VAPOR COLLECTION SYSTEM CALCULATIONS

FOR

BARGE NAME(s): "CBC 1335" thru "CBC 1359"

SOUTHWEST SHIPYARD HULL(s): 9628 thru 9652

200'-0" X 35'-0" X 12'-6" DOUBLE SKIN TANK BARGE (O/D)

CANAL BARGE COMPANY, INC.

May 17, 2011

Prepared by:

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MARINE SOLUTIONS, INC.

Rev. 0 dated May 16, 2011

VCS SYSTEM INFORMATION:

1. GENERAL DESCRIPTION OF VESSEL:

A. NAME (S):	CBC 1335 THRU CBC 1359
B. USCG PROJECT NUMBER:	P016344
C. DIMENSIONS:	200'-0" X 35'-0" X 12'-6"
D. SERVICE:	TANK BARGE (O/D)
E. MAX. DESIGN WORKING PRESSURE:	3.5 PSIG
F. PV VALVE PRESSURE SETTING:	1 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- 1'-7 1/4" B-3'-5 7/8" C-53'-2 23/64" D-42'-3 43/64", E-48'-9 15/16" F- 4'-1 1/4" G-1'-6 1/8" H-8'-0 3/4"

C. P/V VALVE VENTING CAPACITY:

(1) 6" BERGAN KLPH, SET @ 1.0 PSI
(2) MAX. CAPACITY: 21666 BBL/HR OF AIR
(3) 0.5 PSIG VAC.

D. SPILL VALVE RELIEVING CAPACITY: NON INSTALLED

E. MAX. VAPOR-AIR MIXTURE DENSITY: 0.335 LBM/FT^3 FOR SUB D
0.213 LBM/FT^3 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	155.51	155.51
Entrance	1	37.05	37.05
T Branch	5	39.91	199.55
8"X6"RED	1	39.88	39.88
T Run Thru	6	13.3	79.8
		Total	511.79

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 #3 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 1.0 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 (1.228 psig) does not exceed the cargo tank maximum design working pressure of 3.5 psi.

The maximum vacuum that can exist in a tank is 0.512 psig. The barges are constructed as per ABS rules and regulations for a pressure of 3.5 psig and are tested for a pressure of 3.5 psig. Therefor the maximum vacuum of 0.512 psig is with in 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 #1 cargo tank has a trunk top dimension of 46'-8" x 27'-0". 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 3 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	163.73	163.73
Entrance	1	37.05	37.05
T Branch	4	39.91	159.64
T Run	7	13.33	93.31
8" Gate Valve	1	5.32	5.32
		Total	459.05

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 (0.8 psig).

TABLE 1 (SUB CHAPTER "D" CARGOES)

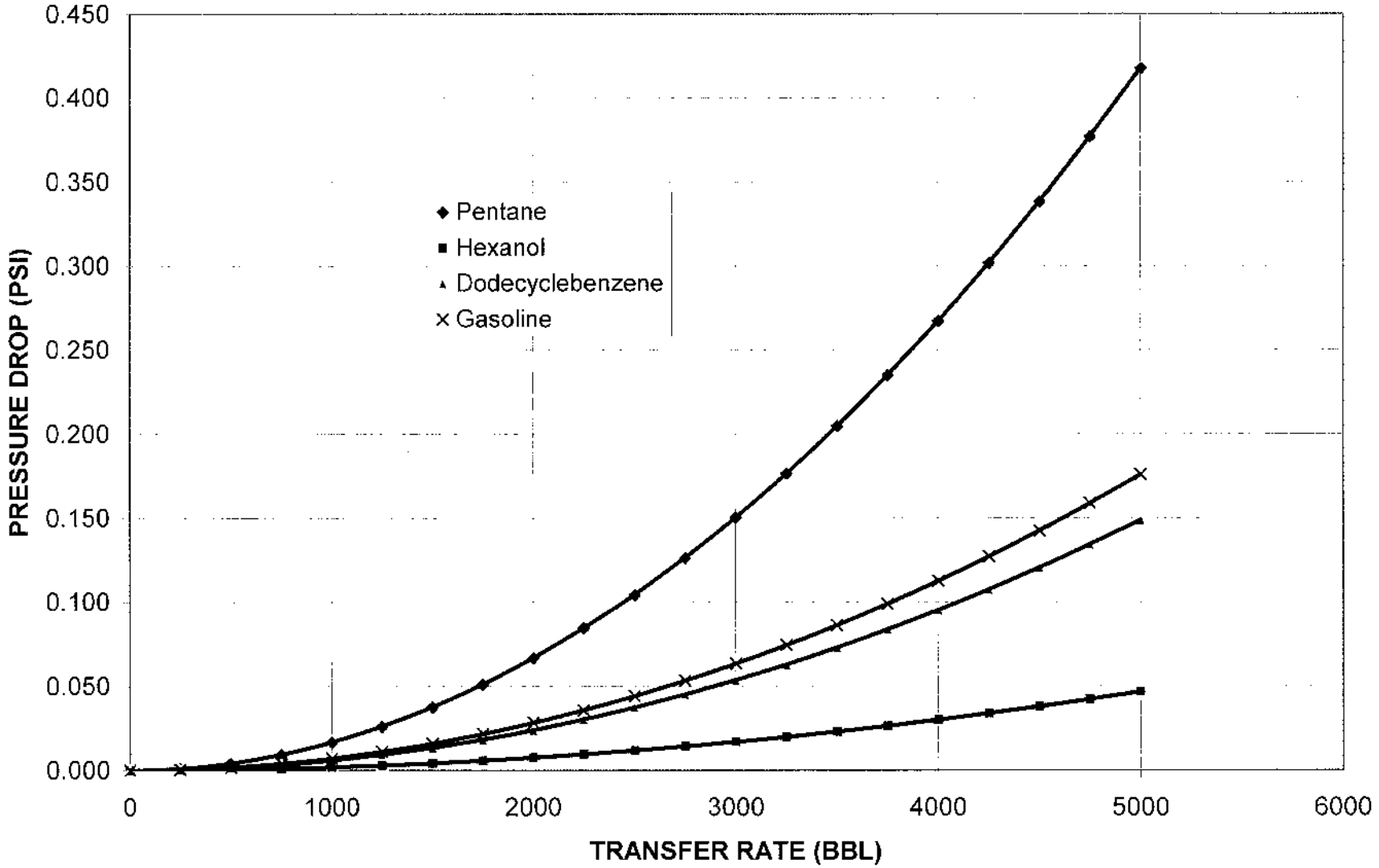
	CHRIS CODE	NAME	VCS CAT	LIQ SG	VAPOR PRESS	VAPOR SG	VAPOR AIR WEIGHT DENSITY	VAPOR GROWTH RATE	PRESSURE DROP TO PV VALVE IN VCS(psig) (LOADING)	VAPOR VOLUMETRIC FLOW RATE (bbl/h)	AIR EQUIVALENT VOLUMETRIC FLOW RATE	PRESSURE DROP TO SHORE CONNECTION IN VCS (psig) (LOADING)*	PRESSURE DROP TO PV VALVE IN VCS(psig) (UNLOADING)	PRESSURI DROP TO SHORE CONNECT IN VCS (ps (UNLOADI
1	ACT	Acetone	1	0.79	10	2	0.121	1.2000	0.050	4200	5372	0.045	0.003	0.002
2	ACP	Acetophenone	1	1.03	0.6	4.14	0.082	1.0120	0.024	3542	3747	0.022	0.001	0.001
19	AAT	Amyl Acetate (iso-)	1	0.88	0.33	4.48	0.079	1.0066	0.023	3523	3649	0.021	0.001	0.001
20	AAI	Amyl Alcohol (iso-, n-, sec-, primary) (See also IAA)	1	0.82	0.3	3.04	0.077	1.0060	0.022	3521	3588	0.020	0.001	0.001
21	AAN	Amyl Alcohol (n-)	1	0.82	0.3	3.04	0.077	1.0060	0.022	3521	3588	0.020	0.001	0.001
23	APM	Amyl Alcohol, Primary	1	0.82	0.3	3.04	0.077	1.0060	0.022	3521	3588	0.020	0.001	0.001
24	ASE	Amyl Alcohol, (sec-)	1	0.82	0.3	3.04	0.077	1.0060	0.022	3521	3588	0.020	0.001	0.001
26	IAA	Amyl Alcohol, (iso-)	1	0.82	0.3	3.04	0.077	1.0060	0.022	3521	3588	0.020	0.001	0.001
34	BAL	Benzyl Alcohol	1	1.05	0.1	3.73	0.075	1.0020	0.022	3507	3536	0.019	0.001	0.001
40	BAX	Butyl Acetate (iso-, n-)	1	0.87	0.6	4	0.082	1.0120	0.024	3542	3738	0.022	0.001	0.001
42	BTA	Butyl Acetate (sec-)	1	0.89	1.5	4	0.095	1.0300	0.029	3605	4088	0.026	0.002	0.001
44	IAL	Butyl Alcohol (iso-)	1	0.81	0.9	2.6	0.080	1.0160	0.024	3563	3722	0.021	0.001	0.001
46	BAS	Butyl Alcohol (sec-)	1	0.81	1.3	2.6	0.083	1.0260	0.025	3591	3820	0.023	0.001	0.001
47	BAT	Butyl Alcohol (tert-)	1	0.78	2.8	2.6	0.095	1.0560	0.030	3696	4189	0.027	0.002	0.001
48	BPH	Butyl Benzyl Phthalate	1	1.12	0.01	10.8	0.074	1.0002	0.021	3501	3511	0.019	0.001	0.001
64	CLS	Caprolactam Solutions	1	1.02	0.05	3.9	0.074	1.0010	0.021	3504	3519	0.019	0.001	0.001
70	CUM	Cumene	1	0.86	0.60	4.20	0.083	1.0120	0.024	3542	3751	0.022	0.001	0.001
72	CHX	Cyclohexane	1	0.78	4.5	2.9	0.114	1.0900	0.039	3815	4740	0.035	0.002	0.002
73	CHN	Cyclohexanol	1	0.95	0.15	3.45	0.075	1.0030	0.022	3511	3550	0.020	0.001	0.001
74	CPD	1,3-Cyclopentadiene dimer (molten)	1	0.89	0.25	4.55	0.078	1.0050	0.023	3518	3615	0.020	0.001	0.001
76	CMP	Cymene (para-)	1	0.86	0.11	4.62	0.076	1.0022	0.022	3508	3551	0.020	0.001	0.001
77	DHN	Decahydronaphthalene	1	0.89	0.1	4.76	0.075	1.0020	0.022	3507	3548	0.019	0.001	0.001
78	IDA	Decaldehyde (iso-)	1	0.83	0.01	5	0.074	1.0002	0.021	3501	3504	0.019	0.001	0.001
79	DAL	Decaldehyde (n-)	1	0.83	0	5.01	0.074	1.0000	0.021	3500	3499	0.019	0.001	0.001
81	DCE	Decane	1	0.74	0.12	4.8	0.076	1.0024	0.022	3508	3558	0.020	0.001	0.001
82	DAX	Decyl Alcohol (all isomers) (Decanol)	1	0.83	0.01	5.3	0.074	1.0002	0.021	3501	3505	0.019	0.001	0.001
83	ISA	Decyl Alcohol (iso-)	1	0.83	0.01	5.3	0.074	1.0002	0.021	3501	3505	0.019	0.001	0.001
84	DAN	Decyl Alcohol (n-)	1	0.83	0.01	5.3	0.074	1.0002	0.021	3501	3505	0.019	0.001	0.001
85	DBZ	Decylbenzene (n-)	1	0.86	0.01	7.52	0.074	1.0002	0.021	3501	3507	0.019	0.001	0.001
87	DAA	Diacetone Alcohol	1	0.97	0.1	4	0.075	1.0020	0.022	3507	3539	0.019	0.001	0.001
91	DPA	Dibutyl Phthalate (ortho-)	1	1.05	0	9.59	0.074	1.0000	0.021	3500	3499	0.019	0.001	0.001
92	DPT	Dicyclopentadiene, See 1,3-Cyclopentadiene Dimer	2	0.98	0.25	4.55	0.078	1.0050	0.023	3518	3615	0.020	0.001	0.001
93	DEB	Diethybenzene	1	0.87	0.08	4.62	0.075	1.0016	0.022	3506	3537	0.019	0.001	0.001
94	DEG	Diethylene Glycol	1	1.12	0.01	3.66	0.074	1.0002	0.021	3501	3503	0.019	0.001	0.001
95	DME	Diethylene Glycol Butyl Ether	1	0.95	0.01	5.5	0.074	1.0002	0.021	3501	3505	0.019	0.001	0.001
100	DGA	Diethylene Glycol Ethyl Ether Acetate	1	0.99	0.02	4.62	0.074	1.0004	0.021	3501	3508	0.019	0.001	0.001
101	DGM	Diethylene Glycol Methyl Ether	1	1.03	0.03	4.14	0.074	1.0006	0.021	3502	3512	0.019	0.001	0.001
111	DBC	Diisobutylcarbinol	1	0.81	0.09	4.97	0.075	1.0018	0.022	3506	3545	0.019	0.001	0.001
112	DBL	Diisobutylene	1	0.72	2	3.86	0.100	1.0400	0.031	3640	4251	0.028	0.002	0.001
113	DIX	Diisobutyl Ketone	1	0.81	0.16	4.9	0.077	1.0032	0.022	3511	3579	0.020	0.001	0.001
119	DIX	Diisopropylbenzene (all isomer)	1	0.86	0.03	5.6	0.074	1.0006	0.021	3502	3516	0.019	0.001	0.001
124	DTL	Dimethyl Phthalate	1	1.19	0	6.69	0.074	1.0000	0.021	3500	3499	0.019	0.001	0.001
130	DOP	Dioctyl Phthalate	1	0.98	0	13.47	0.074	1.0000	0.021	3500	3499	0.019	0.001	0.001
131	DPN	Dipentene	1	0.84	0.1	4.9	0.075	1.0020	0.022	3507	3549	0.019	0.001	0.001
132	DIL	Diphenyl	1	0.99	0.01	5.31	0.074	1.0002	0.021	3501	3505	0.019	0.001	0.001
133	DDO	Diphenyl, Diphenyl Ether Mixture	1	1.07	0.01	5.86	0.074	1.0002	0.021	3501	3505	0.019	0.001	0.001
134	DPE	Diphenyl Ether	1	1.07	0.01	5.87	0.074	1.0002	0.021	3501	3505	0.019	0.001	0.001
136	DPG	Dipropylene Glycol	1	1.03	0.07	4.63	0.075	1.0014	0.022	3505	3532	0.019	0.001	0.001
139	DFF	Distillates: Flashed Feed Stocks	1	0.75	2.3	3.4	0.100	1.0460	0.031	3661	4255	0.028	0.002	0.001
140	DSR	Distillates: Straight Run	1	0.73	2.3	3.4	0.100	1.0460	0.031	3661	4255	0.028	0.002	0.001
145	DOZ	Dodecene (all isomers)	1	0.76	0.02	5.81	0.074	1.0004	0.021	3501	3511	0.019	0.001	0.001
146	DOD	Dodecene	1	0.76	0.02	5.81	0.074	1.0004	0.021	3501	3511	0.019	0.001	0.001
147	DDB	Dodecylbenzene		0.86	4.7	8.4	0.237	1.0940	0.081	3829	6864	0.073	0.004	0.004
155	ETG	Ethoxy Triglycol (crude)	1	1.02	0	6.14	0.074	1.0000	0.021	3500	3499	0.019	0.001	0.001
156	ETA	Ethyl Acetate	1	0.9	4.5	3.04	0.117	1.0900	0.040	3815	4801	0.036	0.002	0.002
157	EAA	Ethyl Acetoacetate	1	1.03	0.2	4.48	0.077	1.0040	0.022	3514	3590	0.020	0.001	0.001
158	EAL	Ethyl Alcohol (Ethanol)	1	0.79	3.5	1.6	0.083	1.0700	0.027	3745	3986	0.025	0.001	0.001
160	ETB	Ethyl Benzene	1	0.87	0.8	3.56	0.081	1.0120	0.024	3542	3710	0.021	0.001	0.001
161	EBT	Ethyl Butanol	1	0.83	0.12	3.52	0.075	1.0024	0.022	3508	3541	0.019	0.001	0.001
162	EBR	Ethyl Butyrate	1	0.88	1	4	0.088	1.0200	0.026	3570	3895	0.023	0.001	0.001

163	ECY	Ethyl Cyclohexane	1	0.79	0.5	3.87	0.080	1.0100	0.024	3535	3692	0.021	0.001	0.001
166	EGL	Ethylene Glycol	1	1.19	0.01	2.21	0.074	1.0002	0.021	3501	3501	0.019	0.001	0.001
169	EMA	Ethylene Glycol Butyl Ether Acetate	1	0.94	0.05	5.52	0.075	1.0010	0.021	3504	3528	0.019	0.001	0.001
172	EGY	Ethylene Glycol Diacetate	1	1.1	0.01	5.03	0.074	1.0002	0.021	3501	3504	0.019	0.001	0.001
178	EME	Ethylene Glycol Methyl Ether	1	1.1	0.01	4.8	0.074	1.0002	0.021	3501	3504	0.019	0.001	0.001
180	EPE	Ethylene Glycol Phenyl Ether	1	1.1	0.01	4.8	0.074	1.0002	0.021	3501	3504	0.019	0.001	0.001
184	EHA	2-Ethylhexaldehyde, See Octyl Aldehydes	1	0.82	0.17	4.41	0.076	1.0034	0.022	3512	3575	0.020	0.001	0.001
186	EHX	2-Ethylhexanol , see Octanol (all isomers)	1	0.84	0.02	4.5	0.074	1.0004	0.021	3501	3508	0.019	0.001	0.001
190	EPR	Ethyl Propionate	1	0.89	3.5	1.6	0.083	1.0700	0.027	3745	3986	0.025	0.001	0.001
191	ETE	Ethyl Toulene	1	0.88	0.28	4.15	0.078	1.0056	0.023	3520	3616	0.020	0.001	0.001
194	FAM	Formamide	1	1.13	0.1	1.55	0.074	1.0020	0.021	3507	3512	0.019	0.001	0.001
195	FAL	Furfuryl Alcohol	1	1.13	0.05	3.4	0.074	1.0010	0.021	3504	3516	0.019	0.001	0.001
197	GAK	Gasoline Blended Stocks: Alkylates	1	0.75	12.5	3.4	0.214	1.2500	0.096	4375	7462	0.086	0.005	0.005
198	GRF	Gasoline Blended Stocks: Reformate	1	0.8	12.5	3.4	0.214	1.2500	0.096	4375	7462	0.086	0.005	0.005
199	GAT	Gasolines: Automotive (containing not over 4.23 gra	1	0.74	12.5	3.4	0.214	1.2500	0.096	4375	7462	0.086	0.005	0.005
200	GAV	Gasolines: Aviation (containing not over 4.86 grams	1	0.71	12.5	3.4	0.214	1.2500	0.096	4375	7462	0.086	0.005	0.005
201	GCS	Gasolines: Casinghead	1	0.67	12.5	3.4	0.214	1.2500	0.096	4375	7462	0.086	0.005	0.005
202	GPL	Gasolines: Polymer	1	0.75	12.5	3.4	0.214	1.2500	0.096	4375	7462	0.086	0.005	0.005
203	GSR	Gasolines: Straight Run	1	0.75	12.5	3.4	0.214	1.2500	0.096	4375	7462	0.086	0.005	0.005
204	GCR	Glycerine	1	1.26	0	3.17	0.074	1.0000	0.021	3500	3499	0.019	0.001	0.001
217	HMX	Heptane (all isomers) (Methylhexane)	1	0.68	2.5	3.45	0.102	1.0500	0.032	3675	4332	0.029	0.002	0.002
218	HPT	Heptane (n-)	1	0.68	2.5	3.45	0.102	1.0500	0.032	3675	4332	0.029	0.002	0.002
220	HTX	Heptanol (all isomers)	1	0.82	0.04	4	0.074	1.0008	0.021	3503	3515	0.019	0.001	0.001
221	HTN	Heptanol (all isomers)	1	0.82	0.04	4	0.074	1.0008	0.021	3503	3515	0.019	0.001	0.001
222	HPX	Heptene (all isomers)	2	0.7	2.9	3.4	0.106	1.0580	0.034	3703	4447	0.031	0.002	0.002
223	THE	Heptene (1-)	1	0.7	2.8	3.4	0.105	1.0560	0.034	3696	4415	0.030	0.002	0.002
229	HXS	Hexane (all isomers)	1	0.66	7	3	0.139	1.1400	0.052	3990	5486	0.047	0.003	0.002
230	HXA	Hexane	1	0.66	7	3	0.139	1.1400	0.052	3990	5486	0.047	0.003	0.002
231	HXO	Hexaonic Acid	1	0.93	0.01	4	0.074	1.0002	0.021	3501	3503	0.019	0.001	0.001
232	HXN	Hexanol	1	0.82	1	3.52	0.085	1.0200	0.025	3570	3845	0.023	0.001	0.001
234	HEX	Hexene (all isomers)	2	0.67	8	2.9	0.145	1.1600	0.056	4060	5694	0.050	0.003	0.003
235	HXE	Hexene (1-)	1	0.67	8.2	2.9	0.147	1.1640	0.057	4074	5749	0.051	0.003	0.003
236	HXT	Hexene (2-)	1	0.67	8.2	2.9	0.147	1.1640	0.057	4074	5749	0.051	0.003	0.003
238	HXG	Hexylene Glycol	4	0.92	0.01	1.1	0.074	1.0002	0.021	3501	3500	0.019	0.001	0.001
243	IPH	Isophorone	1	0.93	0.01	4.75	0.074	1.0002	0.021	3501	3504	0.019	0.001	0.001
244	JPO	Jet Fuels: JP-1 (Kerosene)	1	0.8	0.14	4.5	0.076	1.0028	0.022	3510	3563	0.020	0.001	0.001
245	JPT	Jet Fuels: JP-3	1	0.8	8.51	4.5	0.213	1.1702	0.084	4096	6969	0.075	0.004	0.004
246	JPF	Jet Fuels: JP-4	1	0.81	3.4	4	0.121	1.0680	0.040	3738	4800	0.036	0.002	0.002
247	JPV	Jet Fuels: JP-5 (Kerosene, heavy)	1	0.82	0.1	4	0.075	1.0020	0.022	3507	3539	0.019	0.001	0.001
249	KRS	Kerosene	1	0.81	0.15	4.5	0.076	1.0030	0.022	3511	3568	0.020	0.001	0.001
263	MTT	Methyl Acetate	1	0.92	6.1	2.6	0.119	1.1220	0.043	3927	4999	0.039	0.002	0.002
265	MAL	Methyl Alcohol (See Methanol)	1	0.79	6.63	1.1	0.077	1.1326	0.028	3964	4046	0.025	0.001	0.001
266	MAC	Methyl Amyl Acetate	1	0.86	0.33	4.97	0.080	1.0066	0.023	3523	3666	0.021	0.001	0.001
267	MAA	Methyl Amyl Alcohol	1	0.81	0.43	3.52	0.079	1.0086	0.023	3530	3649	0.021	0.001	0.001
271	MBK	Methyl n-Butyl Ketone	1	0.81	0.97	3.5	0.085	1.0194	0.025	3568	3832	0.023	0.001	0.001
273	MBU	Methyl Butyrate	1	0.9	1.26	3.53	0.089	1.0252	0.027	3588	3935	0.024	0.001	0.001
274	MEK	Methyl Ethyl Ketone	1	0.8	4.5	2.5	0.105	1.0900	0.036	3815	4561	0.032	0.002	0.002
275	MTF	Methyl Formal (Dimethyl Formal)	1	0.86	15.42	2.6	0.189	1.3084	0.093	4579	7341	0.083	0.005	0.004
276	MHK	Methyl Heptyl Ketone	1	0.83	0.06	4.9	0.075	1.0012	0.021	3504	3529	0.019	0.001	0.001
278	MIK	Methyl Isobutyl Ketone	1	0.8	1.15	3.45	0.087	1.0230	0.026	3581	3887	0.023	0.001	0.001
281	MNA	1-Methyl Napthalene	1	1.02	0.01	4.91	0.074	1.0002	0.021	3501	3504	0.019	0.001	0.001
283	MPN	2-Methyl-1-Pentene	1	0.69	6.3	2.9	0.130	1.1260	0.047	3941	5230	0.042	0.002	0.002
284	MTN	5-Methyl-1-Pentene	1	0.67	8.49	2.9	0.149	1.1698	0.059	4094	5828	0.053	0.003	0.003
286	MBE	Methyl Tert-Butyl Ether (MTBE)	1	0.74	0.04	3.1	0.074	1.0008	0.021	3503	3511	0.019	0.001	0.001
288	MNS	Mineral Spirits	1	0.75	0.2	4.3	0.077	1.0040	0.022	3514	3586	0.020	0.001	0.001
289	MRE	Myrcene	1	0.8	0.17	4.7	0.077	1.0034	0.022	3512	3581	0.020	0.001	0.001
295	NSV	Naphtha: Solvent	1	0.87	0.2	3.5	0.076	1.0040	0.022	3514	3569	0.020	0.001	0.001
296	NSS	Naphtha: Stoddard Solvant	1	0.78	0.2	4.3	0.077	1.0040	0.022	3514	3586	0.020	0.001	0.001
297	NVM	Naphtha: Varnish Maker's and Painters (75%)	1	0.77	0.19	4.3	0.077	1.0038	0.022	3513	3582	0.020	0.001	0.001
300	NAX	Nonane (all isomers)	1	0.72	0.27	4.4	0.078	1.0054	0.023	3519	3619	0.020	0.001	0.001
301	NAN	Nonane	1	0.72	0.27	4.4	0.078	1.0054	0.023	3519	3619	0.020	0.001	0.001
304	NON	Nonene	1	0.73	0.35	4.3	0.079	1.0070	0.023	3525	3651	0.021	0.001	0.001
305	NNS	Nonyl Alcohol (all isomers)	1	0.94	0.1	5	0.076	1.0020	0.022	3507	3550	0.020	0.001	0.001
306	NNN	Nonyl Alcohol	1	0.94	0.1	5	0.076	1.0020	0.022	3507	3550	0.020	0.001	0.001
307	NNI	Nonyl Alcohol (iso-)	1	0.94	0.1	5	0.076	1.0020	0.022	3507	3550	0.020	0.001	0.001
309	NNP	Nonyl Phenol	1	0.95	0.01	7.8	0.074	1.0002	0.021	3501	3507	0.019	0.001	0.001
316	OAX	Octane (all isomers)	1	0.7	0.79	3.9	0.084	1.0158	0.025	3555	3805	0.022	0.001	0.001

317	OAN	Octane	1	0.7	0.79	3.9	0.084	1.0158	0.025	3555	3805	0.022	0.001	0.001
320	OTA	Octanol	1	0.83	0.01	4.48	0.074	1.0002	0.021	3501	3504	0.019	0.001	0.001
322	OTE	Octene (1-)	1	0.72	1	3.86	0.087	1.0200	0.026	3570	3880	0.023	0.001	0.001
324	OCX	Octyl Alcohol (iso-, n-) (all isomers), See Octanol (	1	0.83	0.01	4.48	0.074	1.0002	0.021	3501	3504	0.019	0.001	0.001
325	IOA	Octyl Alcohol	1	0.83	0.01	4.48	0.074	1.0002	0.021	3501	3504	0.019	0.001	0.001
364	OTW	Fuel: No. 2	1	0.88	0.56	8	0.092	1.0112	0.027	3539	3955	0.024	0.001	0.001
366	OFR	Fuel: No. 4	1	0.9	0.15	3.4	0.075	1.0030	0.022	3511	3550	0.019	0.001	0.001
367	OFV	Fuel: No. 5	1	0.94	0.15	3.4	0.075	1.0030	0.022	3511	3550	0.019	0.001	0.001
368	OSX	Fuel: No. 6	1	0.95	0.15	3.4	0.075	1.0030	0.022	3511	3550	0.019	0.001	0.001
382	OIL	OIL, Misc: Crude	1	0.95	0.15	3.4	0.075	1.0030	0.022	3511	3550	0.019	0.001	0.001
383	ODS	OIL, Misc: Diesel	1	0.9	0.69	3.4	0.081	1.0138	0.024	3548	3730	0.022	0.001	0.001
389	OLB	OIL, Misc: Lubricating	1	0.9	0.15	1	0.074	1.0030	0.021	3511	3510	0.019	0.001	0.001
403	ORS	OIL, Misc: Resin	1	1.02	0.15	1	0.074	1.0030	0.021	3511	3510	0.019	0.001	0.001
418	OTB	OIL, Misc: Turbine	1	0.87	0.3	5.4	0.080	1.0060	0.023	3521	3665	0.021	0.001	0.001
429	PDC	Pentadecanol, See Alcohols (C13 and above)	1	0.83	0.01	7.88	0.074	1.0002	0.021	3501	3507	0.019	0.001	0.001
433	IPT	Pentane (iso-)	5	0.62	27	2.48	0.335	1.5400	0.228	5390	11501	0.205	0.012	0.011
434	PTA	Pentane (n-)	5	0.63	20.44	2.5	0.256	1.4088	0.146	4931	9191	0.131	0.008	0.007
437	PTE	Pentene (1-)	5	0.64	24.9	2.4	0.299	1.4980	0.193	5243	10568	0.173	0.010	0.009
442	PIN	Pinene	1	0.86	0.35	4.7	0.080	1.0070	0.023	3525	3666	0.021	0.001	0.001
448	PLB	Polybutene	1	0.91	0.01	79.3	0.077	1.0002	0.022	3501	3586	0.020	0.001	0.001
457	PGC	Polypropylene Glycol	1	1.01	0.1	1	0.074	1.0020	0.021	3507	3506	0.019	0.001	0.001
464	IAC	Propyl Acetate (iso-)	1	0.89	1.8	3.52	0.095	1.0360	0.029	3626	4115	0.026	0.002	0.001
465	PAT	Propyl Acetate (n-)	1	0	1.85	3.52	0.095	1.0370	0.029	3630	4132	0.026	0.002	0.001
466	IPA	Propyl Alcohol (Iso-)	1	0.79	3	2.07	0.089	1.0600	0.029	3710	4071	0.026	0.001	0.001
467	PAL	Propyl Alcohol (n-)	1	0.8	1.2	2.07	0.080	1.0240	0.024	3584	3727	0.021	0.001	0.001
468	PBZ	Propylbenzene (n-)	1	0.86	0.2	4.14	0.077	1.0040	0.022	3514	3583	0.020	0.001	0.001
469	IPX	Iso-Propylcyclohexane	1	0.8	0.01	4.35	0.074	1.0002	0.021	3501	3503	0.019	0.001	0.001
473	PPG	Propylene Glycol (1,2-Propandiol)	1	1.04	0.01	2.62	0.074	1.0002	0.021	3501	3502	0.019	0.001	0.001
476	PME	Propylene Glycol Methyl Ether	1	0.92	0.7	3.11	0.081	1.0140	0.024	3549	3711	0.021	0.001	0.001
488	SFL	Sulfolane	1	1.26	0.01	4.14	0.074	1.0002	0.021	3501	3503	0.019	0.001	0.001
493	TTN	Tetradecanol	1	0.82	0	7.39	0.074	1.0000	0.021	3500	3499	0.019	0.001	0.001
494	TTD	1-Tetradecene, See the olefin or Alpha-Olefin Entrie	1	0.77	0.01	6.77	0.074	1.0002	0.021	3501	3506	0.019	0.001	0.001
496	TTG	Tetraethylene Glycol	1	1.12	0.01	6.7	0.074	1.0002	0.021	3501	3506	0.019	0.001	0.001
497	THN	Tetrahydronaphthalene	1	0.97	0.04	4.56	0.074	1.0008	0.021	3503	3518	0.019	0.001	0.001
499	TOL	Toluene	1	0.87	1.5	3.14	0.089	1.0300	0.027	3605	3955	0.024	0.001	0.001
502	TCP	Tricresyl Phosphate (less than 1% of the ortho isom	1	1.16	0.01	12.69	0.074	1.0002	0.021	3501	3513	0.019	0.001	0.001
503	TRD	Tridecane	1	0.76	0.02	6.4	0.074	1.0004	0.021	3501	3512	0.019	0.001	0.001
505	TDN	Tridecanol , See Alcohols (C13 and above)	1	0.85	0.01	6.91	0.074	1.0002	0.021	3501	3506	0.019	0.001	0.001
506	TDC	1-Tridecene	1	0.77	0.01	6.29	0.074	1.0002	0.021	3501	3506	0.019	0.001	0.001
508	TEB	Triethylbenzene	1	0.86	0.02	5.6	0.074	1.0004	0.021	3501	3511	0.019	0.001	0.001
509	TEG	Triethylene Glycol	1	1.12	0.01	5.17	0.074	1.0002	0.021	3501	3504	0.019	0.001	0.001
519	TRE	Trimethylbenzenes (all isomers)	1	0.89	0.14	4.2	0.076	1.0028	0.022	3510	3559	0.020	0.001	0.001
520	TMB	Trimethyl Benzene (1,2,5-)	1	0.89	0.14	4.14	0.076	1.0028	0.022	3510	3558	0.020	0.001	0.001
521	TMD	Trimethyl Benzene (1,2,3-)	1	0.89	0.14	4.14	0.076	1.0028	0.022	3510	3558	0.020	0.001	0.001
522	TME	Trimethyl Benzene (1,2,4-) (Pseudocumene)	1	0.89	0.14	4.14	0.076	1.0028	0.022	3510	3558	0.020	0.001	0.001
529	TRP	Trixylenyl Phosphate	1	1.16	0	14.2	0.074	1.0000	0.021	3500	3499	0.019	0.001	0.001
546	XLX	Xylenes (Ortho-, meta-, para-)	1	0.89	0.51	3.66	0.080	1.0102	0.023	3536	3684	0.021	0.001	0.001
547	XLM	Xylene (M-)	1	0.87	0.51	3.66	0.080	1.0102	0.023	3536	3684	0.021	0.001	0.001
548	XLO	Xylene (O-)	1	0.89	0.4	3.66	0.079	1.0080	0.023	3528	3645	0.021	0.001	0.001
549	XLP	Xylene (P-)	1	0.86	0.51	3.66	0.080	1.0102	0.023	3536	3684	0.021	0.001	0.001
550	XYL	Xylenol	1	1.01	0.1	3.66	0.075	1.0020	0.022	3507	3536	0.019	0.001	0.001
551		Zinc Dialkyldithiophosphate												
			Max.	1.260	27.000	79.300	0.335	1.540	0.228	5390	11501	0.205	0.012	0.011
			Min.	0.000	0.000	1.000	0.000	1.000	0.021	3500	3499	0.019	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)

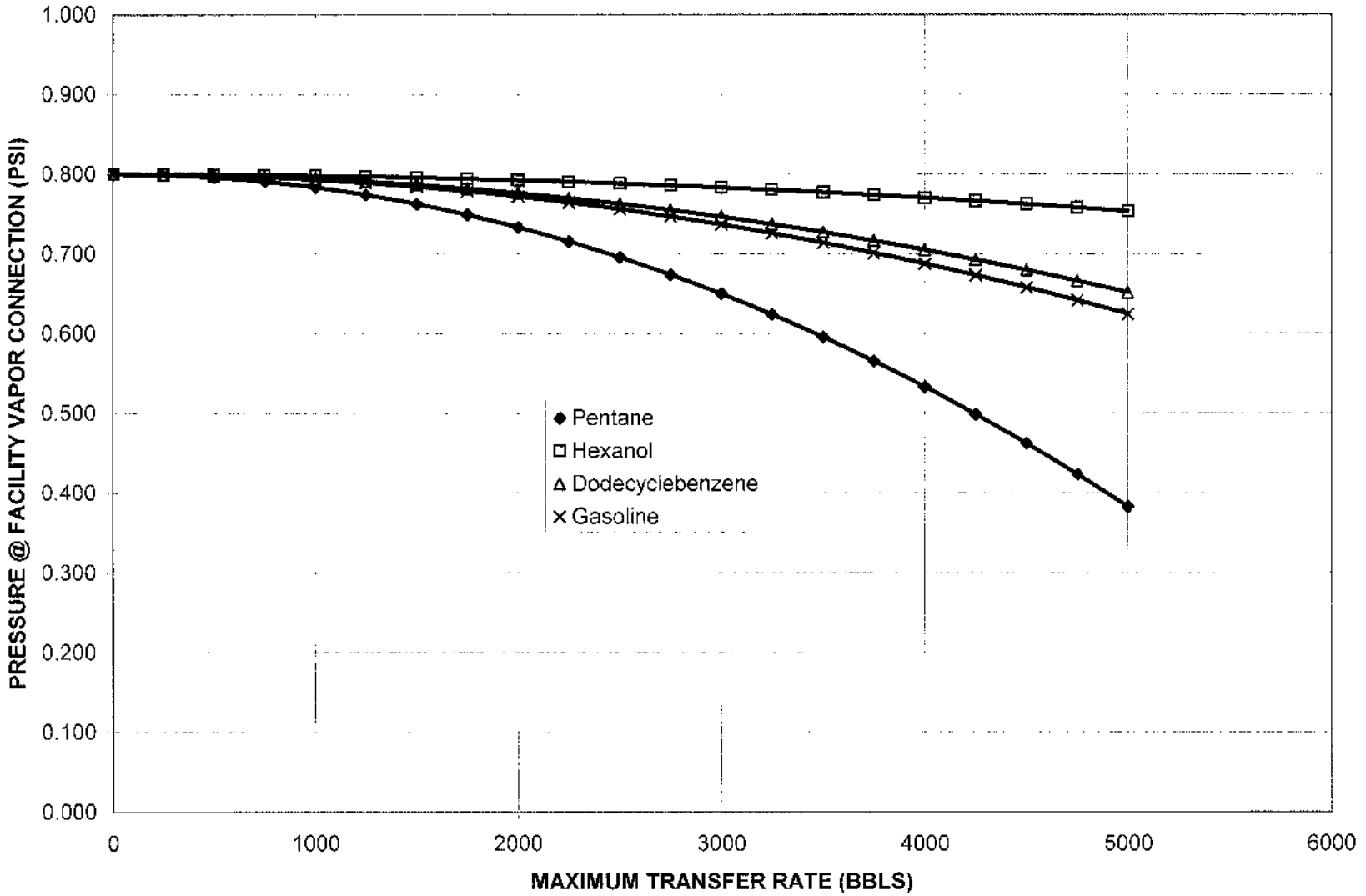
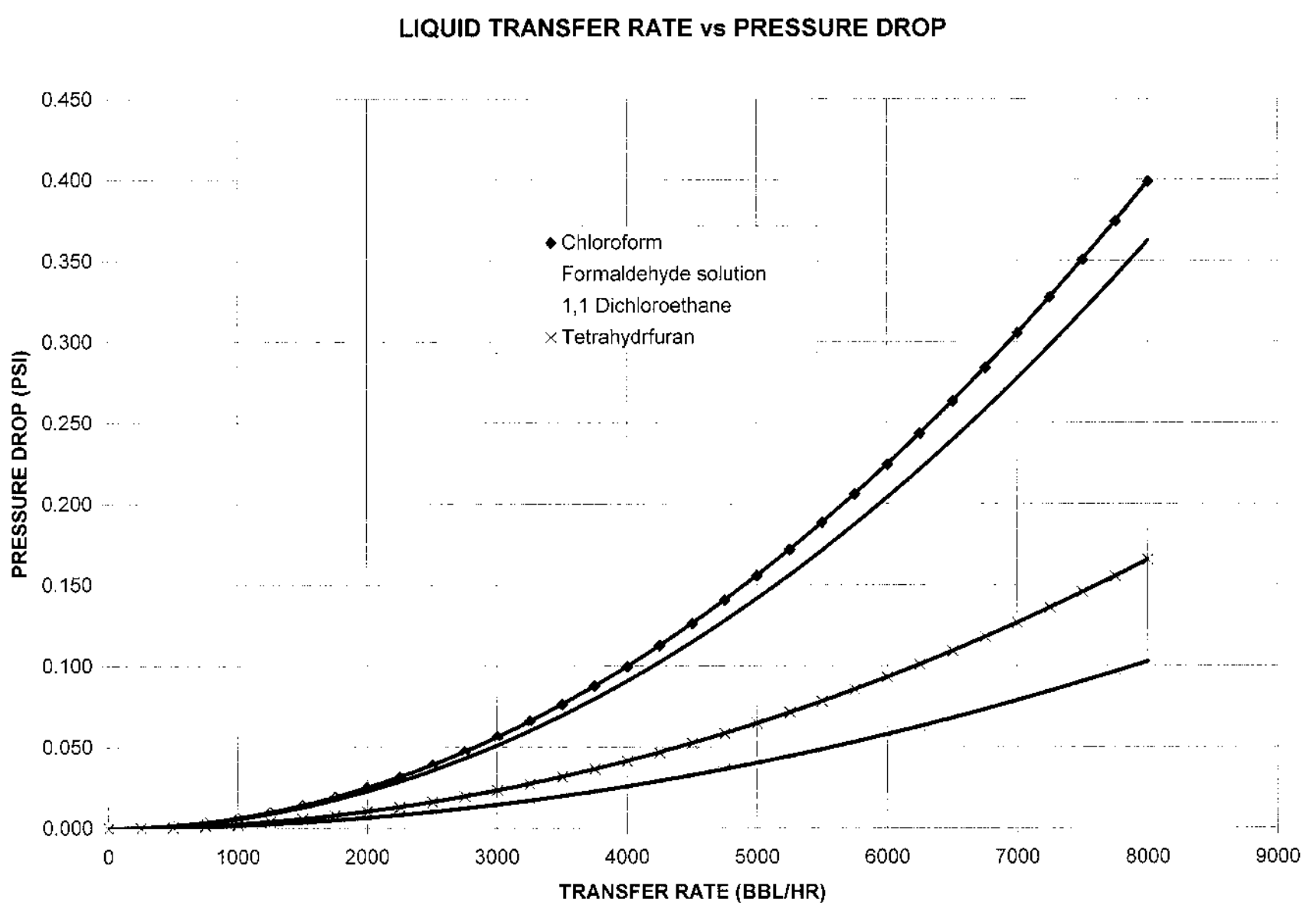


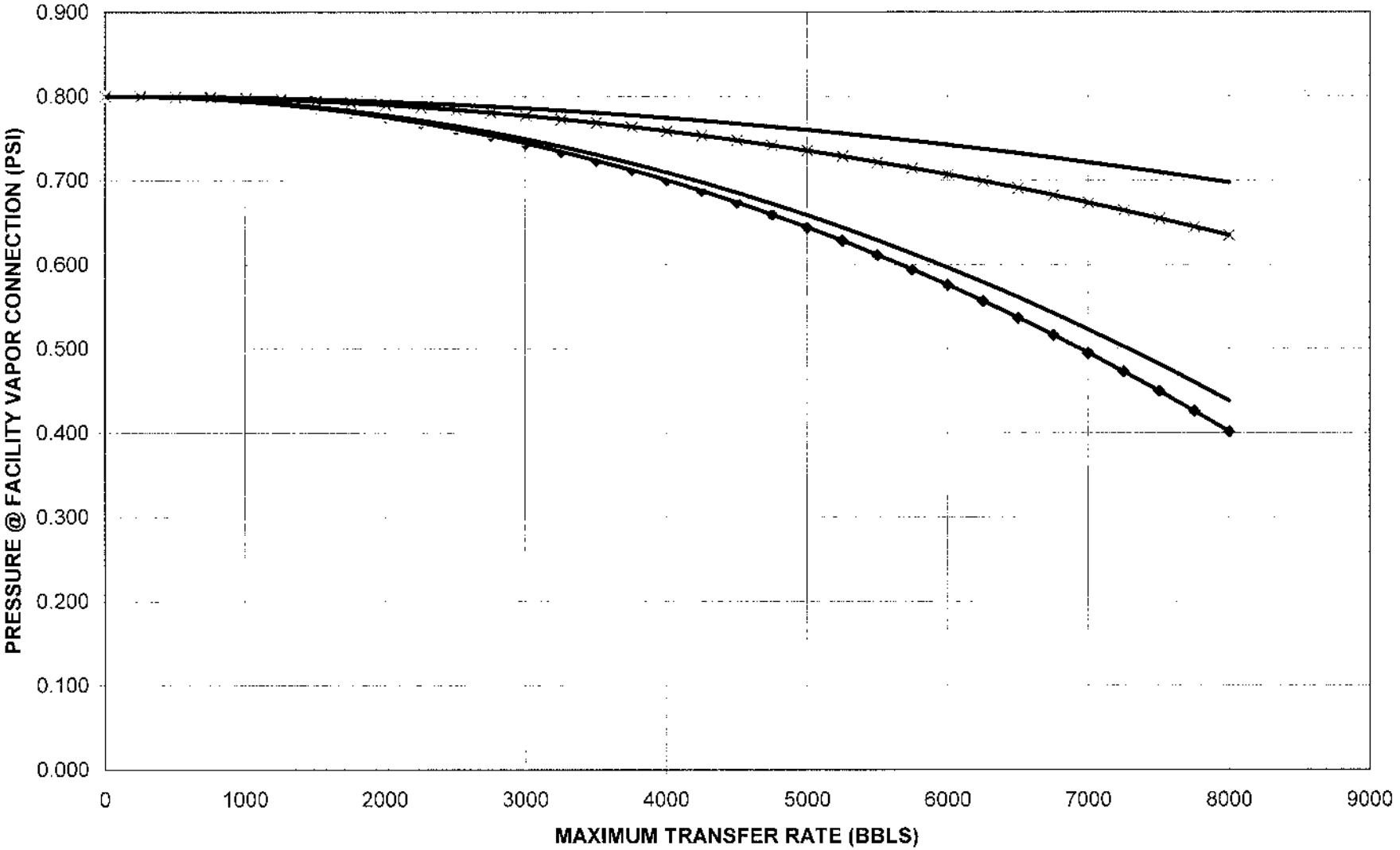
TABLE 4 (SUBCHAPTER "O" CARGOES)

	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	0.095	1.1000	0.033	3850	4298	0.029	0.002	0.002
2	ADN	Adiponitrile	1	0.95	0.01	3.73	0.076	1.0002	0.022	3501	3503	0.020	0.001	0.001
3	ATN	Acetonitrile	3	0.78	0.03	1.41	0.076	1.0006	0.022	3502	3502	0.020	0.001	0.001
4	BAD	Iso-Butyraldehyde	1	0.80	7.80	2.50	0.131	1.1560	0.050	4046	5308	0.045	0.003	0.002
5	BAR	Butyl acrylate (iso-, n-)	2	0.90	0.60	4.42	0.086	1.0120	0.025	3542	3759	0.023	0.001	0.001
6	BMH	Butyl Methacrylate	2	0.88	0.29	4.9	0.081	1.0058	0.024	3520	3640	0.021	0.001	0.001
7	BNZ	Benzene	1	0.88	4.50	2.80	0.114	1.0900	0.039	3815	4671	0.035	0.002	0.002
8	BTR	n-Butyraldehyde	1	0.80	7.80	2.50	0.131	1.1560	0.050	4046	5308	0.045	0.003	0.002
9	BTX	Benzene, Toluene, Xylene mixtures (10% Benzene or more)	1	0.84	7.30	2.80	0.138	1.1460	0.052	4011	5396	0.046	0.003	0.002
10	CCH	Cyclohexanone	1	0.95	0.20	3.40	0.078	1.0040	0.023	3514	3565	0.020	0.001	0.001
11	CHA	Cyclohexylamine	1	0.87	0.62	3.42	0.083	1.0124	0.024	3543	3703	0.022	0.001	0.001
12	CRB	Chlorobenzene	1	1.11	0.80	3.88	0.087	1.0160	0.026	3556	3799	0.023	0.001	0.001
13	CRF	Chloroform	3	1.48	9	4.25	0.213	1.1800	0.085	4130	6916	0.076	0.004	0.004
14	NCT	Coal Tar Naphtha Solvent	1	0.86	0.2	4	0.079	1.0040	0.023	3514	3577	0.020	0.001	0.001
15	CRS	Cresols	1	1.05	0.06	3.72	0.077	1.0012	0.022	3504	3521	0.020	0.001	0.001
16	CTA	Crotonaldehyde	4	0.85	2	2.41	0.089	1.0400	0.028	3640	3943	0.025	0.001	0.001
17	DCH	1,1-Dichloroethane	1	1.18	9.90	3.41	0.188	1.1980	0.077	4193	6592	0.069	0.004	0.004
18	DPP	1,2-Dichloropropane	3	1.16	2.5	3.89	0.110	1.0500	0.035	3675	4418	0.031	0.002	0.002
19	DPU	1,3-Dichloropropene	4	1.23	5.5	3.84	0.149	1.1100	0.053	3885	5443	0.047	0.003	0.002
20	DEN	Diethylamine	3	0.71	1.00	2.50	0.083	1.0200	0.025	3570	3731	0.022	0.001	0.001
21	DIP	Diisopropanolamine	1	0.98	0.01	4.59	0.076	1.0002	0.022	3501	3504	0.020	0.001	0.001
22	DMF	Dimethylformamide	1	0.95	0.30	2.51	0.078	1.0060	0.023	3521	3569	0.020	0.001	0.001
23	DPX	1,1-,1,2-, or 1,3-Dichloropropane	3	1.16	6.30	3.90	0.162	1.1260	0.059	3941	5747	0.053	0.003	0.003
24	EAC	Ethyl acrylate	2	0.93	2.00	3.50	0.099	1.0400	0.031	3640	4163	0.028	0.002	0.001
25	EAI	2-Ethylhexyl acrylate	2	0.89	0.02	6.35	0.076	1.0004	0.022	3501	3512	0.020	0.001	0.001
26	EDC	Ethylene dichloride	1	1.26	4.00	3.42	0.121	1.0800	0.041	3780	4776	0.036	0.002	0.002
27	ETM	Ethyl Methacrylate	2	0.92	1	3.94	0.090	1.0200	0.027	3570	3879	0.024	0.001	0.001
28	EPA	2-Ethyl-3-propylacrolein	1	0.85	0.12	4.5	0.078	1.0024	0.022	3508	3553	0.020	0.001	0.001
29	FFA	Furfural	1	1.20	0.15	3.31	0.078	1.0030	0.022	3511	3547	0.020	0.001	0.001
30	FMS	Formaldehyde solution (37% to 50%)	1	1.13	0.15	1.03	0.076	1.0030	0.022	3511	3510	0.020	0.001	0.001
31	MSO	Mesityl Oxide	1	0.86	0.67	3.5	0.084	1.0134	0.025	3547	3725	0.022	0.001	0.001
32	MAM	Methyl acrylate	2	0.95	4.10	3.00	0.114	1.0820	0.038	3787	4646	0.034	0.002	0.002
33	MBE	Methylcyclopentadiene dimer	1	0.74	0.04	3.10	0.076	1.0008	0.022	3503	3511	0.020	0.001	0.001
34	MMM	Methyl methacrylate	2	0.94	2.02	3.45	0.099	1.0404	0.031	3641	4159	0.028	0.002	0.001
35	MPL	Morpholine	1	1.00	0.80	3.00	0.083	1.0160	0.025	3556	3726	0.022	0.001	0.001
36	NPM	1- or 2-Nitropropane	1	0.99	1.05	3.06	0.086	1.0210	0.026	3574	3804	0.023	0.001	0.001
37	PRD	Pyridine	1	0.98	1.30	2.72	0.086	1.0260	0.026	3591	3830	0.023	0.001	0.001
38	STY	Styrene	2	0.92	0.40	3.60	0.081	1.0080	0.024	3528	3638	0.021	0.001	0.001
39	TCN	1,2,3-Trichloropropane	3	1.39	0.15	5.60	0.079	1.0030	0.023	3511	3583	0.020	0.001	0.001
40	TEN	Triethylamine	3	0.73	2.50	3.49	0.105	1.0500	0.033	3675	4323	0.030	0.002	0.002
41	THF	Tetrahydrfuran	1	0.89	8.50	1.35	0.090	1.1700	0.035	4095	4454	0.032	0.002	0.002
42	VAM	Vinyl acetate	2	0.94	5.80	2.97	0.130	1.1160	0.046	3906	5099	0.042	0.002	0.002
			Max.	1.39	12.5	8.40	0.213	1.198	0.085	4193	6916	0.076	0.004	0.004
			Min.	0.63	0.01	1.03	0.076	1.000	0.022	3501	3502	0.020	0.001	0.001

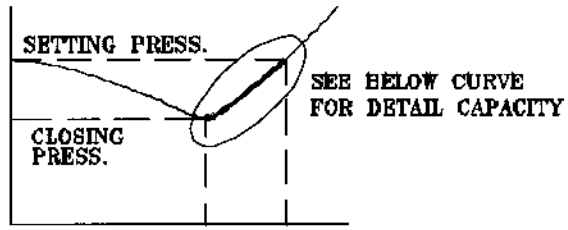
*when barge vapor piping is connected to facility vapor recovery system.


LIQUID TRANSFER RATE vs PRESSURE DROP
PRESSURE DROP (PSI)
0.450
0.400
0.350
0.300
0.250
0.200
0.150
0.100
0.050
0.000
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
TRANSFER RATE (BBL/HR)
Chloroform
Formaldehyde solution
1,1 Dichloroethane
Tetrahydrfuran

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



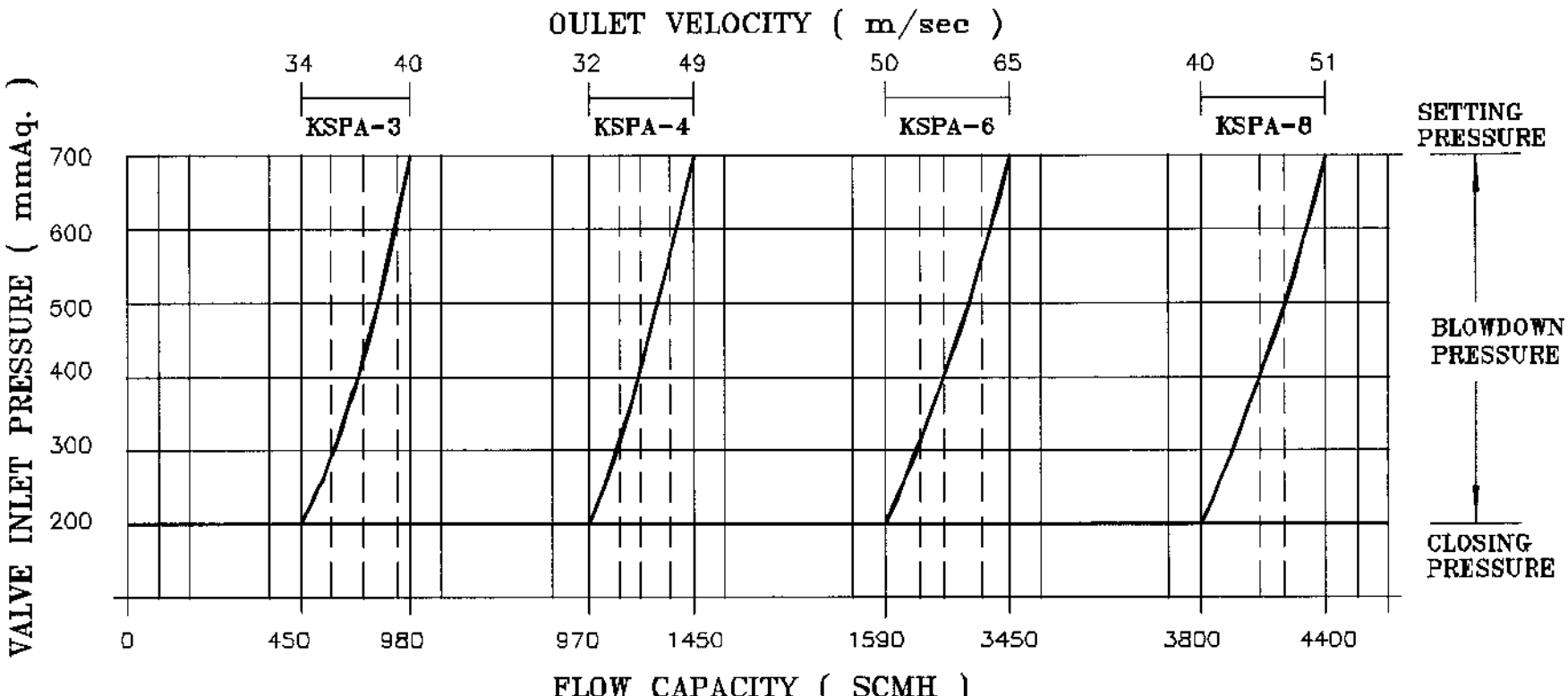
PROGRESS OF VALVE PRESSURE



TANKTECH HIGH VELOCITY VENT VALVES

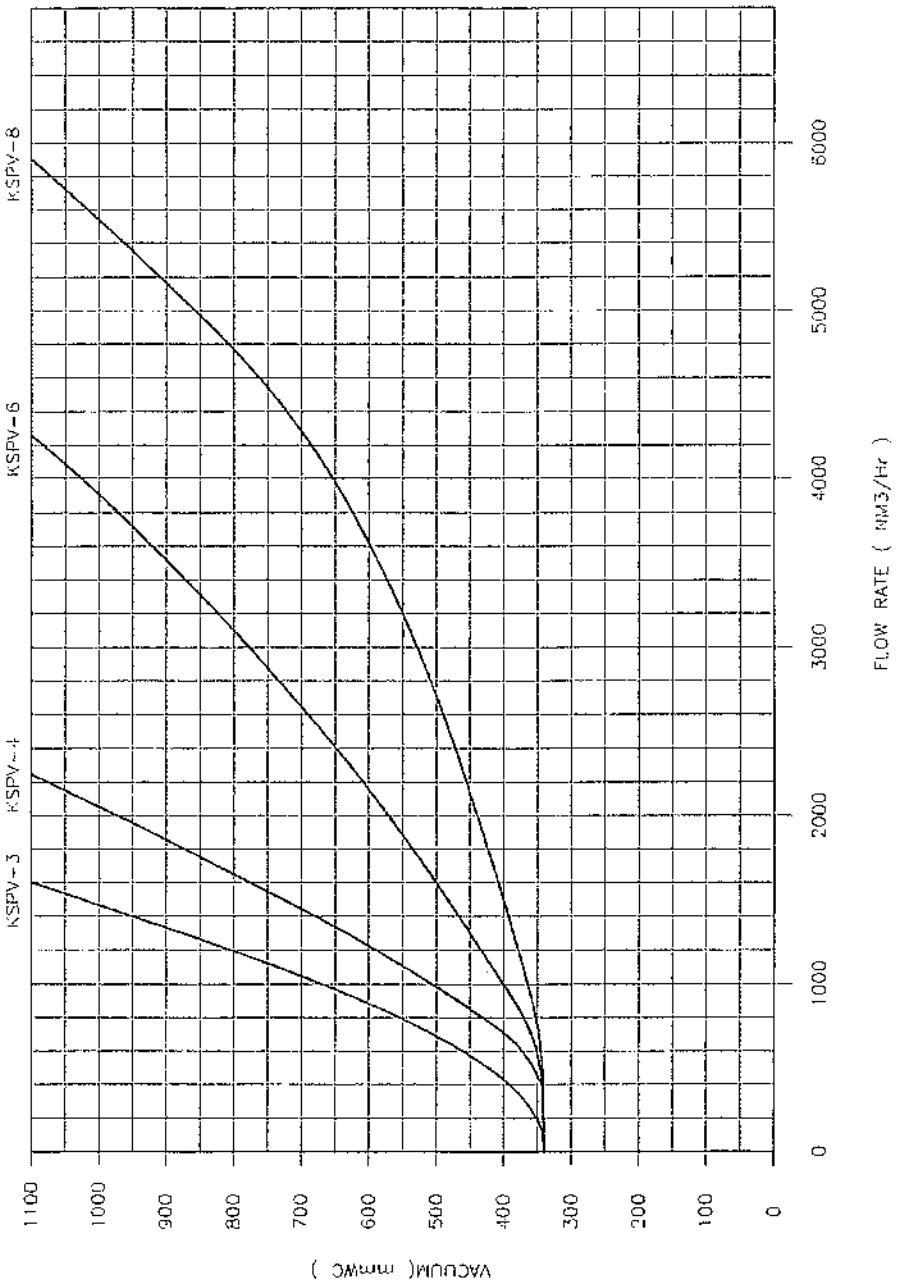
KSPA TYPE FLOW CAPACITY CURVE

700 mmAq. SETTING PRESSURE



FLOW CAPACITY CURVE GRAPH

FLOW TEST PERFORMED ON EQUIPMENT USING AIR, AT TEMP. T=15.6°C AND AMBIENT PRESSURE P=1.0332 KG/CM2.



TANKTECH

TITLE HIGH VELOCITY VACUUM RELIEF VALVE

KSPV TYPE

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

Vessel Name	CBC 1335 thru CBC 1359	**Shipyard**	Southwest
Official Number	0	**Hull Number**	9628 thru 9652

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 3.50 psig — **Raised Trunk** [X] **Flush Deck** [ ]

3. Authorized Maximum Cargo Transfer Rate(s) 3500 bbl/hr loading (max 2 tanks simultaneously); 800 bbl/hr discharging

4. Authorized Maximum Cargo Density 0.346 lbm/ft^3

5. Authorized VCS Categories 1 through 7

6. Cargoes with the highest vapor density and/or pressure drop:

a. Cargo Name: **Iso-Pentane (PTY)**

b. Cargo Name: **Iso-Pentane (PTY)**

7. Pressure Vacuum Valve:

Manufacturer	**BERGAN KLPH**
Size	**6"**
CG Approval	**162.017/0000144/3**

Settings in psig:

Pressure-side	1
Vacuum-side	0.5

8. VCS Pipe Sizes:

Approx. Inside Diameter

Longitudinal Header (inches)	8
Transverse Header (Inches)	8

Required Venting Capacity of Pressure-Side of P/V valve	11504	bbl/hr (air)
Required Venting Capacity of Vacuum-Side of P/V valve	800	bbl/hr (air)

9. Tank Overfill Protection System (check appropriate box or boxes)

a. High Level/Tank Overfill Alarm	[X]	Type	BERGAN GUARD		
b. Overfill Control Shutdown	[X]	Type	BERGAN GUARD		
c. Spill Valve	[ ]	Type	N/A	Meets ASTM F1271	**Setting in psig** N/A
d. Rupture Disk	[ ]	Type	N/A		

10. Closed Gauging Verify the vessel has closed gauging that satisfies 46 CFR 39.20-3 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 39.40, this vessel's vapor collection system has been inspected to the plans approved by Marine Safety Center letters Serial # C1-1101625 dated May 27, 2011, 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, Serial #C1-1101625.
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.

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.

11d. Previous applicable approval letters:

VCS Approval Letter	C1-1101625 dated May 27, 2011	MSC Plan Reviewer	LT M. D. Armstrong