Trixylenyl phosphate	1
UDC	Undecene	1
UND	1-Undecyl alcohol	1
VAM	Vinyl acetate	2
VNT	Vinyltoluene	2
XLX	Xylenes (ortho-, meta-, para-)	1

Vapor Control System (VCS) Categories

Category 1: (No additional VCS requirements above those for benzene, gasolines and crude oil) All requirements applying to the handling of oil and hazardous materials in Titles 33 and 46 Code of Federal Regulations (CFR) apply to these cargoes. Those specifically dealing with vapor control systems are in 33 CFR 155.750, 33 CFR 156.120, 33 CFR 156.170, 46 CFR 35.35 and 46 CFR 39. The cargo tank venting system calculations (46 CFR 39.20-11) and the pressure drop calculations (46 CFR 39.30-1(b)) must use appropriate friction factors, vapor densities and vapor growth rates.

Category 2: (Polymerizes) Polymerization and residue build-up of these cargoes can adversely affect the vessel by fouling safety components and restricting vapor flow which could lead to cargo tank overpressurization. The vessel's owner must develop a method of ensuring all VCS safety components are functional and polymer build-up is not causing an unsafe condition due to increased pressure in the vapor control piping and cargo tanks. The method shall be acceptable to the local Officer in Charge, Marine Inspection. This is in addition to the requirements of Category 1. Please note that a material not normally considered a monomer can be a problem in detonation arrester.

Category 3: (Highly toxic) VCSs for these toxic cargoes cannot use a spill valve or rupture disk as the primary means to meet the overfill protection requirement of 46 CFR 39.20-9. This requirement is in addition to the requirements of Category 1.

Category 4: (Polymerizes and highly toxic) Must comply with requirements of Categories 1, 2 and 3.

Category 5: (High vapor pressure) VCS pressure drop calculations for cargoes with a vapor pressure greater than 14.7 psia at 115 F must take into account increased vapor-air mixture densities and vapor growth rates as compared to Category 1 cargoes. Consult the Marine Safety Center's VCS Guidelines for further information. This requirement is in addition to the requirements of Category 1.

Category 6: (High vapor pressure and highly toxic) Must comply with requirements of Categories 1, 3 and 5.

Category 7: (High vapor pressure and polymerizes) Must comply with requirements of Categories 1, 2 and 5.



Marine Safety Center Vapor Control System (VCS) Plan Review Information Sheet (PRIS)



Vessel Name	E2MS 101	Shipyard	Trinity Marine Products, Ashland City, TN
Coast Guard Number	CG1433325	Hull Number	5271

1. This sheet consolidates critical VCS parameters for MSC Staff Engineers and CG Field Inspectors dealing with Vapor Control Systems. CG Inspectors should verify the vessel's VCS design is consistent with the information listed in boxes 2, 6, 7 & 8 prior to updating the vapor control endorsement on the vessel's Certificate of Inspection. For cases where the information in the VCS PRIS does not reflect the vessel's design the CG Inspector should contact the MSC's Cargo Authority branch.

2. Tank Maximum Design Working Pressure	<input style="width: 80px;" type="text" value="3.00"/> psig	Raised Trunk	<input checked="" type="checkbox"/>
		Flush Deck	<input type="checkbox"/>

3. Authorized Maximum Cargo Transfer Rate(s)	<input style="width: 80px;" type="text" value="3,500"/>	bbl/hr loading (max 2 tanks simultaneously)
	<input style="width: 80px;" type="text" value="3,500"/>	bbl/hr discharging

4. Authorized Maximum Vapor-Air Mixture Density	<input style="width: 100px;" type="text" value="0.368"/> lbm/ft ³
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5. Authorized VCS Categories	<input style="width: 100px;" type="text" value="1 through 7"/>
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6. Cargoes with the highest vapor density and/or pressure drop:	
a. Cargo Name	<u>Pentane (all isomers) [PTY]</u>
b. Cargo Name	<u>Pentane (all isomers) [PTY]</u>

7. Pressure Vacuum Valve:		8. VCS Pipe Sizes:	
Manufacturer	<input style="width: 150px;" type="text" value="ERL"/>	Settings in psig:	Approx. Inside Diameter
Size	<input style="width: 150px;" type="text" value="SUPERAC Model II-6"/>	Pressure-side	Longitudinal Header (inches)
CG Approval	<input style="width: 150px;" type="text" value="162.017/167/4"/>	Vacuum-side	Transverse Header (Inches)
		<input style="width: 50px;" type="text" value="2.5"/>	<input style="width: 50px;" type="text" value="8"/>
		<input style="width: 50px;" type="text" value="0.5"/>	<input style="width: 50px;" type="text" value="8"/>
	Required Venting Capacity of Pressure-Side of P/V valve	<input style="width: 80px;" type="text" value="9337"/>	<input style="width: 80px;" type="text" value="bbl/hr (air)"/>
	Required Venting Capacity of Vacuum-Side of P/V valve	<input style="width: 80px;" type="text" value="3500"/>	<input style="width: 80px;" type="text" value="bbl/hr (air)"/>

9. Tank Overfill Protection System (check appropriate box or boxes)			
a. High Level/Tank Overfill Alarm	<input checked="" type="checkbox"/>	Type	<input style="width: 150px;" type="text" value="ERL Level Alert Model II"/>
b. Overfill Control Shutdown	<input checked="" type="checkbox"/>	Type	<input style="width: 150px;" type="text" value="ERL Level Alert Model II"/>
c. Spill Valve	<input type="checkbox"/>	Type	N/A
d. Rupture Disk	<input type="checkbox"/>	Type	N/A
		Meets ASTM F1271	<input style="width: 80px;" type="text" value="N/A"/>

10. Closed Gauging Verify the vessel has closed gauging that satisfies 46 CFR 39.2003 and 151.15-10(c).

11. Instructions/Guidelines for the OCMI:

11a. The following is the Marine Safety Center's recommended COI endorsement:

In accordance with 46 CFR Part 39, excluding part 39.4000, this vessel's vapor collection system has been inspected to the plans approved by MSC Letter C1-1701047 dated March 24, 2017, and has been found acceptable for the collection of bulk liquid cargo vapors annotated with "Yes" in the CAA's VCS column of the vessel's Cargo Authority Attachment. The VCS system has been approved with a pressure side 2.5 psig P/V valve with Coast Guard Approval 162.017/167/4. The cargo tank top is suitable for a maximum allowable working pressure (MAWP) of 3 psi. When the vessel is carrying cargoes containing greater than 0.5% benzene, the person in charge is responsible for ensuring the provisions of 46 US Code of Federal Regulations Part 197, Subpart C are applied.

In accordance with 46 CFR Part 39.1017 and 39.5000(e) this vessel's VCS has been evaluated and approved for multi-breasted tandem loading with other vessels specifically approved to tandem load with this vessel.

11b. The MSC approval letter/s must be available at the OCMI's request.

11c. Verify isolation valve at the vapor connection flange is manually operable and designed in a way it is "clearly" open or closed.

VCS Approval Letter	<input style="width: 150px;" type="text" value="MSC Letter C1-1701047 dated March 24, 2017"/>	MSC Plan Reviewer	<input style="width: 150px;" type="text" value="LT M. P. Comerford"/>
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