

VAPOR COLLECTION SYSTEM CALCULATIONS

FOR

BARGE NAME(s): "CBC 1400" thru "CBC 1409"

SOUTHWEST SHIPYARD HULL(s): 9780 thru 9789

USCG PROJECT P021416

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

CANAL BARGE COMPANY, INC.

January 16, 2018

Prepared by:

A handwritten signature in black ink, appearing to read 'K. Kumaria', is written over a light blue horizontal line.

**Chetan Kumaria, PE, MBA
MARINE SOLUTIONS, INC.
P.O. Box 218197
NASHVILLE, TN. 37221-8197.
615-364-9598**

MARINE SOLUTIONS, INC.

Rev. 0 dated JANUARY 16, 2018

VCS SYSTEM INFORMATION:

1. GENERAL DESCRIPTION OF VESSEL:

A. NAME (S): CBC 1400 THRU CBC 1409
 B. USCG PROJECT NUMBER: P021416
 C. DIMENSIONS: 200'-0" X 35'-0" X 12'-6", BOX
 D. SERVICE: TANK BARGE (O/D)
 E. MAX. DESIGN WORKING PRESSURE: 3.5 PSIG
 F. PV VALVE PRESSURE SETTING: 1.5 PSIG
 G. PV VALVE VACUUM SETTING: 0.5 PSIG
 H. MAX. DISCHARGE RATE: 800 BBL/HR

2. VAPOR CONTROL SYSTEM

A. PIPE DIAMETER: 7.981 INCHES IPS
 B. PIPE LENGTHS: A- 1'-11 15/16" B-2'-7 3/16" C-38'-3 61/64" D-1'-8", E-53'-3"
 F- 0'-11 7/64" G-45'-10 1/4" H-2'-4 9/16" I-13'-8"

C. P/V VALVE VENTING CAPACITY:

(1) 6" BERGAN KLPH, SET @ 1.5 PSI
 (2) MAX. CAPACITY: 19433 BBL/HR OF AIR
 (3) 0.5 PSIG-VAC.

D. SPILL VALVE RELIEVING CAPACITY: NON INSTALLED

E. MAX. VAPOR-AIR MIXTURE DENSITY: 0.346 LBM/FT³ FOR SUB D
 0.213 LBM/FT³ FOR SUB O

F. MAX. LIQUID LOADING RATE: 3500 BBL/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 1 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	99.471	99.471
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	415.841

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 1.5 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 (1.691 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. Therefore the maximum vacuum of 0.512 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 #1 cargo tank has a trunk top dimension of 40'-0" 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	158.667	158.667
Entrance	1	37.05	37.05
T Branch	4	39.91	159.64
T Run	9	13.33	119.97
8" Gate Valve	1	5.32	5.32
		Total	480.647

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 (1.2 psig).

TABLE 1 (SUB CHAPTER "D" CARGOES)

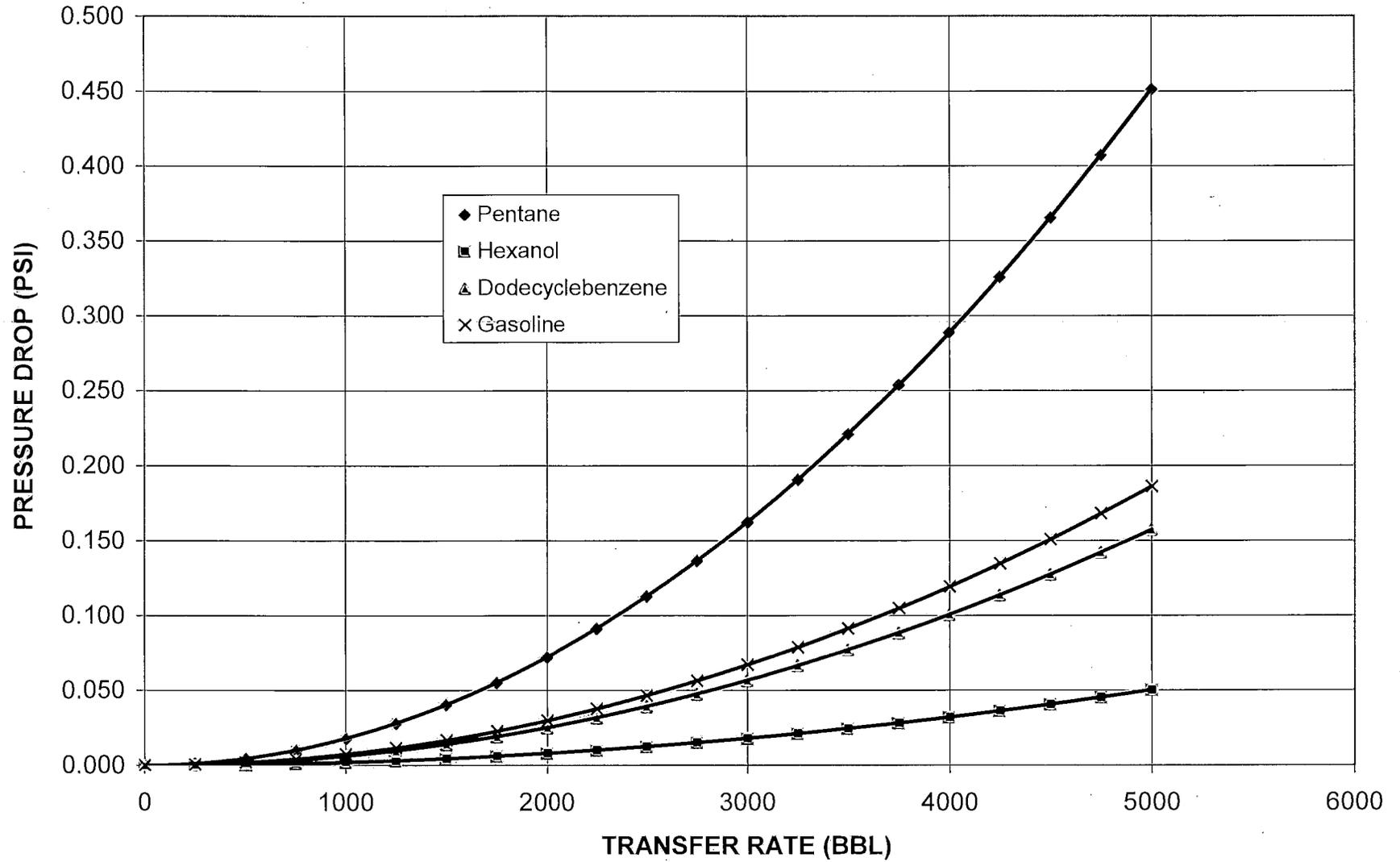
CHRIS CODE	NAME	VCS CAT	LIQ SG	VAPOR PRESS	VAPOR SG	VAPOR AIR WEIGHT DENSITY	VAPOR GROWTH RATE	PRESSURE DROP TO PV VALVE IN VCS(psig) (LOADING)	VAPOR VOLUMETRIC FLOW RATE (bbl/h)	AIR EQUIVALENT VOLUMETRIC FLOW RATE	PRESSURE	PRESSURE	PRESSURE	
											DROP TO SHORE CONNECTION IN VCS (psig) (LOADING)*	DROP TO PV VALVE IN VCS(psig) (UNLOADING)	DROP TO SHORE CONNECTION IN VCS (psig) (UNLOADING)*	
1	ACT	Acetone	1	0.79	10	2	0.123	1.2000	0.041	4200	5340	0.048	0.002	0.002
2	ACP	Acetophenone	1	1.03	0.6	4.14	0.085	1.0120	0.020	3542	3741	0.023	0.001	0.001
19	AAT	Amyl Acetate (iso-)	1	0.88	0.33	4.48	0.081	1.0066	0.019	3523	3645	0.022	0.001	0.001
20	AAI	Amyl Alcohol (iso-, n-, sec-, primary) (See also IAA	1	0.82	0.3	3.04	0.079	1.0060	0.019	3521	3586	0.021	0.001	0.001
21	AAN	Amyl Alcohol (n-)	1	0.82	0.3	3.04	0.079	1.0060	0.019	3521	3586	0.021	0.001	0.001
23	APM	Amyl Alcohol, Primary	1	0.82	0.3	3.04	0.079	1.0060	0.019	3521	3586	0.021	0.001	0.001
24	ASE	Amyl Alcohol, (sec-)	1	0.82	0.3	3.04	0.079	1.0060	0.019	3521	3586	0.021	0.001	0.001
26	IAA	Amyl Alcohol, (iso-)	1	0.82	0.3	3.04	0.079	1.0060	0.019	3521	3586	0.021	0.001	0.001
34	BAL	Benzyl Alcohol	1	1.05	0.1	3.73	0.077	1.0020	0.018	3507	3535	0.021	0.001	0.001
40	BAX	Butyl Acetate (iso-, n-)	1	0.87	0.6	4	0.084	1.0120	0.020	3542	3733	0.023	0.001	0.001
42	BTA	Butyl Acetate (sec-)	1	0.89	1.5	4	0.097	1.0300	0.024	3605	4074	0.028	0.001	0.001
44	IAL	Butyl Alcohol (iso-)	1	0.81	0.9	2.6	0.083	1.0180	0.020	3563	3717	0.023	0.001	0.001
46	BAS	Butyl Alcohol (sec-)	1	0.81	1.3	2.6	0.086	1.0260	0.021	3591	3814	0.024	0.001	0.001
47	BAT	Butyl Alcohol (tert-)	1	0.78	2.8	2.6	0.097	1.0560	0.025	3696	4175	0.029	0.001	0.002
48	BPH	Butyl Benzyl Phthalate	1	1.12	0.01	10.8	0.076	1.0002	0.018	3501	3510	0.021	0.001	0.001
64	CLS	Caprolactam Solutions	1	1.02	0.05	3.9	0.077	1.0010	0.018	3504	3518	0.021	0.001	0.001
70	CUM	Cumene	1	0.86	0.60	4.20	0.085	1.0120	0.020	3542	3745	0.023	0.001	0.001
72	CHX	Cyclohexane	1	0.78	4.5	2.9	0.116	1.0900	0.032	3815	4714	0.037	0.002	0.002
73	CHN	Cyclohexanol	1	0.95	0.15	3.45	0.078	1.0030	0.018	3511	3549	0.021	0.001	0.001
74	CPD	1,3-Cyclopentadiene dimer (molten)	1	0.69	0.25	4.55	0.080	1.0050	0.019	3518	3612	0.022	0.001	0.001
76	CMP	Cymene (para-)	1	0.86	0.11	4.62	0.078	1.0022	0.018	3508	3550	0.021	0.001	0.001
77	DHN	Decahydronaphthalene	1	0.89	0.1	4.76	0.078	1.0020	0.018	3507	3546	0.021	0.001	0.001
78	IDA	Decaldehyde (iso-)	1	0.83	0.01	5	0.076	1.0002	0.018	3501	3504	0.021	0.001	0.001
79	DAL	Decaldehyde (n-)	1	0.83	0	5.01	0.076	1.0000	0.018	3500	3499	0.020	0.001	0.001
81	DCE	Decane	1	0.74	0.12	4.8	0.078	1.0024	0.018	3508	3556	0.021	0.001	0.001
82	DAX	Decyl Alcohol (all isomers) (Decanol)	1	0.83	0.01	5.3	0.076	1.0002	0.018	3501	3504	0.021	0.001	0.001
83	ISA	Decyl Alcohol (iso-)	1	0.83	0.01	5.3	0.076	1.0002	0.018	3501	3504	0.021	0.001	0.001
84	DAN	Decyl Alcohol (n-)	1	0.83	0.01	5.3	0.076	1.0002	0.018	3501	3504	0.021	0.001	0.001
85	DBZ	Decylbenzene (n-)	1	0.86	0.01	7.52	0.076	1.0002	0.018	3501	3507	0.021	0.001	0.001
87	DAA	Diacetone Alcohol	1	0.97	0.1	4	0.077	1.0020	0.018	3507	3538	0.021	0.001	0.001
91	DPA	Dibutyl Phthalate (ortho-)	1	1.05	0	9.59	0.076	1.0000	0.018	3500	3499	0.020	0.001	0.001
92	DPT	Dicyclopentadiene, See 1,3-Cyclopentadiene Dime	2	0.98	0.25	4.55	0.080	1.0050	0.019	3518	3612	0.022	0.001	0.001
93	DEB	Diethylbenzene	1	0.87	0.08	4.62	0.077	1.0016	0.018	3506	3536	0.021	0.001	0.001
94	DEG	Diethylene Glycol	1	1.12	0.01	3.66	0.076	1.0002	0.018	3501	3503	0.021	0.001	0.001
95	DME	Diethylene Glycol Butyl Ether	1	0.95	0.01	5.5	0.076	1.0002	0.018	3501	3505	0.021	0.001	0.001
100	DGA	Diethylene Glycol Ethyl Ether Acetate	1	0.99	0.02	4.62	0.076	1.0004	0.018	3501	3508	0.021	0.001	0.001
101	DGM	Diethylene Glycol Methyl Ether	1	1.03	0.03	4.14	0.076	1.0006	0.018	3502	3511	0.021	0.001	0.001
111	DBC	Diisobutylcarbinol	1	0.81	0.09	4.97	0.078	1.0018	0.018	3506	3544	0.021	0.001	0.001
112	DBL	Diisobutylene	1	0.72	2	3.86	0.103	1.0400	0.026	3640	4233	0.030	0.001	0.002
113	DIX	Diisobutyl Ketone	1	0.81	0.16	4.9	0.079	1.0032	0.019	3511	3577	0.021	0.001	0.001
119	DIX	Diisopropylbenzene (all isomer)	1	0.86	0.03	5.6	0.077	1.0006	0.018	3502	3516	0.021	0.001	0.001
124	DTL	Dimethyl Phthalate	1	1.19	0	6.69	0.076	1.0000	0.018	3500	3499	0.020	0.001	0.001
130	DOP	Diethyl Phthalate	1	0.98	0	13.47	0.076	1.0000	0.018	3500	3499	0.020	0.001	0.001
131	DPN	Dipentene	1	0.84	0.1	4.9	0.078	1.0020	0.018	3507	3548	0.021	0.001	0.001
132	DIL	Diphenyl	1	0.99	0.01	5.31	0.076	1.0002	0.018	3501	3504	0.021	0.001	0.001
133	DDO	Diphenyl, Diphenyl Ether Mixture	1	1.07	0.01	5.86	0.076	1.0002	0.018	3501	3505	0.021	0.001	0.001
134	DPE	Diphenyl Ether	1	1.07	0.01	5.87	0.076	1.0002	0.018	3501	3505	0.021	0.001	0.001
136	DPG	Dipropylene Glycol	1	1.03	0.07	4.63	0.077	1.0014	0.018	3505	3531	0.021	0.001	0.001
139	DFD	Distillates; Flashed Feed Stocks	1	0.75	2.3	3.4	0.102	1.0460	0.026	3661	4238	0.030	0.001	0.002
140	DSR	Distillates; Straight Run	1	0.73	2.3	3.4	0.102	1.0460	0.026	3661	4238	0.030	0.001	0.002
145	DOZ	Dodecene (all isomers)	1	0.76	0.02	5.81	0.076	1.0004	0.018	3501	3511	0.021	0.001	0.001
146	DOD	Dodecene	1	0.76	0.02	5.81	0.076	1.0004	0.018	3501	3511	0.021	0.001	0.001
147	DDB	Dodecylbenzene	1	0.86	4.7	8.4	0.239	1.0940	0.067	3829	6791	0.077	0.003	0.004
155	ETA	Ethoxy Triglycol (crude)	1	1.02	0	6.14	0.076	1.0000	0.018	3500	3499	0.020	0.001	0.001
156	ETA	Ethyl Acetate	1	0.9	4.5	3.04	0.119	1.0900	0.033	3815	4774	0.038	0.002	0.002
157	EAA	Ethyl Acetoacetate	1	1.03	0.2	4.48	0.079	1.0040	0.019	3514	3588	0.022	0.001	0.001
158	EAL	Ethyl Alcohol (Ethanol)	1	0.79	3.5	1.6	0.086	1.0700	0.023	3745	3979	0.026	0.001	0.001
160	ETB	Ethyl Benzene	1	0.87	0.6	3.56	0.083	1.0120	0.020	3542	3705	0.023	0.001	0.001
161	EBT	Ethyl Butanol	1	0.83	0.12	3.52	0.077	1.0024	0.018	3508	3540	0.021	0.001	0.001
162	EBR	Ethyl Butyrate	1	0.88	1	4	0.090	1.0200	0.022	3570	3885	0.025	0.001	0.001
163	ECY	Ethyl Cyclohexane	1	0.79	0.5	3.87	0.083	1.0100	0.020	3535	3687	0.023	0.001	0.001
166	EGL	Ethylene Glycol	1	1.19	0.01	2.21	0.076	1.0002	0.018	3501	3501	0.020	0.001	0.001
169	EMA	Ethylene Glycol Butyl Ether Acetate	1	0.94	0.05	5.52	0.077	1.0010	0.018	3504	3527	0.021	0.001	0.001
172	EGY	Ethylene Glycol Diacetate	1	1.1	0.01	5.03	0.076	1.0002	0.018	3501	3504	0.021	0.001	0.001
178	EME	Ethylene Glycol Methyl Ether	1	1.1	0.01	4.8	0.076	1.0002	0.018	3501	3504	0.021	0.001	0.001

180	EPE	Ethylene Glycol Phenyl Ether	1	1.1	0.01	4.8	0.076	1.0002	0.018	3501	3504	0.021	0.001	0.001
184	EHA	2-Ethylhexaldehyde, See Octyl Aldehydes	1	0.82	0.17	4.41	0.079	1.0034	0.018	3512	3573	0.021	0.001	0.001
186	EHX	2-Ethylhexanol, see Octanol (all isomers)	1	0.84	0.02	4.5	0.076	1.0004	0.018	3501	3508	0.021	0.001	0.001
190	EPR	Ethyl Propionate	1	0.89	3.5	1.6	0.086	1.0700	0.023	3745	3979	0.026	0.001	0.001
191	ETE	Ethyl Toulene	1	0.88	0.28	4.15	0.080	1.0056	0.019	3520	3613	0.022	0.001	0.001
194	FAM	Formamide	1	1.13	0.1	1.55	0.076	1.0020	0.018	3507	3512	0.021	0.001	0.001
195	FAL	Furfuryl Alcohol	1	1.13	0.05	3.4	0.077	1.0010	0.018	3504	3515	0.021	0.001	0.001
197	GAK	Gasoline Blended Stocks: Alkylates	1	0.75	12.5	3.4	0.217	1.2500	0.079	4375	7386	0.091	0.004	0.005
198	GRF	Gasoline Blended Stocks: Reformate	1	0.8	12.5	3.4	0.217	1.2500	0.079	4375	7386	0.091	0.004	0.005
199	GAT	Gasolines: Automotive (containing not over 4.23 gr. l	1	0.74	12.5	3.4	0.217	1.2500	0.079	4375	7386	0.091	0.004	0.005
200	GAV	Gasolines: Aviation (containing not over 4.86 gram: l	1	0.71	12.5	3.4	0.217	1.2500	0.079	4375	7386	0.091	0.004	0.005
201	GCS	Gasolines: Casinghead	1	0.67	12.5	3.4	0.217	1.2500	0.079	4375	7386	0.091	0.004	0.005
202	GPL	Gasolines: Polymer	1	0.75	12.5	3.4	0.217	1.2500	0.079	4375	7386	0.091	0.004	0.005
203	GSR	Gasolines: Straight Run	1	0.75	12.5	3.4	0.217	1.2500	0.079	4375	7386	0.091	0.004	0.005
204	GCR	Glycerine	1	1.26	0	3.17	0.076	1.0000	0.018	3500	3499	0.020	0.001	0.001
217	HMX	Heptane (all isomers) (Methylhexane)	1	0.68	2.5	3.45	0.105	1.0500	0.027	3675	4313	0.031	0.001	0.002
218	HPT	Heptane (n-)	1	0.68	2.5	3.45	0.105	1.0500	0.027	3675	4313	0.031	0.001	0.002
220	HTX	Heptanol (all isomers)	1	0.82	0.04	4	0.077	1.0008	0.018	3503	3515	0.021	0.001	0.001
221	HTN	Heptanol (all isomers)	1	0.82	0.04	4	0.077	1.0008	0.018	3503	3515	0.021	0.001	0.001
222	HPX	Heptene (all isomers)	2	0.7	2.9	3.4	0.109	1.0580	0.028	3703	4426	0.033	0.001	0.002
223	THE	Heptene (1-)	1	0.7	2.8	3.4	0.107	1.0560	0.028	3696	4395	0.032	0.001	0.002
229	HXS	Hexane (all isomers)	1	0.66	7	3	0.142	1.1400	0.043	3990	5446	0.050	0.002	0.003
230	HXA	Hexane	1	0.66	7	3	0.142	1.1400	0.043	3990	5446	0.050	0.002	0.003
231	HXO	Hexanoic Acid	1	0.93	0.01	4	0.076	1.0002	0.018	3501	3503	0.021	0.001	0.001
232	HXN	Hexanol	1	0.82	1	3.52	0.088	1.0200	0.021	3570	3837	0.025	0.001	0.001
234	HEX	Hexene (all isomers)	2	0.67	8	2.9	0.147	1.1600	0.046	4060	5651	0.053	0.002	0.003
235	HXE	Hexene (1-)	1	0.67	8.2	2.9	0.149	1.1640	0.047	4074	5705	0.054	0.002	0.003
236	HXT	Hexene (2-)	1	0.67	8.2	2.9	0.149	1.1640	0.047	4074	5705	0.054	0.002	0.003
238	HXG	Hexylene Glycol	4	0.92	0.01	1.1	0.076	1.0002	0.018	3501	3500	0.020	0.001	0.001
243	IPH	Isophorone	1	0.93	0.01	4.75	0.076	1.0002	0.018	3501	3504	0.021	0.001	0.001
244	JPO	Jet Fuels: JP-1 (Kerosene)	1	0.8	0.14	4.5	0.078	1.0028	0.018	3510	3561	0.021	0.001	0.001
245	JPT	Jet Fuels: JP-3	1	0.8	8.51	4.5	0.216	1.1702	0.069	4096	6899	0.080	0.004	0.004
246	JPF	Jet Fuels: JP-4	1	0.81	3.4	4	0.124	1.0680	0.033	3738	4770	0.038	0.002	0.002
247	JPV	Jet Fuels: JP-5 (Kerosene, heavy)	1	0.82	0.1	4	0.077	1.0020	0.018	3507	3538	0.021	0.001	0.001
249	KRS	Kerosene	1	0.81	0.15	4.5	0.078	1.0030	0.018	3511	3566	0.021	0.001	0.001
263	MTT	Methyl Acetate	1	0.92	6.1	2.6	0.122	1.1220	0.036	3927	4970	0.041	0.002	0.002
265	MAL	Methyl Alcohol (See Methanol)	1	0.79	6.63	1.1	0.079	1.1326	0.024	3964	4043	0.027	0.001	0.001
266	MAC	Methyl Amyl Acetate	1	0.86	0.33	4.97	0.082	1.0066	0.019	3523	3662	0.022	0.001	0.001
267	MAA	Methyl Amyl Alcohol	1	0.81	0.43	3.52	0.081	1.0086	0.019	3530	3645	0.022	0.001	0.001
271	MBK	Methyl n-Butyl Ketone	1	0.81	0.97	3.5	0.087	1.0194	0.021	3568	3825	0.024	0.001	0.001
273	MBU	Methyl Butyrate	1	0.9	1.26	3.53	0.091	1.0252	0.022	3588	3924	0.026	0.001	0.001
274	MEK	Methyl Ethyl Ketone	1	0.8	4.5	2.5	0.108	1.0900	0.030	3815	4539	0.034	0.002	0.002
275	MTF	Methyl Formal (Dimethyl Formal)	1	0.86	15.42	2.6	0.192	1.3084	0.076	4579	7272	0.088	0.004	0.005
276	MHK	Methyl Heptyl Ketone	1	0.83	0.06	4.9	0.077	1.0012	0.018	3504	3528	0.021	0.001	0.001
278	MIK	Methyl Isobutyl Ketone	1	0.8	1.15	3.45	0.089	1.0230	0.022	3581	3878	0.025	0.001	0.001
281	MNA	1-Methyl Naphthalene	1	1.02	0.01	4.91	0.076	1.0002	0.018	3501	3504	0.021	0.001	0.001
283	MPN	2-Methyl-1-Pentene	1	0.69	6.3	2.9	0.132	1.1260	0.039	3941	5195	0.045	0.002	0.002
284	MTN	5-Methyl-1-Pentene	1	0.67	8.49	2.9	0.152	1.1698	0.048	4094	5782	0.056	0.003	0.003
286	MBE	Methyl Tert-Butyl Ether (MTBE)	1	0.74	0.04	3.1	0.076	1.0008	0.018	3503	3511	0.021	0.001	0.001
288	MNS	Mineral Spirits	1	0.75	0.2	4.3	0.079	1.0040	0.019	3514	3584	0.021	0.001	0.001
289	MRE	Myrcene	1	0.8	0.17	4.7	0.079	1.0034	0.019	3512	3578	0.021	0.001	0.001
295	NSV	Naphtha: Solvent	1	0.87	0.2	3.5	0.078	1.0040	0.018	3514	3567	0.021	0.001	0.001
296	NSS	Naphtha: Stoddard Solvant	1	0.78	0.2	4.3	0.079	1.0040	0.019	3514	3584	0.021	0.001	0.001
297	NVM	Naphtha: Varnish Maker's and Painters (75%)	1	0.77	0.19	4.3	0.079	1.0038	0.019	3513	3580	0.021	0.001	0.001
300	NAX	Nonane (all isomers)	1	0.72	0.27	4.4	0.080	1.0054	0.019	3519	3616	0.022	0.001	0.001
301	NAN	Nonane	1	0.72	0.27	4.4	0.080	1.0054	0.019	3519	3616	0.022	0.001	0.001
304	NON	Nonene	1	0.73	0.35	4.3	0.081	1.0070	0.019	3525	3647	0.022	0.001	0.001
305	NNS	Nonyl Alcohol (all isomers)	1	0.94	0.1	5	0.078	1.0020	0.018	3507	3549	0.021	0.001	0.001
306	NNN	Nonyl Alcohol	1	0.94	0.1	5	0.078	1.0020	0.018	3507	3549	0.021	0.001	0.001
307	NNI	Nonyl Alcohol (iso-)	1	0.94	0.1	5	0.078	1.0020	0.018	3507	3549	0.021	0.001	0.001
309	NNP	Nonyl Phenol	1	0.95	0.01	7.6	0.076	1.0002	0.018	3501	3507	0.021	0.001	0.001
316	OAX	Octane (all isomers)	1	0.7	0.79	3.9	0.087	1.0158	0.021	3555	3797	0.024	0.001	0.001
317	OAN	Octane	1	0.7	0.79	3.9	0.087	1.0158	0.021	3555	3797	0.024	0.001	0.001
320	OTA	Octanol	1	0.83	0.01	4.48	0.076	1.0002	0.018	3501	3503	0.021	0.001	0.001
322	OTE	Octene (1-)	1	0.72	1	3.86	0.089	1.0200	0.022	3570	3871	0.025	0.001	0.001
324	OCX	Octyl Alcohol (iso-, n-) (all isomers), See Octanol (1	0.83	0.01	4.48	0.076	1.0002	0.018	3501	3503	0.021	0.001	0.001
325	IOA	Octyl Alcohol	1	0.83	0.01	4.48	0.076	1.0002	0.018	3501	3503	0.021	0.001	0.001
364	OTW	Fuel: No. 2	1	0.88	0.56	8	0.094	1.0112	0.022	3539	3943	0.026	0.001	0.001
366	OFR	Fuel: No. 4	1	0.9	0.15	3.4	0.078	1.0030	0.018	3511	3548	0.021	0.001	0.001
367	OFV	Fuel: No. 5	1	0.94	0.15	3.4	0.078	1.0030	0.018	3511	3548	0.021	0.001	0.001
368	OSX	Fuel: No. 6	1	0.95	0.15	3.4	0.078	1.0030	0.018	3511	3548	0.021	0.001	0.001
382	OIL	OIL, Misc: Crude	1	0.95	0.15	3.4	0.078	1.0030	0.018	3511	3548	0.021	0.001	0.001

383 ODS	OIL, Misc: Diesel	1	0.9	0.69	3.4	0.084	1.0138	0.020	3548	3724	0.023	0.001	0.001
389 OLB	OIL, Misc: Lubricating	1	0.9	0.15	1	0.076	1.0030	0.018	3511	3510	0.021	0.001	0.001
403 ORS	OIL, Misc: Resin	1	1.02	0.15	1	0.076	1.0030	0.018	3511	3510	0.021	0.001	0.001
418 OTB	OIL, Misc: Turbine	1	0.87	0.3	5.4	0.082	1.0060	0.019	3521	3661	0.022	0.001	0.001
429 PDC	Pentadecanol, See Alcohols (C13 and above)	1	0.83	0.01	7.88	0.076	1.0002	0.018	3501	3507	0.021	0.001	0.001
433 IPT	Pentane (iso-)	5	0.62	27	2.48	0.346	1.5400	0.191	5390	11501	0.221	0.010	0.012
434 PTA	Pentane (n-)	5	0.63	20.44	2.5	0.264	1.4088	0.122	4931	9191	0.141	0.006	0.007
437 PTE	Pentene (1-)	5	0.64	24.9	2.4	0.309	1.4980	0.162	5243	10568	0.187	0.008	0.010
442 PIN	Pinene	1	0.86	0.35	4.7	0.082	1.0070	0.019	3525	3662	0.022	0.001	0.001
448 PLB	Polybutene	1	0.91	0.01	79.3	0.080	1.0002	0.019	3501	3583	0.021	0.001	0.001
457 PGC	Polypropylene Glycol	1	1.01	0.1	1	0.076	1.0020	0.018	3507	3506	0.021	0.001	0.001
464 IAC	Propyl Acetate (iso-)	1	0.89	1.8	3.52	0.097	1.0360	0.024	3626	4101	0.028	0.001	0.001
465 PAT	Propyl Acetate (n-)	1	0	1.85	3.52	0.098	1.0370	0.025	3630	4118	0.028	0.001	0.001
466 IPA	Propyl Alcohol (iso-)	1	0.79	3	2.07	0.091	1.0600	0.024	3710	4060	0.028	0.001	0.001
467 PAL	Propyl Alcohol (n-)	1	0.8	1.2	2.07	0.082	1.0240	0.020	3584	3722	0.023	0.001	0.001
468 PBZ	Propylbenzene (n-)	1	0.86	0.2	4.14	0.079	1.0040	0.019	3514	3580	0.021	0.001	0.001
469 IPX	Iso-Propylcyclohexane	1	0.8	0.01	4.35	0.076	1.0002	0.018	3501	3503	0.021	0.001	0.001
473 PPG	Propylene Glycol (1,2-Propandiol)	1	1.04	0.01	2.62	0.076	1.0002	0.018	3501	3501	0.020	0.001	0.001
476 PME	Propylene Glycol Methyl Ether	1	0.92	0.7	3.11	0.083	1.0140	0.020	3549	3706	0.023	0.001	0.001
488 SFL	Sulfolane	1	1.26	0.01	4.14	0.076	1.0002	0.018	3503	3503	0.021	0.001	0.001
493 TTN	Tetradecanol	1	0.82	0	7.39	0.076	1.0000	0.018	3500	3499	0.020	0.001	0.001
494 TTD	1-Tetradecene, See the olefin or Alpha-Olefin Entry	1	0.77	0.01	6.77	0.076	1.0002	0.018	3501	3506	0.021	0.001	0.001
496 TTG	Tetraethylene Glycol	1	1.12	0.01	6.7	0.076	1.0002	0.018	3501	3506	0.021	0.001	0.001
497 THN	Tetrahydronaphthalene	1	0.97	0.04	4.56	0.077	1.0008	0.018	3503	3517	0.021	0.001	0.001
499 TOL	Toluene	1	0.87	1.5	3.14	0.091	1.0300	0.023	3605	3945	0.026	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	0.018	3501	3512	0.021	0.001	0.001
503 TRD	Tridecane	1	0.76	0.02	6.4	0.076	1.0004	0.018	3501	3512	0.021	0.001	0.001
505 TDN	Tridecanol, See Alcohols (C13 and above)	1	0.85	0.01	6.91	0.076	1.0002	0.018	3501	3506	0.021	0.001	0.001
506 TDC	1-Tridecane	1	0.77	0.01	6.29	0.076	1.0002	0.018	3501	3505	0.021	0.001	0.001
508 TEB	Triethylbenzene	1	0.86	0.02	5.6	0.076	1.0004	0.018	3501	3510	0.021	0.001	0.001
509 TEG	Triethylene Glycol	1	1.12	0.01	5.17	0.076	1.0002	0.018	3501	3504	0.021	0.001	0.001
519 TRE	Trimethylbenzenes (all isomers)	1	0.89	0.14	4.2	0.078	1.0028	0.018	3510	3557	0.021	0.001	0.001
520 TMB	Trimethyl Benzene (1,2,5-)	1	0.89	0.14	4.14	0.078	1.0028	0.018	3510	3556	0.021	0.001	0.001
521 TMD	Trimethyl Benzene (1,2,3-)	1	0.89	0.14	4.14	0.078	1.0028	0.018	3510	3556	0.021	0.001	0.001
522 TME	Trimethyl Benzene (1,2,4-) (Pseudocumene)	1	0.89	0.14	4.14	0.078	1.0028	0.018	3510	3556	0.021	0.001	0.001
529 TRP	Trixylenyl Phosphate	1	1.16	0	14.2	0.076	1.0000	0.018	3500	3499	0.020	0.001	0.001
546 XLX	Xylenes (Ortho-, meta-, para-)	1	0.89	0.51	3.66	0.082	1.0102	0.020	3536	3680	0.023	0.001	0.001
547 XLM	Xylene (M-)	1	0.87	0.51	3.66	0.082	1.0102	0.020	3536	3680	0.023	0.001	0.001
548 XLO	Xylene (O-)	1	0.89	0.4	3.66	0.081	1.0080	0.019	3528	3641	0.022	0.001	0.001
549 XLP	Xylene (P-)	1	0.86	0.51	3.66	0.082	1.0102	0.020	3536	3680	0.023	0.001	0.001
550 XYL	Xylenol	1	1.01	0.1	3.66	0.077	1.0020	0.018	3507	3535	0.021	0.001	0.001
551	Zinc Dialkylidithiophosphate												
	Max.		1.260	27.000	79.300	0.346	1.540	0.191	5390	11501	0.221	0.010	0.012
	Min.		0.000	0.000	1.000	0.000	1.000	0.018	3500	3499	0.020	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)

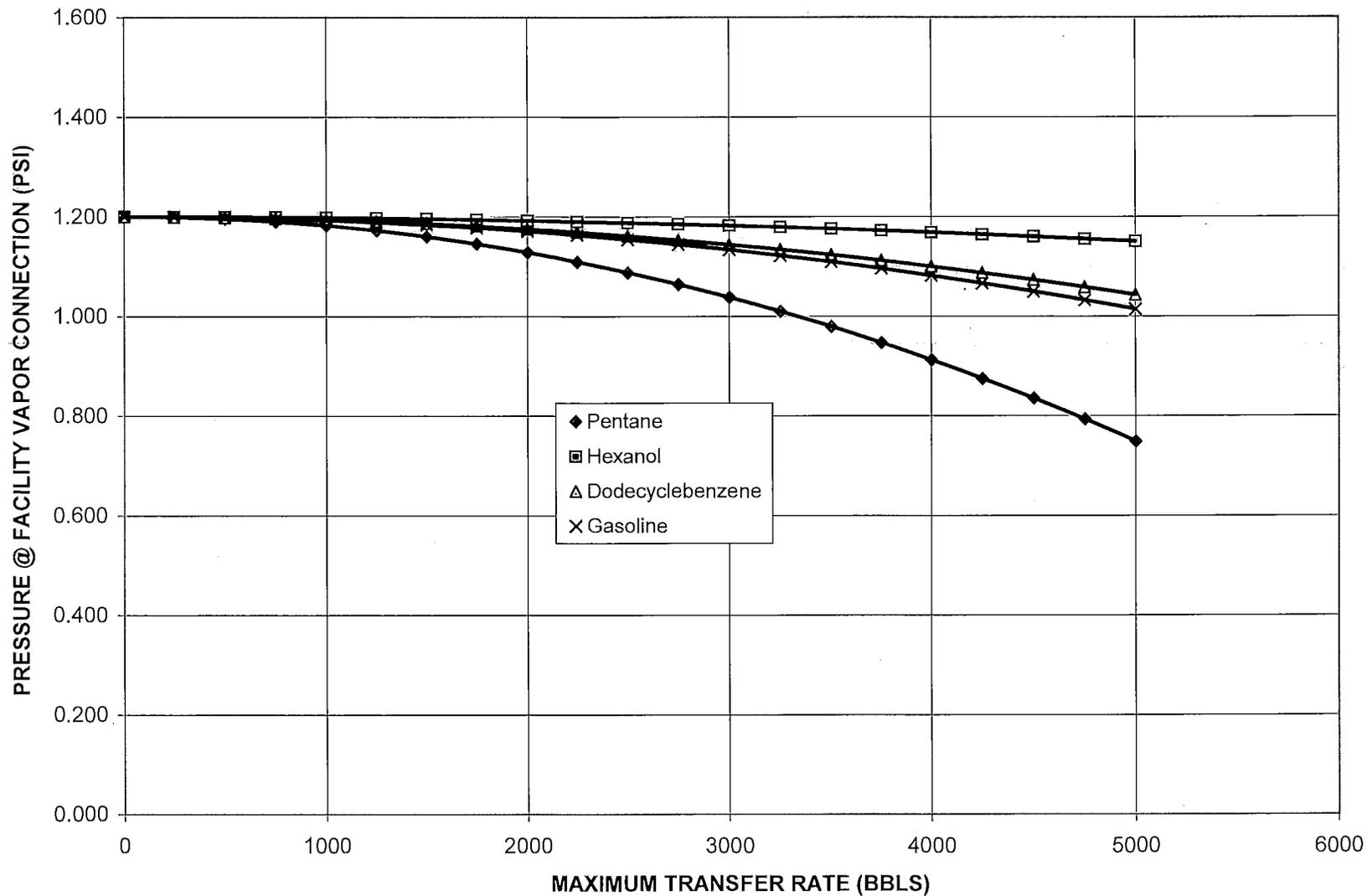
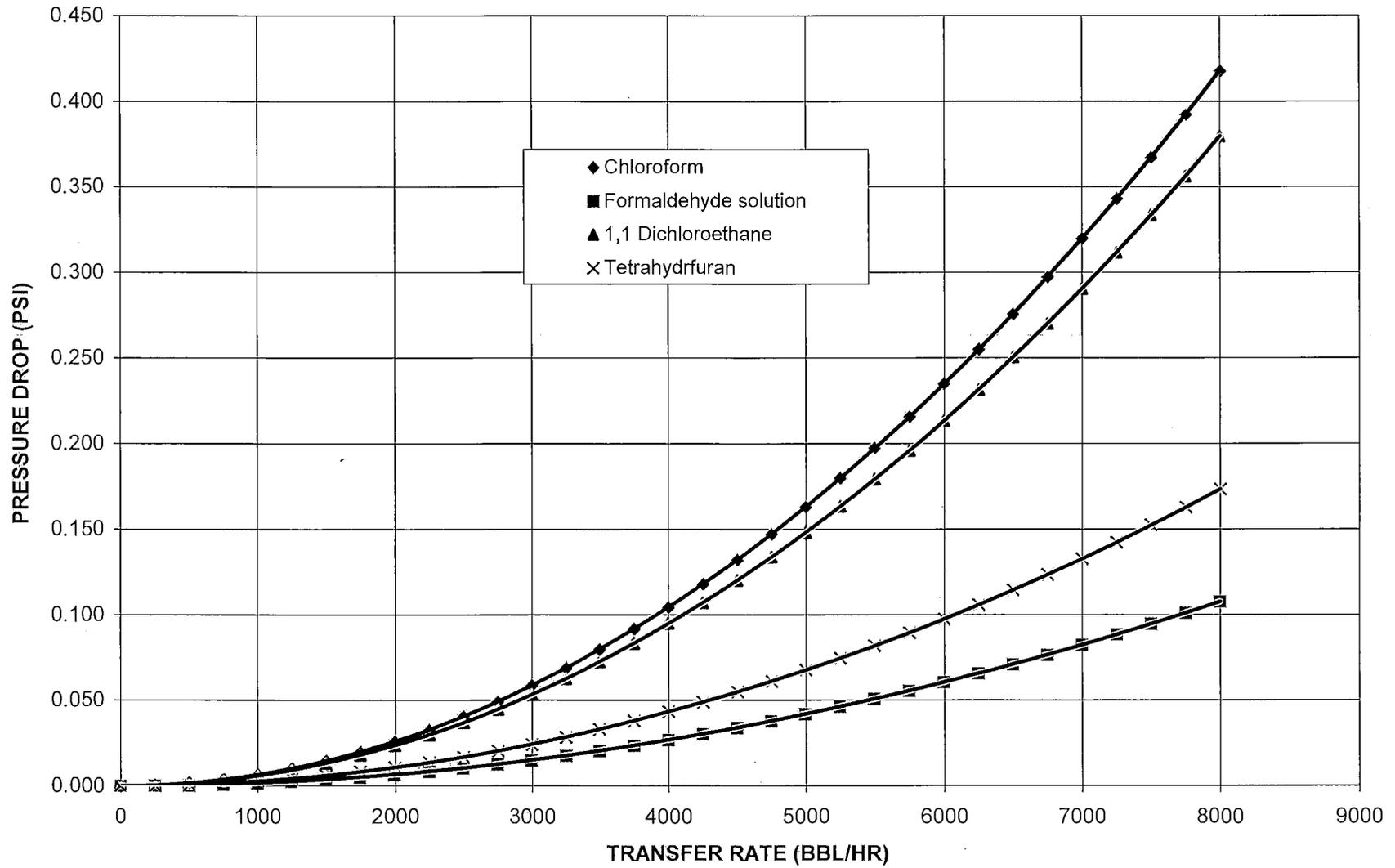


TABLE 4 (SUBCHAPTER "O" CARGOES)

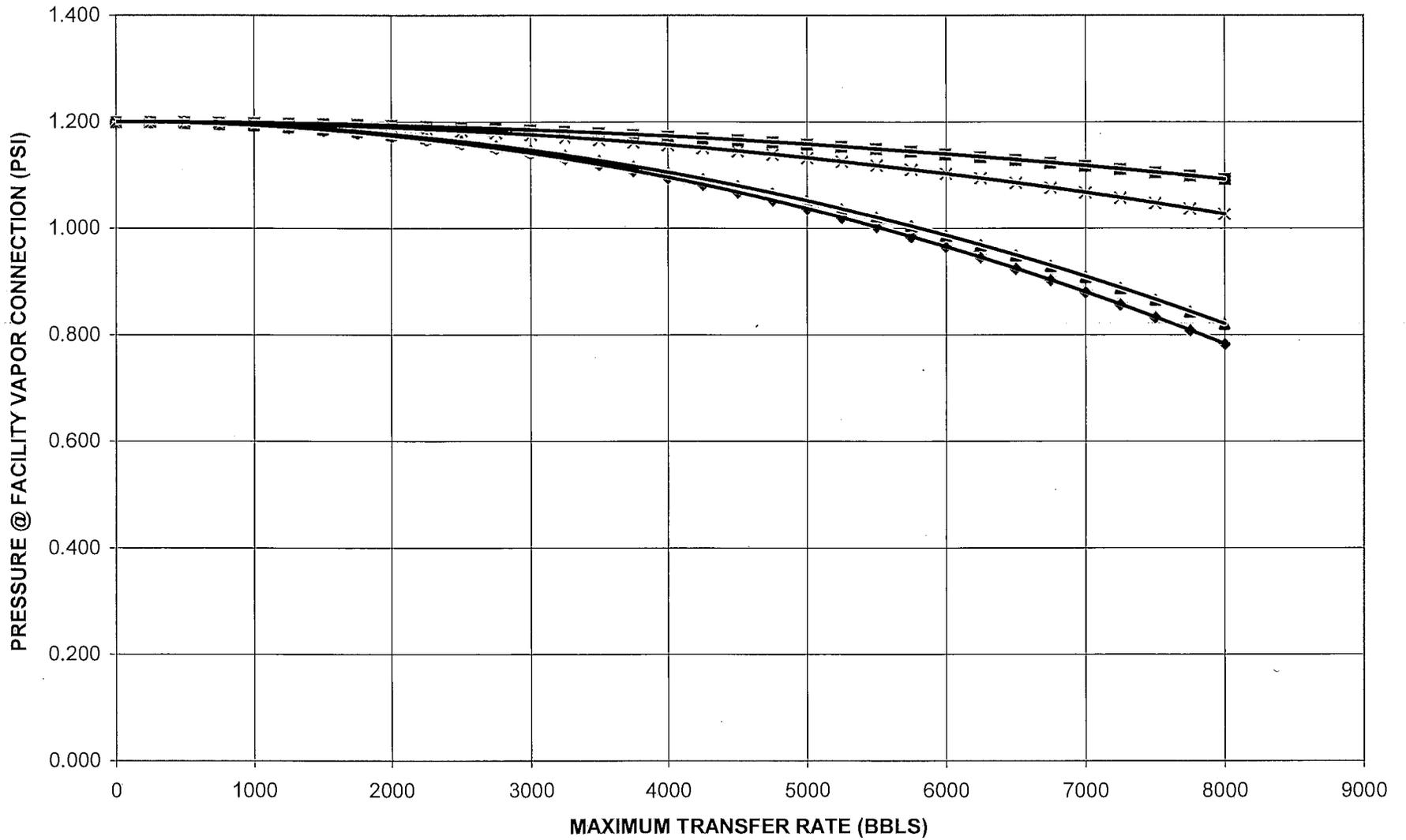
CHRIS CODE	NAME	VCS CAT	LIQ SG	VAPOR PRESS	VAPOR SG	VAPOR WEIGHT DENSITY	VAPOR GROWTH RATE	PRESSURE DROP TO PV VALVE IN VCS(psig) (LOADING)	VAPOR VOLUMETRIC FLOW RATE (bbl/h)	AIR EQUIVALENT VOLUMETRIC FLOW RATE	PRESSURE DROP TO SHORE CONNECTION IN VCS (psig) (LOADING)*	PRESSURE DROP TO PV VALVE IN VCS(psig) (UNLOADING)	PRESSURE DROP TO SHORE CONNECTION IN VCS (psig) (UNLOADING)*
1 ACN	Acrylonitrile	4	0.81	5.00	1.80	0.095	1.1000	0.027	3850	4298	0.031	0.001	0.002
2 ADN	Adiponitrile	1	0.95	0.01	3.73	0.076	1.0002	0.018	3501	3503	0.021	0.001	0.001
3 ATN	Acetonitrile	3	0.78	0.03	1.41	0.076	1.0006	0.018	3502	3502	0.021	0.001	0.001
4 BAD	Iso-Butyraldehyde	1	0.80	7.80	2.50	0.131	1.1580	0.041	4046	5308	0.047	0.002	0.002
5 BAR	Butyl acrylate (iso-, n-)	2	0.90	0.60	4.42	0.086	1.0120	0.020	3542	3759	0.024	0.001	0.001
6 BMH	Butyl Methacrylate	2	0.88	0.29	4.9	0.081	1.0058	0.019	3520	3640	0.022	0.001	0.001
7 BNZ	Benzene	1	0.88	4.50	2.80	0.114	1.0900	0.032	3815	4671	0.036	0.002	0.002
8 BTR	n-Butyraldehyde	1	0.80	7.80	2.50	0.131	1.1560	0.041	4046	5308	0.047	0.002	0.002
9 BTX	Benzene, Toluene, Xylene mixtures (10% Benzene or more)	1	0.84	7.30	2.80	0.138	1.1460	0.042	4011	5396	0.049	0.002	0.003
10 CCH	Cyclohexanone	1	0.95	0.20	3.40	0.078	1.0040	0.018	3514	3565	0.021	0.001	0.001
11 CHA	Cyclohexylamine	1	0.87	0.62	3.42	0.083	1.0124	0.020	3543	3703	0.023	0.001	0.001
12 CRB	Chlorobenzene	1	1.11	0.80	3.88	0.087	1.0160	0.021	3556	3799	0.024	0.001	0.001
13 CRF	Chloroform	3	1.48	9	4.25	0.213	1.1800	0.069	4130	6916	0.080	0.004	0.004
14 NCT	Coal Tar Naphtha Solvent	1	0.86	0.2	4	0.079	1.0040	0.019	3514	3577	0.021	0.001	0.001
15 CRS	Cresols	1	1.05	0.06	3.72	0.077	1.0012	0.018	3504	3521	0.021	0.001	0.001
16 CTA	Crotonaldehyde	4	0.85	2	2.41	0.089	1.0400	0.022	3640	3943	0.026	0.001	0.001
17 DCH	1,1-Dichloroethane	1	1.18	9.90	3.41	0.188	1.1980	0.063	4193	6592	0.073	0.003	0.004
18 DPP	1,2-Dichloropropane	3	1.16	2.5	3.89	0.110	1.0500	0.028	3675	4418	0.033	0.001	0.002
19 DPU	1,3-Dichloropropane	4	1.23	5.5	3.84	0.149	1.1100	0.043	3885	5443	0.050	0.002	0.003
20 DEN	Diethylamine	3	0.71	1.00	2.50	0.083	1.0200	0.020	3570	3731	0.023	0.001	0.001
21 DIP	Diisopropanolamine	1	0.98	0.01	4.59	0.076	1.0002	0.018	3501	3504	0.021	0.001	0.001
22 DMF	Dimethylformamide	1	0.95	0.30	2.51	0.078	1.0060	0.018	3521	3569	0.021	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	0.048	3941	5747	0.055	0.002	0.003
24 EAC	Ethyl acrylate	2	0.93	2.00	3.50	0.099	1.0400	0.025	3640	4163	0.029	0.001	0.002
25 EAI	2-Ethylhexyl acrylate	2	0.89	0.02	6.35	0.076	1.0004	0.018	3501	3512	0.021	0.001	0.001
26 EDC	Ethylene dichloride	1	1.26	4.00	3.42	0.121	1.0800	0.033	3780	4776	0.038	0.002	0.002
27 ETM	Ethyl Methacrylate	2	0.92	1	3.94	0.090	1.0200	0.022	3570	3879	0.025	0.001	0.001
28 EPA	2-Ethyl-3-propylacrolein	1	0.85	0.12	4.5	0.078	1.0024	0.018	3508	3553	0.021	0.001	0.001
29 FFA	Furfural	1	1.20	0.15	3.31	0.078	1.0030	0.018	3511	3547	0.021	0.001	0.001
30 FMS	Formaldehyde solution (37% to 50%)	1	1.13	0.15	1.03	0.076	1.0030	0.018	3511	3510	0.021	0.001	0.001
31 MSO	Mesityl Oxide	1	0.86	0.67	3.5	0.084	1.0134	0.020	3547	3725	0.023	0.001	0.001
32 MAM	Methyl acrylate	2	0.95	4.10	3.00	0.114	1.0820	0.031	3787	4646	0.036	0.002	0.002
33 MBE	Methylcyclopentadiene dimer	1	0.74	0.04	3.10	0.076	1.0008	0.018	3503	3511	0.021	0.001	0.001
34 MMM	Methyl methacrylate	2	0.94	2.02	3.45	0.099	1.0404	0.025	3641	4159	0.029	0.001	0.002
35 MPL	Morpholine	1	1.00	0.80	3.00	0.083	1.0160	0.020	3556	3726	0.023	0.001	0.001
36 NPM	1- or 2-Nitropropane	1	0.99	1.05	3.06	0.086	1.0210	0.021	3574	3804	0.024	0.001	0.001
37 PRD	Pyridine	1	0.98	1.30	2.72	0.086	1.0260	0.021	3591	3830	0.025	0.001	0.001
38 STY	Styrene	2	0.92	0.40	3.60	0.081	1.0080	0.019	3528	3638	0.022	0.001	0.001
39 TCN	1,2,3-Trichloropropane	3	1.39	0.15	5.60	0.079	1.0030	0.019	3511	3583	0.021	0.001	0.001
40 TEN	Triethylamine	3	0.73	2.50	3.49	0.105	1.0500	0.027	3675	4323	0.031	0.001	0.002
41 THF	Tetrahydrofuran	1	0.89	8.50	1.35	0.090	1.1700	0.029	4095	4454	0.033	0.001	0.002
42 VAM	Vinyl acetate	2	0.94	5.80	2.97	0.130	1.1160	0.038	3906	5099	0.043	0.002	0.002
		Max.	1.39	12.5	8.40	0.213	1.198	0.069	4193	6916	0.080	0.004	0.004
		Min.	0.63	0.01	1.03	0.076	1.000	0.018	3501	3502	0.021	0.001	0.001

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

LIQUID TRANSFER RATE vs PRESSURE DROP



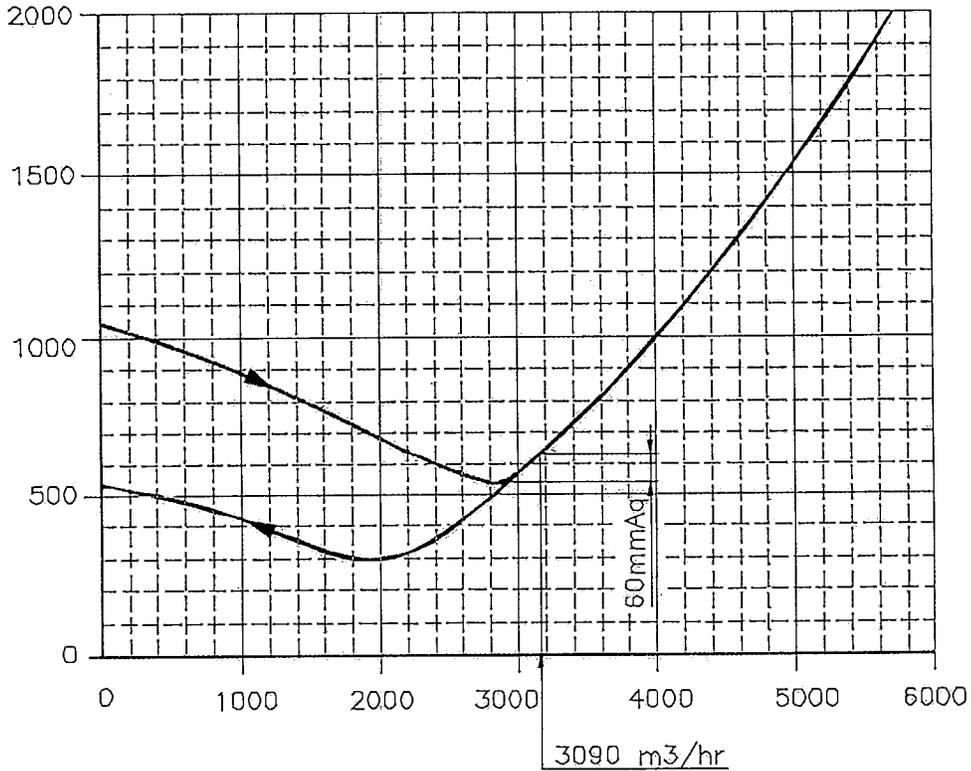
PRESSURE vs MAXIMUM TRANSFER RATE (FOR SUB-CHAPTER "O" CARGOES)



HIGH VELOCITY VENT VALVE FLOW CAPACITY CURVE

MODEL : KSPA-6
 SIZE : 6"(150A)
 SETTING PRESSURE : 1050mmAq

VALVE INLET PRESSURE, mmAq
 (1mmAq = 0.0014286PSI)

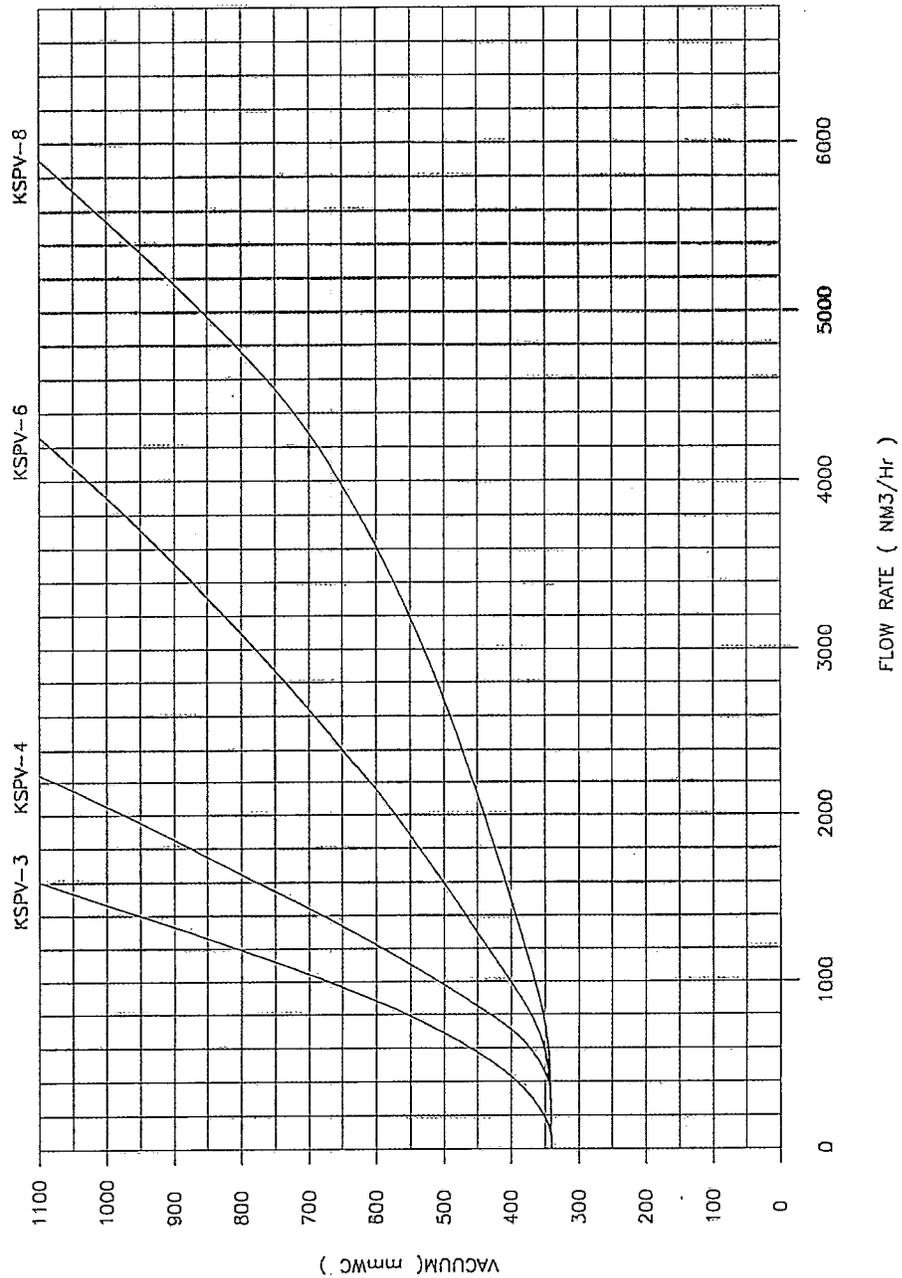


FLOW CAPACITY CURVE, SCM(H Standard cubic meter per hour)
 (1SCMH = 6.289BBL/hr)

APPLICABLE STANDARD	TEST CONDITION	SHEET NO. 1/1
IMO MSC/Circ.677 API Standard 2000	FLOW TEST PERFORMED ON EQUIPMENT USING AIR, AT TEMP.T=15.6°C AND AMBIENT PRESSURE P=1.0332Kg/cm ²	

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

12



Marine Safety Center Form for Tank Vessels Installing a Vapor Control System



1. Vessel Name	CBC 1400 THRU CBC 1409	Shipyard	SOUTHWEST
Official Number	NOT YET ASSIGNED	Hull #	9780 THRU 9789.

2. **Purpose:** This form consolidates the information required for VCS approval. Entering the requested information will expedite your approval and significantly decrease the probability the MSC will return the submission for revision.

3. **Tank Design:**

Raised Trunk Maximum Design Working Pressure: 3.5 psig

Flush Deck Existing Raised Trunk Barges need MSC approval letter serial number and date which approved its MDWP

4. Requested Maximum Cargo Transfer Rates

<u>3500</u>	bbl/hr loading
<u>800</u>	bbl/hr discharging

5. Requested Maximum Cargo-Air Mixture Vapor Density:

List the requested cargoes with the (a) highest vapor density and (b) highest pressure drop. They are not always the same cargo.

a. Cargo Name	<u>PENTANE</u>	<u>0.346</u>	lbm/ft ³
b. Cargo Name	<u>PENTANE</u>	<u>0.346</u>	lbm/ft ³

6. VCS Categories Requested (list): 1 THRU 5

7. Pressure Drop for the cargo(es) from Section 5 for the following scenarios:

	Cargo A psi	Cargo B psi
a. Most Remote Cargo Tank to P/V valve	<u>0.191</u>	<u>0.191</u>
b. Most Remote Cargo Tank to VCS Facility Connection	<u>0.221</u>	<u>0.221</u>
c. ΔP across P/V valve @ cargoes' Maximum Transfer Rate	<u>1.5</u>	<u>1.5</u>
d. ΔP across Vacuum P/V @ MTR or Max. Discharge Rate	<u>0.5</u>	
e. ΔP across Spill Valve for Max. Density Cargo at MTR	<u>—</u>	

8. Pressure Vacuum Valve:

Manufacturer <u>BERGAN</u>	Settings in psig:
Model/Size <u>KLPH-6</u>	Pressure-side <u>1.5</u>
CG Approval Number <u>162.019/144/3</u>	Vacuum-side <u>0.5</u>

Include the Manufacturer's ΔP versus Flow for both parts of P/V & Spill Valve:

9. VCS Pipe Sizes:

Longitudinal Header 7.981 Inches Transverse Headers 7.981 Inches

10. Closed Gauging

Check the box to signify the vessel will have closed gauging meeting 46 CFR 151.151-10(c). MSC Electrical Branch and the OCMI will verify the closed gauging meets these requirements.

11. Tank Overfill Protection System (check appropriate box or boxes and list make/model)

a. High Level/Tank Overfill Alarm	<input checked="" type="checkbox"/>	<u>BERGAN</u>	Setting in psig
b. Overfill Control Shutdown	<input checked="" type="checkbox"/>	<u>BERGAN</u>	
c. Spill Valve	<input type="checkbox"/>		Meets ASTM F1271 <input type="checkbox"/>
d. Rupture Disk	<input type="checkbox"/>		

If applicable, Calculations demonstrate compliance with 39.20-9(b)(2).

12. Submittal Includes a Graph or Table showing the ΔP through the VCS piping from the most remote cargo tank to the facility connection as a function of liquid transfer rate for both cargoes in Section 5.

13. Submittal Includes a Graph or Table showing the Facility Pressure @ the vessel's vapor connect versus allowable transfer rate. This graph demonstrates the barge can satisfy 46 CFR 39.30-1(d)(3). See MSC "Guidelines" at www.msc.uscg/hq/msc for an example.

14. Previous VCS approval letters:

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Plan Review Information Sheet (PRIS) for Unmanned Inland Tank Barge

1. Vessel Identification	Hull Type	Service	ABS classified?
CBC 1400, O.N. 1284532, Southwest Shipyard Hull No. 9780	I/II/III	O/D	No
CBC 1401, O.N. 1284533, Southwest Shipyard Hull No. 9781	I/II/III	O/D	No
CBC 1402, O.N. 1284530, Southwest Shipyard Hull No. 9782	I/II/III	O/D	No
CBC 1403, O.N. 1284534, Southwest Shipyard Hull No. 9783	I/II/III	O/D	No
CBC 1404, O.N. 1284535, Southwest Shipyard Hull No. 9784	I/II/III	O/D	No
CBC 1405, O.N. 1284531, Southwest Shipyard Hull No. 9785	I/II/III	O/D	No
CBC 1406, O.N. 1284536, Southwest Shipyard Hull No. 9786	I/II/III	O/D	No
CBC 1407, O.N. 1284537, Southwest Shipyard Hull No. 9787	I/II/III	O/D	No
CBC 1408, O.N. 1284538, Southwest Shipyard Hull No. 9788	I/II/III	O/D	No
CBC 1409, O.N. 1284539, Southwest Shipyard Hull No. 9789	I/II/III	O/D	No

2. Route Permitted - Routes and Conditions

R Rivers
LBS Lakes, Bays, and Sounds

3. Cargo Authority - "Authorization" Tab in "Cargo" Window

Authorization:

46 CFR Sub. D Authority:	Highest Grade	A	Capacity (bbls)	11,689		
46 CFR Sub. O Authority:	Part 151	Yes	Part 153	No	Part 154	No
33 CFR Sub. O Authority:	Part 151.47	No	Part 151.49a	No	Part 151.49b	No

4. "Conditions of Carriage" Tab in "Cargo" Window

a. The following statement should appear at the beginning of the COI's "Conditions of Carriage" section:

Only those cargoes named in the vessel's Cargo Authority Attachment may be carried, and then only in the tanks indicated. 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.

Per 46 CFR 150.130, the Person In Charge of the vessel is responsible for ensuring that the compatibility requirements of 46 CFR 150 are met. Cargoes must be checked for compatibility using the figures, tables, and appendices of 46 CFR 150 in conjunction with the reactive group numbers from the "Compat Group No" column listed in the vessel's Cargo Authority Attachment.

b. The maximum design density of cargo which may be filled to the tank top is 9.16 lbs/gal. Cargoes with higher densities, up to 13.33 lbs/gal, may be carried as slack loads, but shall not exceed the tank weight limits as listed below.

Note: Per 46 CFR 151.10-15(c)(2) the max. tank weights listed below reflect uniform (within 5%) loading at the deepest draft allowed. When carrying Subchapter O cargoes at shallower drafts, the barge(s) should always be loaded uniformly.

5. Loading Constraints

<u>Loading Constraints - Structural</u>			<u>Loading Constraints - Stability</u>				
Tank	Max Cargo		Hull Type	Route	Max. Load (ST)	Max Draft (ft, in)	Max Density (lbs/gal)
	Wgt/Each Tank (ST)	Max Density (lbs/gal)					
1C	579	13.33	I	R	1580	9'-0"	13.33
2C	730	13.33	II	R	1689	9'-6"	12.49
3C	657	13.33	III	R	1799	10'-0"	11.66
			III	R	1871	10'-4"	9.16
			I	LBS	1580	9'-0"	12.41
			II	LBS	1689	9'-6"	10.99