

VAPOR COLLECTION SYSTEM CALCULATIONS

FOR

BARGE NAME(s): "CBC 225", "CBC 226" & "CBC 227"

OFFICIAL NUMBER(s): 1081767, 1081768 & 1081769

200'-0" X 54'-0" X 12'-0" DOUBLE SKIN TANK BARGE (O/D)

CANAL BARGE COMPANY, INC.

April 16, 2018

Prepared by:

A handwritten signature in black ink, appearing to read 'Kumaria.', is positioned above the printed name.

**Chetan Kumaria, PE, MBA
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MARINE SOLUTIONS, INC.

16-Apr-18

VCS SYSTEM INFORMATION:

1. GENERAL DESCRIPTION OF VESSEL:

A. NAME (S): CBC 225 THRU CBC 227
B. USCG OFFICIAL NUMBER: 1081767, 1081768, 1081769
C. DIMENSIONS: 200'-0" X 54'-0" X 12'-0"
D. SERVICE: TANK BARGE (O/D)
E. MAX. DESIGN WORKING PRESSURE: 3 PSIG
F. PV VALVE PRESSURE SETTING: 1.7 PSIG
G. PV VALVE VACUUM SETTING: 0.5 PSIG
H. MAX. DISCHARGE RATE: 800 BBLS/HR

2. VAPOR CONTROL SYSTEM

A. PIPE DIAMETER: 7.981 INCHES IPS
B. PIPE LENGTHS: A- 0'-10 9/16" B-6'-9" C-8'-0" D-14'-0", E-80'-0"
F- 1'-5 1/8" G-8'-0" H-19'-8"

C. P/V VALVE VENTING CAPACITY:

(1) 6" BERGAN KLPH, SET @ 1.7 PSI
(2) MAX. CAPACITY: 27946 BBL/HR OF AIR
(3) 0.5 PSIG VAC.

D. SPILL VALVE RELIEVING CAPACITY:

NON INSTALLED

E. MAX. VAPOR-AIR MIXTURE DENSITY:

0.350 LBM/FT³ FOR SUB D
0.214 LBM/FT³ FOR SUB O

F. MAX. LIQUID LOADING RATE:

3500 BBLS/HR

G. DARCY FRICTION FACTOR:

0.014

H. VCS CARGOES:

SEE TABLE 1 & TABLE 4

I. ADDITIONAL MIS. INFORMATION:

SYSTEM IS DESIGNED TO ACCOMMODATE INTERNAL VISUAL INSPECTION.

VCS CALCULATIONS

1. CARGO AUTHORITY::

The vapor collection system installed on this barge is designed to carry the cargoes listed in Table 1, Table 4 and Crude Oil and Gasoline Blends. These Cargoes are to be listed on the barge's Certificate of Inspection.

2. DETERMINING VAPOR_AIR MIXTURE DENSITY AND VAPOR GROWTH RATE:

Pentane (iso-) has the heaviest vapor-air mixture density and the heighest vapor growth rate (see Table 1)

3. THE MAXIMUM LIQUID TRANSFER RATE AS IMPOSED BY THE CAPACITY OF THE CARGO VENTING SYSTEM:

Tank 3 is the farthest tank from the P/V valve. Using Crane's Technical Paper No. 410, the total equivalent length (L) for the path is shown in Table 2.

TABLE 2

PIPE/FITTINGS	QUANTITY	UNIT EQ. LENGHT (FT)	TOTAL EQ. LENGTH (FT)
Straight Pipe	1	72.13	72.13
Entrance	1	37.05	37.05
T Branch	4	39.91	159.64
8"X6"RED	1	39.88	39.88
T Run Thru	6	13.3	79.8
		Total	388.5

Using Darcy's Equation, with a 0.014 friction factor and the maximum liquid transfer rate, the pressure drop along the VCS piping between the #1 cargo tank and the P/V valve for each cargo is shown in Table 1 & Table 4.

Using a 3500 bbl/h liquid transfer rate, the vapor-air mixture and air-equivalent volumetric flow rate for each cargo are given in Table 1 & Table 4. At a setting of 1.7 psig, the Bergan KLPH-6 PV Valve has an adequate pressure relieving capacity of air for each cargo listed in Table 1 & Table 4. The greatest pressure drop in the venting system (1.881 psig) does not exceed the cargo tank maximum design working pressure of 3.0 psi.

The maximum vacuum that can exist in a tank is 0.511 psig. The barges are constructed as per ABS rules and regulations for a pressure of 3.0 psig and are tested for a pressure of 3.0 psig. Therefore the maximum vacuum of 0.510 psig is within the design capacity of these barges and an unloading rate of 800 bbl/h is acceptable.

4. THE MAXIMUM LIQUID TRANSFER RATE AS IMPOSED BY THE RELIEVING CAPACITY OF THE CARGO TANK SPILL VALVE. Non-installed

5. THE MAXIMUM LIQUID TRANSFER RATE AS IMPOSED BY THE SET POINT OF THE OVERFILL ALARM.

The #2P cargo tank has a trunk top dimension of 52'-0" x 23'-6". The set point of the overfill alarm is set at 9" below the trunk top at tank centerline. With a liquid transfer rate of 3500 bbl/h, the person in charge of transfer of transfer operation has more than 2 minutes to stop the transfer operation before tank overflows. Thus VCS meets 46 CFR 39.20-9.

6. THE MAXIMUM LIQUID TRANSFER RATE AS IMPOSED BY 46 CFR 39.30-1(d)(3).

This requires the sum of the pressure drop along the longest path and the pressure at the facility vapor connection not to exceed 80 percent of the P/V valve setting. The total equivalent length from cargo tank 1 to the vapor connection is given in Table 3.

TABLE 3

PIPE/FITTINGS	QUANTITY	UNIT EQ. LENGTH (FT)	TOTAL EQ. LENGTH (FT)
Straight Pipe	1	131.974	131.974
Entrance	1	37.05	37.05
T Branch	3	39.91	119.73
T Run	10	13.33	133.3
8" Gate Valve	1	5.32	5.32
		Total	427.374

Pressure drop at the maximum liquid transfer rate of 3500 bbl/h along this path for each cargo is given in Tables 1 & 4. The largest pressure drop does not exceed 80 percent of the P/V valve pressure setting (1.36 psig).

TABLE 1 (SUB CHAPTER "D" CARGOES)

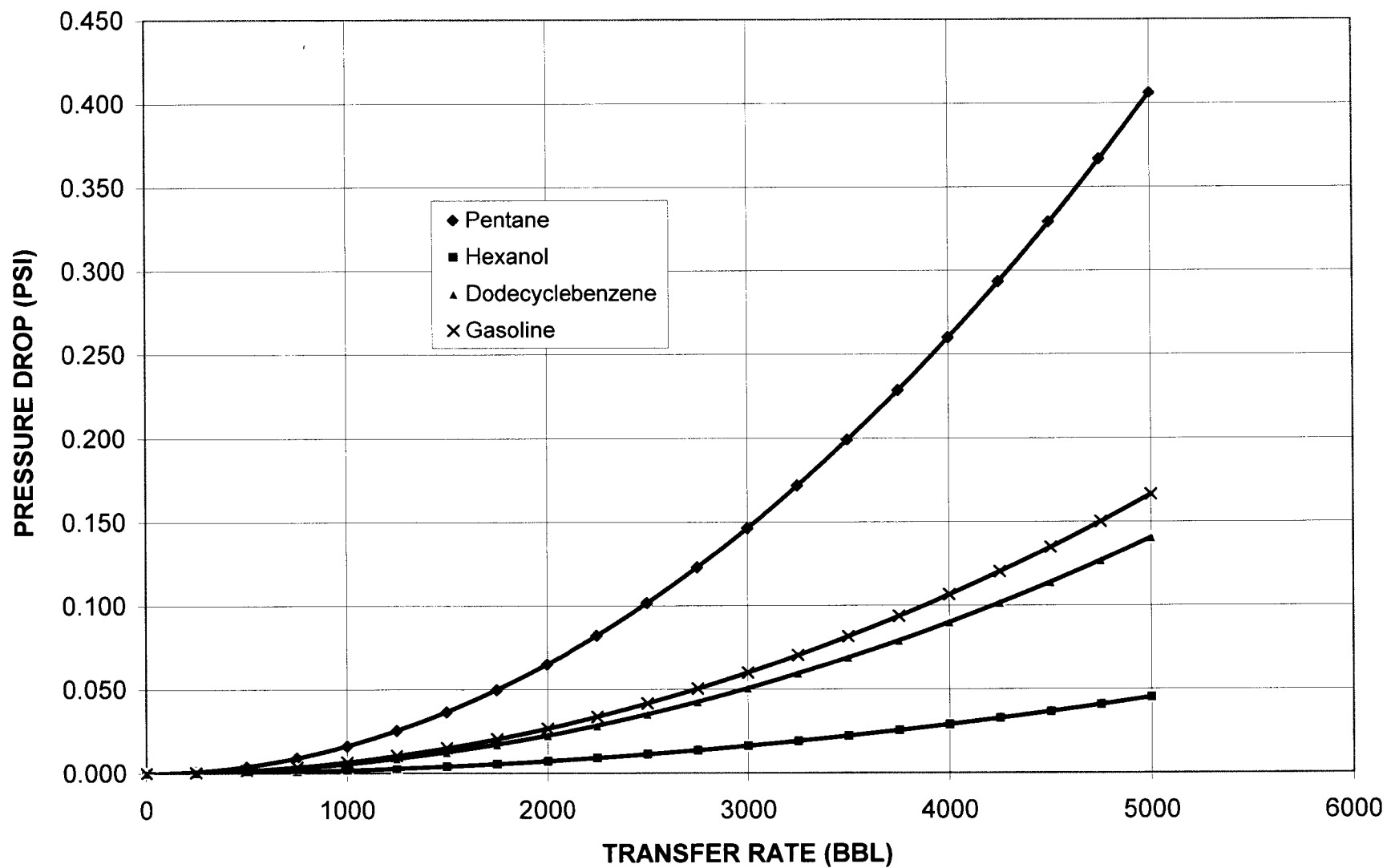
CHRIS CODE	NAME	VCS CAT	LIQ SG	VAPOR PRESS	VAPOR SG	VAPOR AIR WEIGHT DENSITY	VAPOR GROWTH RATE	PRESSURE DROP TO PV VALVE IN VCS(psig) (LOADING)	VAPOR VOLUMETRIC FLOW RATE (bb/h)	AIR EQUIVALENT VOLUMETRIC FLOW RATE	PRESSURE DROP TO SHORE CONNECTION IN VCS (psig) (LOADING)*	PRESSURE DROP TO PV VALVE IN VCS(psig) (UNLOADING)	PRESSURE DROP TO SHORE CONNECTION IN VCS (psig) (UNLOADING)*
1 ACT	Acetone	1	0.79	10	2	0.124	1.2000	0.039	4200	5327	0.043	0.002	0.002
2 ACP	Acetophenone	1	1.03	0.6	4.14	0.086	1.0120	0.019	3542	3739	0.021	0.001	0.001
19 AAT	Amyl Acetate (iso-)	1	0.88	0.33	4.48	0.082	1.0066	0.018	3523	3643	0.020	0.001	0.001
20 AAI	Amyl Alcohol (iso-, n-, sec-, primary) (See also IAA	1	0.82	0.3	3.04	0.080	1.0060	0.018	3521	3585	0.019	0.001	0.001
21 AAN	Amyl Alcohol (n-)	1	0.82	0.3	3.04	0.080	1.0060	0.018	3521	3585	0.019	0.001	0.001
23 APM	Amyl Alcohol, Primary	1	0.82	0.3	3.04	0.080	1.0060	0.018	3521	3585	0.019	0.001	0.001
24 ASE	Amyl Alcohol, (sec-)	1	0.82	0.3	3.04	0.080	1.0060	0.018	3521	3585	0.019	0.001	0.001
26 IAA	Amyl Alcohol, (iso-)	1	0.82	0.3	3.04	0.080	1.0060	0.018	3521	3585	0.019	0.001	0.001
34 BAL	Benzyl Alcohol	1	1.05	0.1	3.73	0.078	1.0020	0.017	3507	3535	0.019	0.001	0.001
40 BAX	Butyl Acetate (iso-, n-)	1	0.87	0.6	4	0.085	1.0120	0.019	3542	3730	0.021	0.001	0.001
42 BTA	Butyl Acetate (sec-)	1	0.89	1.5	4	0.098	1.0300	0.023	3605	4069	0.025	0.001	0.001
44 IAL	Butyl Alcohol (iso-)	1	0.81	0.9	2.6	0.084	1.0180	0.019	3563	3715	0.021	0.001	0.001
46 BAS	Butyl Alcohol (sec-)	1	0.81	1.3	2.6	0.087	1.0260	0.020	3591	3811	0.022	0.001	0.001
47 BAT	Butyl Alcohol (tert-)	1	0.78	2.8	2.6	0.098	1.0560	0.024	3696	4169	0.026	0.001	0.001
48 BPH	Butyl Benzyl Phthalate	1	1.12	0.01	10.8	0.077	1.0002	0.017	3501	3510	0.019	0.001	0.001
64 CLS	Caprolactam Solutions	1	1.02	0.05	3.9	0.078	1.0010	0.017	3504	3518	0.019	0.001	0.001
70 CUM	Cumene	1	0.86	0.60	4.20	0.086	1.0120	0.019	3542	3743	0.021	0.001	0.001
72 CHX	Cyclohexane	1	0.78	4.5	2.9	0.117	1.0900	0.030	3815	4704	0.033	0.002	0.002
73 CHN	Cyclohexanol	1	0.95	0.15	3.45	0.079	1.0030	0.017	3511	3549	0.019	0.001	0.001
74 CPD	1,3-Cyclopentadiene dimer (molten)	1	0.69	0.25	4.55	0.081	1.0050	0.018	3518	3610	0.020	0.001	0.001
76 CMP	Cymene (para-)	1	0.86	0.11	4.62	0.079	1.0022	0.017	3508	3549	0.019	0.001	0.001
77 DHN	Decahydronaphthalene	1	0.89	0.1	4.76	0.079	1.0020	0.017	3507	3546	0.019	0.001	0.001
78 IDA	Decaldehyde (iso-)	1	0.83	0.01	5	0.077	1.0002	0.017	3501	3504	0.018	0.001	0.001
79 DAL	Decaldehyde (n-)	1	0.83	0	5.01	0.077	1.0000	0.017	3500	3499	0.018	0.001	0.001
81 DCE	Decane	1	0.74	0.12	4.8	0.079	1.0024	0.017	3508	3556	0.019	0.001	0.001
82 DAX	Decyl Alcohol (all isomers) (Decanol)	1	0.83	0.01	5.3	0.077	1.0002	0.017	3501	3504	0.018	0.001	0.001
83 ISA	Decyl Alcohol (iso-)	1	0.83	0.01	5.3	0.077	1.0002	0.017	3501	3504	0.018	0.001	0.001
84 DAN	Decyl Alcohol (n-)	1	0.83	0.01	5.3	0.077	1.0002	0.017	3501	3504	0.018	0.001	0.001
85 DBZ	Decylbenzene (n-)	1	0.86	0.01	7.52	0.077	1.0002	0.017	3501	3507	0.019	0.001	0.001
87 DAA	Diacetone Alcohol	1	0.97	0.1	4	0.078	1.0020	0.017	3507	3538	0.019	0.001	0.001
91 DPA	Dibutyl Phthalate (ortho-)	1	1.05	0	9.59	0.077	1.0000	0.017	3500	3499	0.018	0.001	0.001
92 DPT	Dicyclopentadiene, See 1,3-Cyclopentadiene Dime	2	0.98	0.25	4.55	0.081	1.0050	0.018	3518	3610	0.020	0.001	0.001
93 DEB	Diethylbenzene	1	0.87	0.08	4.62	0.078	1.0016	0.017	3506	3535	0.019	0.001	0.001
94 DEG	Diethylene Glycol	1	1.12	0.01	3.66	0.077	1.0002	0.017	3501	3503	0.018	0.001	0.001
95 DME	Diethylene Glycol Butyl Ether	1	0.95	0.01	5.5	0.077	1.0002	0.017	3501	3505	0.018	0.001	0.001
100 DGA	Diethylene Glycol Ethyl Ether Acetate	1	0.99	0.02	4.62	0.077	1.0004	0.017	3501	3508	0.019	0.001	0.001
101 DGM	Diethylene Glycol Methyl Ether	1	1.03	0.03	4.14	0.077	1.0006	0.017	3502	3511	0.019	0.001	0.001
111 DBC	Diisobutylcarbinol	1	0.81	0.09	4.97	0.079	1.0018	0.017	3506	3543	0.019	0.001	0.001
112 DBL	Diisobutylene	1	0.72	2	3.86	0.104	1.0400	0.024	3640	4226	0.027	0.001	0.001
113 DIX	Diisobutyl Ketone	1	0.81	0.16	4.9	0.080	1.0032	0.017	3511	3576	0.019	0.001	0.001
119 DIX	Diisopropylbenzene (all isomer)	1	0.86	0.03	5.6	0.078	1.0006	0.017	3502	3516	0.019	0.001	0.001
124 DTL	Dimethyl Phthalate	1	1.19	0	6.69	0.077	1.0000	0.017	3500	3499	0.018	0.001	0.001
130 DOP	Diethyl Phthalate	1	0.98	0	13.47	0.077	1.0000	0.017	3500	3499	0.018	0.001	0.001
131 DPN	Dipentene	1	0.84	0.1	4.9	0.079	1.0020	0.017	3507	3547	0.019	0.001	0.001
132 DIL	Diphenyl	1	0.99	0.01	5.31	0.077	1.0002	0.017	3501	3504	0.018	0.001	0.001
133 DDO	Diphenyl, Diphenyl Ether Mixture	1	1.07	0.01	5.86	0.077	1.0002	0.017	3501	3505	0.018	0.001	0.001
134 DPE	Diphenyl Ether	1	1.07	0.01	5.87	0.077	1.0002	0.017	3501	3505	0.018	0.001	0.001
136 DPG	Dipropylene Glycol	1	1.03	0.07	4.63	0.078	1.0014	0.017	3505	3531	0.019	0.001	0.001
139 DFF	Distillates: Flashed Feed Stocks	1	0.75	2.3	3.4	0.103	1.0460	0.024	3661	4231	0.027	0.001	0.001
140 DSR	Distillates: Straight Run	1	0.73	2.3	3.4	0.103	1.0460	0.024	3661	4231	0.027	0.001	0.001
145 DOZ	Dodecane (all isomers)	1	0.76	0.02	5.81	0.077	1.0004	0.017	3501	3511	0.019	0.001	0.001
146 DOD	Dodecane	1	0.76	0.02	5.81	0.077	1.0004	0.017	3501	3511	0.019	0.001	0.001
147 DDB	Dodecylbenzene	1	0.86	4.7	8.4	0.240	1.0940	0.063	3829	6762	0.069	0.003	0.004
155 ETG	Ethoxy Triglycol (crude)	1	1.02	0	6.14	0.077	1.0000	0.017	3500	3499	0.018	0.001	0.001
156 ETA	Ethyl Acetate	1	0.9	4.5	3.04	0.120	1.0900	0.031	3815	4763	0.034	0.002	0.002
157 EAA	Ethyl Acetoacetate	1	1.03	0.2	4.48	0.080	1.0040	0.018	3514	3587	0.019	0.001	0.001
158 EAL	Ethyl Alcohol (Ethanol)	1	0.79	3.5	1.6	0.087	1.0700	0.022	3745	3976	0.024	0.001	0.001
160 ETB	Ethyl Benzene	1	0.87	0.6	3.56	0.084	1.0120	0.019	3542	3703	0.021	0.001	0.001
161 EBT	Ethyl Butanol	1	0.83	0.12	3.52	0.078	1.0024	0.017	3508	3540	0.019	0.001	0.001
162 EBR	Ethyl Butyrate	1	0.88	1	4	0.091	1.0200	0.021	3570	3882	0.023	0.001	0.001
163 ECY	Ethyl Cyclohexane	1	0.79	0.5	3.87	0.084	1.0100	0.019	3535	3685	0.020	0.001	0.001
166 EGL	Ethylene Glycol	1	1.19	0.01	2.21	0.077	1.0002	0.017	3501	3501	0.018	0.001	0.001
169 EMA	Ethylene Glycol Butyl Ether Acetate	1	0.94	0.05	5.52	0.078	1.0010	0.017	3504	3527	0.019	0.001	0.001
172 EGY	Ethylene Glycol Diacetate	1	1.1	0.01	5.03	0.077	1.0002	0.017	3501	3504	0.018	0.001	0.001
178 EME	Ethylene Glycol Methyl Ether	1	1.1	0.01	4.8	0.077	1.0002	0.017	3501	3504	0.018	0.001	0.001

180 EPE	Ethylene Glycol Phenyl Ether	1	1.1	0.01	4.8	0.077	1.0002	0.017	3501	3504	0.018	0.001	0.001
184 EHA	2-Ethylhexaldehyde, See Octyl Aldehydes	1	0.82	0.17	4.41	0.080	1.0034	0.017	3512	3572	0.019	0.001	0.001
186 EHX	2-Ethylhexanol, see Octanol (all isomers)	1	0.84	0.02	4.5	0.077	1.0004	0.017	3501	3508	0.019	0.001	0.001
190 EPR	Ethyl Propionate	1	0.89	3.5	1.6	0.087	1.0700	0.022	3745	3976	0.024	0.001	0.001
191 ETE	Ethyl Toluene	1	0.88	0.28	4.15	0.081	1.0056	0.018	3520	3612	0.020	0.001	0.001
194 FAM	Formamide	1	1.13	0.1	1.55	0.077	1.0020	0.017	3507	3512	0.019	0.001	0.001
195 FAL	Furfuryl Alcohol	1	1.13	0.05	3.4	0.077	1.0010	0.017	3504	3515	0.019	0.001	0.001
197 GAK	Gasoline Blended Stocks: Alkylates	1	0.75	12.5	3.4	0.218	1.2500	0.074	4375	7357	0.081	0.004	0.004
198 GRF	Gasoline Blended Stocks: Reformate	1	0.8	12.5	3.4	0.218	1.2500	0.074	4375	7357	0.081	0.004	0.004
199 GAT	Gasolines: Automotive (containing not over 4.23 gr 1	1	0.74	12.5	3.4	0.218	1.2500	0.074	4375	7357	0.081	0.004	0.004
200 GAV	Gasolines: Aviation (containing not over 4.86 gram: 1	1	0.71	12.5	3.4	0.218	1.2500	0.074	4375	7357	0.081	0.004	0.004
201 GCS	Gasolines: Casinghead	1	0.67	12.5	3.4	0.218	1.2500	0.074	4375	7357	0.081	0.004	0.004
202 GPL	Gasolines: Polymer	1	0.75	12.5	3.4	0.218	1.2500	0.074	4375	7357	0.081	0.004	0.004
203 GSR	Gasolines: Straight Run	1	0.75	12.5	3.4	0.218	1.2500	0.074	4375	7357	0.081	0.004	0.004
204 GCR	Glycerine	1	1.26	0	3.17	0.077	1.0000	0.017	3500	3499	0.018	0.001	0.001
217 HMX	Heptane (all isomers) (Methylhexane)	1	0.68	2.5	3.45	0.106	1.0500	0.025	3675	4306	0.028	0.001	0.001
218 HPT	Heptane (n-)	1	0.68	2.5	3.45	0.106	1.0500	0.025	3675	4306	0.028	0.001	0.001
220 HTX	Heptanol (all isomers)	1	0.82	0.04	4	0.077	1.0008	0.017	3503	3515	0.019	0.001	0.001
221 HTN	Heptanol (all isomers)	1	0.82	0.04	4	0.077	1.0008	0.017	3503	3515	0.019	0.001	0.001
222 HPX	Heptene (all isomers)	2	0.7	2.9	3.4	0.110	1.0580	0.027	3703	4418	0.029	0.001	0.002
223 THE	Heptene (1-)	1	0.7	2.8	3.4	0.108	1.0560	0.026	3696	4387	0.029	0.001	0.002
229 HXS	Hexane (all isomers)	1	0.66	7	3	0.143	1.1400	0.040	3990	5431	0.044	0.002	0.002
230 HXA	Hexane	1	0.66	7	3	0.143	1.1400	0.040	3990	5431	0.044	0.002	0.002
231 HXO	Hexanoic Acid	1	0.93	0.01	4	0.077	1.0002	0.017	3501	3503	0.018	0.001	0.001
232 HXN	Hexanol	1	0.82	1	3.52	0.089	1.0200	0.020	3570	3833	0.022	0.001	0.001
234 HEX	Hexene (all isomers)	2	0.67	8	2.9	0.148	1.1600	0.043	4060	5634	0.048	0.002	0.002
235 HXE	Hexene (1-)	1	0.67	8.2	2.9	0.150	1.1640	0.044	4074	5687	0.049	0.002	0.003
236 HXT	Hexene (2-)	1	0.67	8.2	2.9	0.150	1.1640	0.044	4074	5687	0.049	0.002	0.003
238 HXG	Hexylene Glycol	4	0.92	0.01	1.1	0.077	1.0002	0.017	3501	3500	0.018	0.001	0.001
243 IPH	Isophorone	1	0.93	0.01	4.75	0.077	1.0002	0.017	3501	3504	0.018	0.001	0.001
244 JPO	Jet Fuels: JP-1 (Kerosene)	1	0.8	0.14	4.5	0.079	1.0028	0.017	3510	3561	0.019	0.001	0.001
245 JPT	Jet Fuels: JP-3	1	0.8	8.51	4.5	0.217	1.1702	0.065	4096	6871	0.071	0.003	0.004
246 JPF	Jet Fuels: JP-4	1	0.81	3.4	4	0.125	1.0680	0.031	3738	4759	0.034	0.002	0.002
247 JPV	Jet Fuels: JP-5 (Kerosene, heavy)	1	0.82	0.1	4	0.078	1.0020	0.017	3507	3538	0.019	0.001	0.001
249 KRS	Kerosene	1	0.81	0.15	4.5	0.079	1.0030	0.017	3511	3565	0.019	0.001	0.001
263 MTT	Methyl Acetate	1	0.92	6.1	2.6	0.123	1.1220	0.034	3927	4958	0.037	0.002	0.002
265 MAL	Methyl Alcohol (See Methanol)	1	0.79	6.63	1.1	0.080	1.1326	0.022	3964	4042	0.025	0.001	0.001
266 MAC	Methyl Amyl Acetate	1	0.86	0.33	4.97	0.083	1.0066	0.018	3523	3660	0.020	0.001	0.001
267 MAA	Methyl Amyl Alcohol	1	0.81	0.43	3.52	0.082	1.0086	0.018	3530	3644	0.020	0.001	0.001
271 MBK	Methyl n-Butyl Ketone	1	0.81	0.97	3.5	0.088	1.0194	0.020	3568	3822	0.022	0.001	0.001
273 MBU	Methyl Butyrate	1	0.9	1.26	3.53	0.092	1.0252	0.021	3588	3920	0.023	0.001	0.001
274 MEK	Methyl Ethyl Ketone	1	0.8	4.5	2.5	0.109	1.0900	0.028	3815	4531	0.031	0.001	0.002
275 MTF	Methyl Formal (Dimethyl Formal)	1	0.86	15.42	2.6	0.193	1.3084	0.072	4579	7245	0.079	0.004	0.004
276 MHK	Methyl Heptyl Ketone	1	0.83	0.06	4.9	0.078	1.0012	0.017	3504	3528	0.019	0.001	0.001
278 MIK	Methyl Isobutyl Ketone	1	0.8	1.15	3.45	0.090	1.0230	0.021	3581	3875	0.023	0.001	0.001
281 MNA	1-Methyl Naphthalene	1	1.02	0.01	4.91	0.077	1.0002	0.017	3501	3504	0.018	0.001	0.001
283 MPN	2-Methyl-1-Pentene	1	0.69	6.3	2.9	0.133	1.1260	0.037	3941	5182	0.040	0.002	0.002
284 MTN	5-Methyl-1-Pentene	1	0.67	8.49	2.9	0.153	1.1698	0.045	4094	5765	0.050	0.002	0.003
286 MBE	Methyl Tert-Butyl Ether (MTBE)	1	0.74	0.04	3.1	0.077	1.0008	0.017	3503	3511	0.019	0.001	0.001
288 MNS	Mineral Spirits	1	0.75	0.2	4.3	0.080	1.0040	0.018	3514	3583	0.019	0.001	0.001
289 MRE	Myrcene	1	0.8	0.17	4.7	0.080	1.0034	0.018	3512	3578	0.019	0.001	0.001
295 NSV	Naphtha: Solvent	1	0.87	0.2	3.5	0.079	1.0040	0.017	3514	3566	0.019	0.001	0.001
296 NSS	Naphtha: Stoddard Solvant	1	0.78	0.2	4.3	0.080	1.0040	0.018	3514	3583	0.019	0.001	0.001
297 NVM	Naphtha: Varnish Maker's and Painters (75%)	1	0.77	0.19	4.3	0.080	1.0038	0.018	3513	3579	0.019	0.001	0.001
300 NAX	Nonane (all isomers)	1	0.72	0.27	4.4	0.081	1.0054	0.018	3519	3615	0.020	0.001	0.001
301 NAN	Nonane	1	0.72	0.27	4.4	0.081	1.0054	0.018	3519	3615	0.020	0.001	0.001
304 NON	Nonene	1	0.73	0.35	4.3	0.082	1.0070	0.018	3525	3645	0.020	0.001	0.001
305 NNS	Nonyl Alcohol (all isomers)	1	0.94	0.1	5	0.079	1.0020	0.017	3507	3549	0.019	0.001	0.001
306 NNN	Nonyl Alcohol	1	0.94	0.1	5	0.079	1.0020	0.017	3507	3549	0.019	0.001	0.001
307 NNI	Nonyl Alcohol (iso-)	1	0.94	0.1	5	0.079	1.0020	0.017	3507	3549	0.019	0.001	0.001
309 NNP	Nonyl Phenol	1	0.95	0.01	7.6	0.077	1.0002	0.017	3501	3507	0.019	0.001	0.001
316 OAX	Octane (all isomers)	1	0.7	0.79	3.9	0.088	1.0158	0.020	3555	3794	0.022	0.001	0.001
317 OAN	Octane	1	0.7	0.79	3.9	0.088	1.0158	0.020	3555	3794	0.022	0.001	0.001
320 OTA	Octanol	1	0.83	0.01	4.48	0.077	1.0002	0.017	3501	3503	0.018	0.001	0.001
322 OTE	Octene (1-)	1	0.72	1	3.86	0.090	1.0200	0.020	3570	3868	0.023	0.001	0.001
324 OCX	Octyl Alcohol (iso-, n-) (all isomers), See Octanol (1	1	0.83	0.01	4.48	0.077	1.0002	0.017	3501	3503	0.018	0.001	0.001
325 IOA	Octyl Alcohol	1	0.83	0.01	4.48	0.077	1.0002	0.017	3501	3503	0.018	0.001	0.001
364 OTW	Fuel: No. 2	1	0.88	0.56	8	0.095	1.0112	0.021	3539	3938	0.023	0.001	0.001
366 OFR	Fuel: No. 4	1	0.9	0.15	3.4	0.079	1.0030	0.017	3511	3548	0.019	0.001	0.001
367 OFV	Fuel: No. 5	1	0.94	0.15	3.4	0.079	1.0030	0.017	3511	3548	0.019	0.001	0.001
368 OSX	Fuel: No. 6	1	0.95	0.15	3.4	0.079	1.0030	0.017	3511	3548	0.019	0.001	0.001
382 OIL	OIL, Misc: Crude	1	0.95	0.15	3.4	0.079	1.0030	0.017	3511	3548	0.019	0.001	0.001

383 ODS	OIL, Misc: Diesel	1	0.9	0.69	3.4	0.085	1.0138	0.019	3548	3722	0.021	0.001	0.001
389 OLB	OIL, Misc: Lubricating	1	0.9	0.15	1	0.077	1.0030	0.017	3511	3510	0.019	0.001	0.001
403 ORS	OIL, Misc: Resin	1	1.02	0.15	1	0.077	1.0030	0.017	3511	3510	0.019	0.001	0.001
418 OTB	OIL, Misc: Turbine	1	0.87	0.3	5.4	0.083	1.0060	0.018	3521	3659	0.020	0.001	0.001
429 PDC	Pentadecanol, See Alcohols (C13 and above)	1	0.83	0.01	7.88	0.077	1.0002	0.017	3501	3507	0.019	0.001	0.001
433 IPT	Pentane (iso-)	5	0.62	27	2.48	0.350	1.5400	0.181	5390	11501	0.199	0.009	0.010
434 PTA	Pentane (n-)	5	0.63	20.44	2.5	0.267	1.4088	0.116	4931	9191	0.127	0.006	0.007
437 PTE	Pentene (1-)	5	0.64	24.9	2.4	0.313	1.4980	0.153	5243	10568	0.168	0.008	0.009
442 PIN	Pinene	1	0.86	0.35	4.7	0.083	1.0070	0.018	3525	3660	0.020	0.001	0.001
448 PLB	Polybutene	1	0.91	0.01	79.3	0.081	1.0002	0.018	3501	3582	0.019	0.001	0.001
457 PGC	Polypropylene Glycol	1	1.01	0.1	1	0.077	1.0020	0.017	3507	3506	0.018	0.001	0.001
464 IAC	Propyl Acetate (iso-)	1	0.89	1.8	3.52	0.098	1.0360	0.023	3626	4096	0.025	0.001	0.001
465 PAT	Propyl Acetate (n-)	1	0	1.85	3.52	0.099	1.0370	0.023	3630	4112	0.025	0.001	0.001
466 IPA	Propyl Alcohol (iso-)	1	0.79	3	2.07	0.092	1.0600	0.022	3710	4056	0.025	0.001	0.001
467 PAL	Propyl Alcohol (n-)	1	0.8	1.2	2.07	0.083	1.0240	0.019	3584	3721	0.021	0.001	0.001
468 PBZ	Propylbenzene (n-)	1	0.86	0.2	4.14	0.080	1.0040	0.018	3514	3580	0.019	0.001	0.001
469 IPX	Iso-Propylcyclohexane	1	0.8	0.01	4.35	0.077	1.0002	0.017	3501	3503	0.018	0.001	0.001
473 PPG	Propylene Glycol (1,2-Propandiol)	1	1.04	0.01	2.62	0.077	1.0002	0.017	3501	3501	0.018	0.001	0.001
476 PME	Propylene Glycol Methyl Ether	1	0.92	0.7	3.11	0.084	1.0140	0.019	3549	3704	0.021	0.001	0.001
488 SFL	Sulfolane	1	1.26	0.01	4.14	0.077	1.0002	0.017	3501	3503	0.018	0.001	0.001
493 TTN	Tetradecanol	1	0.82	0	7.39	0.077	1.0000	0.017	3500	3499	0.018	0.001	0.001
494 TTD	1-Tetradecene, See the olefin or Alpha-Olefin Entry	1	0.77	0.01	6.77	0.077	1.0002	0.017	3501	3506	0.018	0.001	0.001
496 TTG	Tetraethylene Glycol	1	1.12	0.01	6.7	0.077	1.0002	0.017	3501	3506	0.018	0.001	0.001
497 THN	Tetrahydronaphthalene	1	0.97	0.04	4.56	0.078	1.0008	0.017	3503	3517	0.019	0.001	0.001
499 TOL	Toluene	1	0.87	1.5	3.14	0.092	1.0300	0.021	3605	3941	0.023	0.001	0.001
502 TCP	Tricresyl Phosphate (less than 1% of the ortho ison	1	1.16	0.01	12.69	0.077	1.0002	0.017	3501	3512	0.019	0.001	0.001
503 TRD	Tridecane	1	0.76	0.02	6.4	0.077	1.0004	0.017	3501	3512	0.019	0.001	0.001
505 TDN	Tridecanol, See Alcohols (C13 and above)	1	0.85	0.01	6.91	0.077	1.0002	0.017	3501	3506	0.018	0.001	0.001
506 TDC	1-Tridecene	1	0.77	0.01	6.29	0.077	1.0002	0.017	3501	3505	0.018	0.001	0.001
508 TEB	Triethylbenzene	1	0.86	0.02	5.6	0.077	1.0004	0.017	3501	3510	0.019	0.001	0.001
509 TEG	Triethylene Glycol	1	1.12	0.01	5.17	0.077	1.0002	0.017	3501	3504	0.018	0.001	0.001
519 TRE	Trimethylbenzenes (all isomers)	1	0.89	0.14	4.2	0.079	1.0028	0.017	3510	3556	0.019	0.001	0.001
520 TMB	Trimethyl Benzene (1,2,5-)	1	0.89	0.14	4.14	0.079	1.0028	0.017	3510	3556	0.019	0.001	0.001
521 TMD	Trimethyl Benzene (1,2,3-)	1	0.89	0.14	4.14	0.079	1.0028	0.017	3510	3556	0.019	0.001	0.001
522 TME	Trimethyl Benzene (1,2,4-) (Pseudocumene)	1	0.89	0.14	4.14	0.079	1.0028	0.017	3510	3556	0.019	0.001	0.001
529 TRP	Trixylenyl Phosphate	1	1.16	0	14.2	0.077	1.0000	0.017	3500	3499	0.018	0.001	0.001
546 XLX	Xylenes (Ortho-, meta-, para-)	1	0.89	0.51	3.66	0.083	1.0102	0.019	3536	3678	0.020	0.001	0.001
547 XLM	Xylene (M-)	1	0.87	0.51	3.66	0.083	1.0102	0.019	3536	3678	0.020	0.001	0.001
548 XLO	Xylene (O-)	1	0.89	0.4	3.66	0.082	1.0080	0.018	3528	3640	0.020	0.001	0.001
549 XLP	Xylene (P-)	1	0.86	0.51	3.66	0.083	1.0102	0.019	3536	3678	0.020	0.001	0.001
550 XYL	Xylenol	1	1.01	0.1	3.66	0.078	1.0020	0.017	3507	3534	0.019	0.001	0.001
551	Zinc Dialkylidithiophosphate												
	Max.		1.260	27.000	79.300	0.350	1.540	0.181	5390	11501	0.199	0.009	0.010
	Min.		0.000	0.000	1.000	0.000	1.000	0.017	3500	3499	0.018	0.000	0.000

*when barge vapor piping is connected to facility vapor recovery system.

LIQUID TRANSFER RATE vs PRESSURE DROP



PRESSURE vs MAXIMUM TRANSFER RATE (FOR SUB-CHAPTER "D" CARGOES)

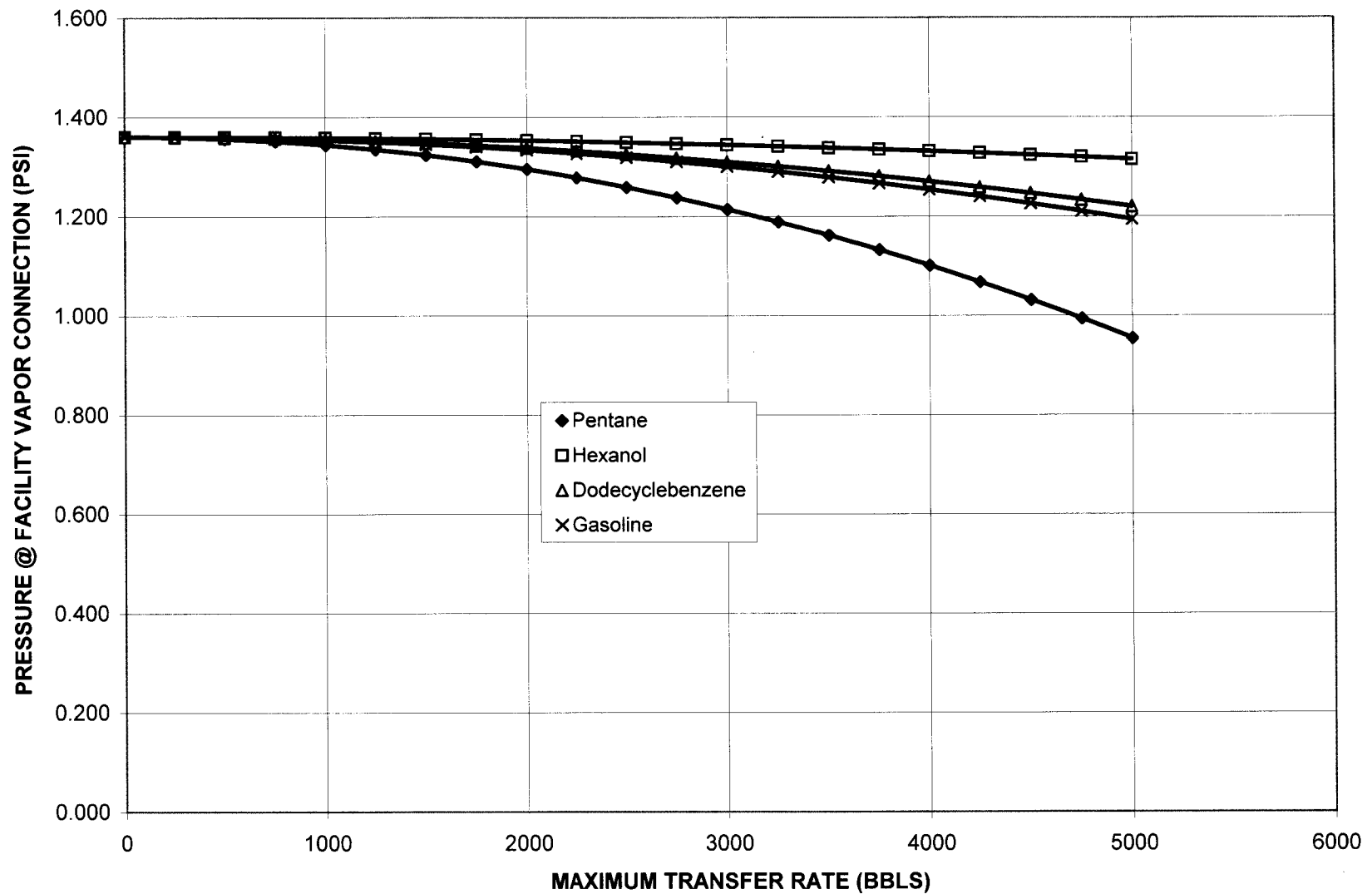
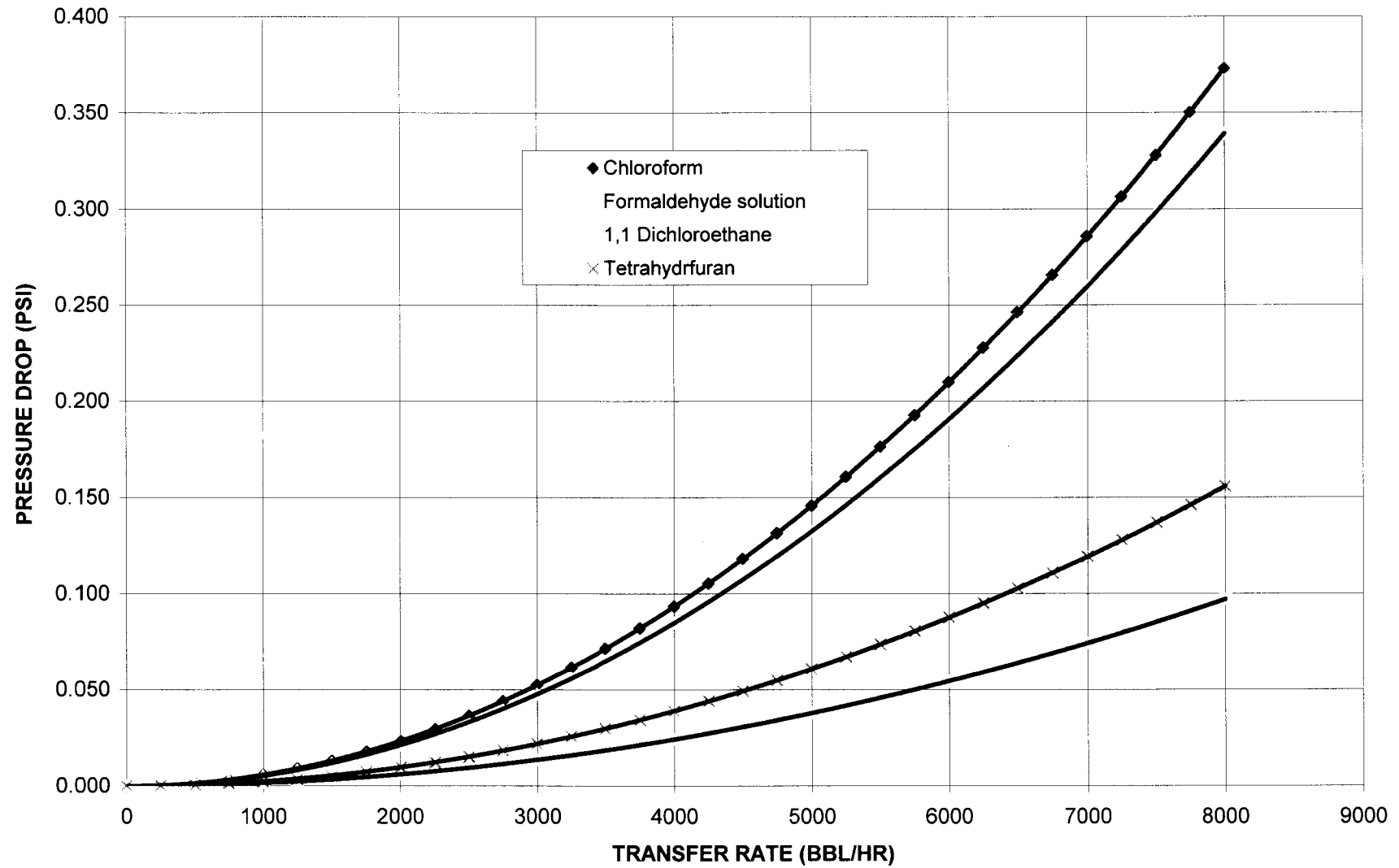


TABLE 4 (SUBCHAPTER "O" CARGOES)

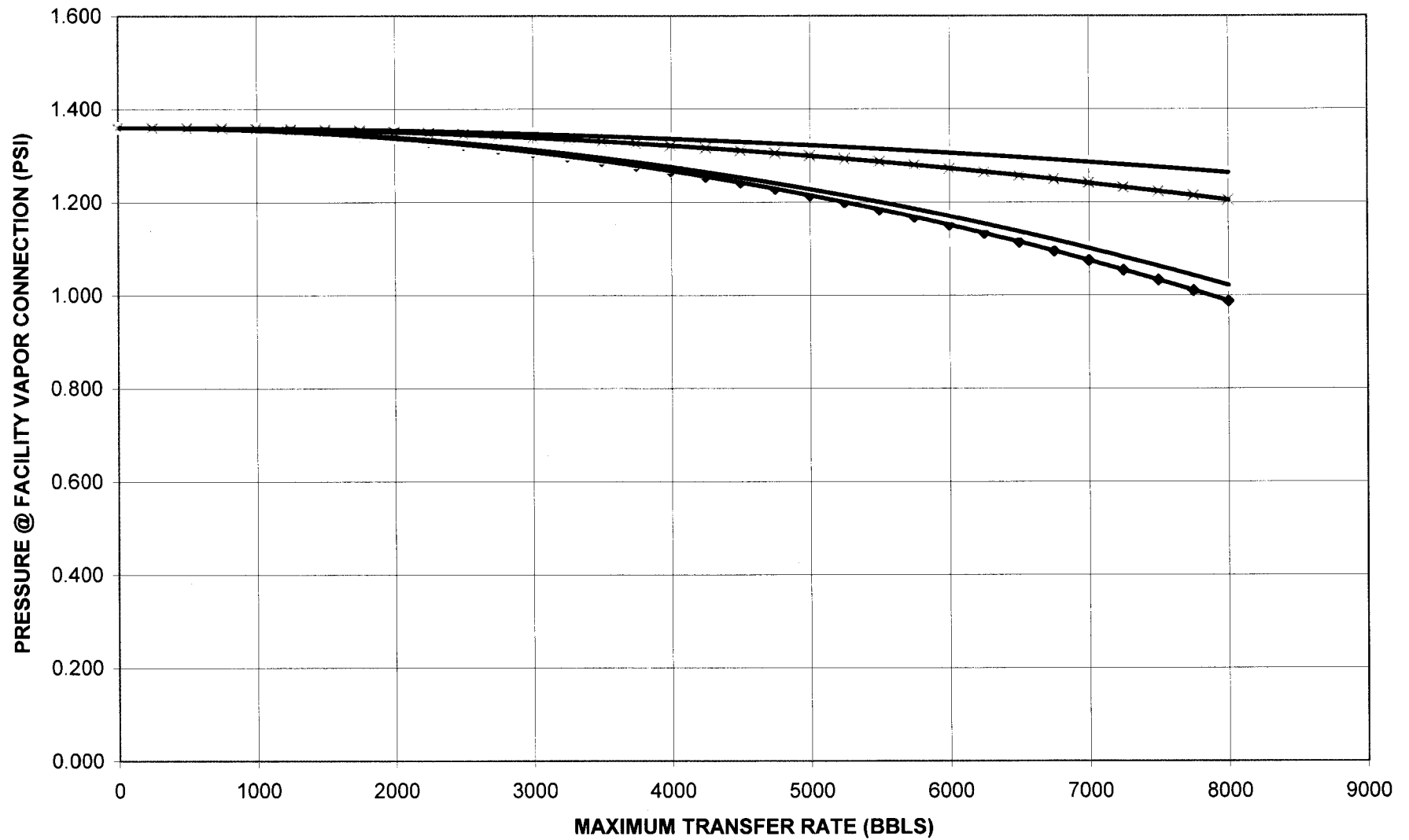
CHRIS CODE	NAME	VCS CAT	LIQ SG	VAPOR PRESS	VAPOR SG	VAPOR AIR WEIGHT DENSITY	VAPOR GROWTH RATE	PRESSURE DROP TO PV VALVE IN VCS (psig) (LOADING)	VAPOR VOLUMETRIC FLOW RATE (bbl/h)	AIR EQUIVALENT VOLUMETRIC FLOW RATE	PRESSURE DROP TO SHORE CONNECTION IN VCS (psig) (LOADING)*	PRESSURE DROP TO PV VALVE IN VCS (psig) (UNLOADING)	PRESSURE DROP TO SHORE CONNECTION IN VCS (psig) (UNLOADING)*
1 ACN	Acrylonitrile	4	0.81	5.00	1.80	0.096	1.1000	0.025	3850	4293	0.028	0.001	0.001
2 ADN	Adiponitrile	1	0.95	0.01	3.73	0.077	1.0002	0.017	3501	3503	0.018	0.001	0.001
3 ATN	Acetonitrile	3	0.78	0.03	1.41	0.077	1.0006	0.017	3502	3502	0.018	0.001	0.001
4 BAD	Iso-Butyraldehyde	1	0.80	7.80	2.50	0.132	1.1560	0.038	4046	5295	0.042	0.002	0.002
5 BAR	Butyl acrylate (iso-, n-)	2	0.90	0.60	4.42	0.087	1.0120	0.019	3542	3756	0.021	0.001	0.001
6 BMH	Butyl Methacrylate	2	0.88	0.29	4.9	0.082	1.0058	0.018	3520	3639	0.020	0.001	0.001
7 BNZ	Benzene	1	0.88	4.50	2.80	0.115	1.0900	0.030	3815	4662	0.033	0.002	0.002
8 BTR	n-Butyraldehyde	1	0.80	7.80	2.50	0.132	1.1560	0.038	4046	5295	0.042	0.002	0.002
9 BTX	Benzene, Toluene, Xylene mixtures (10% Benzene or more)	1	0.84	7.30	2.80	0.139	1.1460	0.040	4011	5382	0.044	0.002	0.002
10 CCH	Cyclohexanone	1	0.95	0.20	3.40	0.079	1.0040	0.017	3514	3564	0.019	0.001	0.001
11 CHA	Cyclohexylamine	1	0.87	0.62	3.42	0.084	1.0124	0.019	3543	3701	0.021	0.001	0.001
12 CRB	Chlorobenzene	1	1.11	0.80	3.88	0.088	1.0160	0.020	3556	3797	0.022	0.001	0.001
13 CRF	Chloroform	3	1.48	9	4.25	0.214	1.1800	0.065	4130	6889	0.071	0.003	0.004
14 NCT	Coal Tar Naphtha Solvent	1	0.86	0.2	4	0.080	1.0040	0.017	3514	3577	0.019	0.001	0.001
15 CRS	Cresols	1	1.05	0.06	3.72	0.078	1.0012	0.017	3504	3521	0.019	0.001	0.001
16 CTA	Crotonaldehyde	4	0.85	2	2.41	0.090	1.0400	0.021	3640	3939	0.023	0.001	0.001
17 DCH	1,1-Dichloroethane	1	1.18	9.90	3.41	0.189	1.1980	0.059	4193	6568	0.065	0.003	0.003
18 DPP	1,2-Dichloropropane	3	1.16	2.5	3.89	0.111	1.0500	0.027	3675	4410	0.029	0.001	0.002
19 DPU	1,3-Dichloropropene	4	1.23	5.5	3.84	0.150	1.1100	0.040	3885	5427	0.044	0.002	0.002
20 DEN	Diethylamine	3	0.71	1.00	2.50	0.084	1.0200	0.019	3570	3729	0.021	0.001	0.001
21 DIP	Diisopropanolamine	1	0.98	0.01	4.59	0.077	1.0002	0.017	3501	3504	0.018	0.001	0.001
22 DMF	Dimethylformamide	1	0.95	0.30	2.51	0.079	1.0060	0.017	3521	3568	0.019	0.001	0.001
23 DPX	1,1-, 1,2-, or 1,3-Dichloropropane	3	1.16	6.30	3.90	0.163	1.1260	0.045	3941	5728	0.049	0.002	0.003
24 EAC	Ethyl acrylate	2	0.93	2.00	3.50	0.100	1.0400	0.024	3640	4157	0.026	0.001	0.001
25 EAI	2-Ethylhexyl acrylate	2	0.89	0.02	6.35	0.077	1.0004	0.017	3501	3512	0.019	0.001	0.001
26 EDC	Ethylene dichloride	1	1.26	4.00	3.42	0.122	1.0800	0.031	3780	4765	0.034	0.002	0.002
27 ETM	Ethyl Methacrylate	2	0.92	1	3.94	0.091	1.0200	0.021	3570	3876	0.023	0.001	0.001
28 EPA	2-Ethyl-3-propylacrolein	1	0.85	0.12	4.5	0.079	1.0024	0.017	3508	3552	0.019	0.001	0.001
29 FFA	Furfural	1	1.20	0.15	3.31	0.079	1.0030	0.017	3511	3546	0.019	0.001	0.001
30 FMS	Formaldehyde solution (37% to 50%)	1	1.13	0.15	1.03	0.077	1.0030	0.017	3511	3510	0.019	0.001	0.001
31 MSO	Mesityl Oxide	1	0.86	0.67	3.5	0.085	1.0134	0.019	3547	3723	0.021	0.001	0.001
32 MAM	Methyl acrylate	2	0.95	4.10	3.00	0.115	1.0820	0.029	3787	4637	0.032	0.002	0.002
33 MBE	Methylcyclopentadiene dimer	1	0.74	0.04	3.10	0.077	1.0008	0.017	3503	3511	0.019	0.001	0.001
34 MMM	Methyl methacrylate	2	0.94	2.02	3.45	0.100	1.0404	0.024	3641	4154	0.026	0.001	0.001
35 MPL	Morpholine	1	1.00	0.80	3.00	0.084	1.0160	0.019	3556	3724	0.021	0.001	0.001
36 NPM	1- or 2-Nitropropane	1	0.99	1.05	3.06	0.087	1.0210	0.020	3574	3801	0.022	0.001	0.001
37 PRD	Pyridine	1	0.98	1.30	2.72	0.087	1.0260	0.020	3591	3827	0.022	0.001	0.001
38 STY	Styrene	2	0.92	0.40	3.60	0.082	1.0080	0.018	3528	3637	0.020	0.001	0.001
39 TCN	1,2,3-Trichloropropane	3	1.39	0.15	5.60	0.080	1.0030	0.018	3511	3583	0.019	0.001	0.001
40 TEN	Triethylamine	3	0.73	2.50	3.49	0.106	1.0500	0.025	3675	4315	0.028	0.001	0.001
41 THF	Tetrahydrofuran	1	0.89	8.50	1.35	0.091	1.1700	0.027	4095	4450	0.030	0.001	0.002
42 VAM	Vinyl acetate	2	0.94	5.80	2.97	0.131	1.1160	0.035	3906	5086	0.039	0.002	0.002
		Max.	1.39	12.5	8.40	0.214	1.198	0.065	4193	6889	0.071	0.003	0.004
		Min.	0.63	0.01	1.03	0.077	1.000	0.017	3501	3502	0.018	0.001	0.001

*when barge vapor piping is connected to facility vapor recovery system.

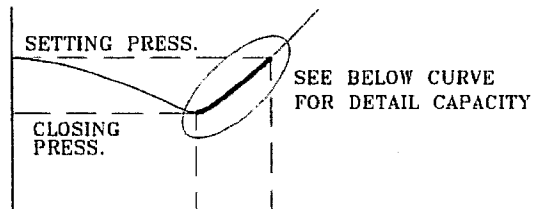
LIQUID TRANSFER RATE vs PRESSURE DROP



PRESSURE vs MAXIMUM TRANSFER RATE (FOR SUB-CHAPTER "O" CARGOES)



PROGRESS OF VALVE PRESSURE



TANKTECH HIGH VELOCITY VENT VALVES

KSPA TYPE FLOW CAPACITY CURVE

1200 mmAq. SETTING PRESSURE

