

MARINE SOLUTIONS, INC.

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E-mail

MSI/161201/S05

April 17, 2017

Commanding Officer (MSC)
Attn: Chief-Tank Vessel & Offshore Branch
United States Coast Guard, STOP 7430
2703 Martin Luther King Jr. Ave., SE
Washington, DC 20593.

Sub: 200'-0" x 35' x 12'-0" Double Skin Tank Barges (D/O) (Type I Hull)
Barge Name(s): "CBC 1390 thru CBC 1399"
Southwest Shipyard Hulls: 9768 thru 9777
Plan Submittal

Encl.: 1. Dwg. No. 161201VP-1, SH 1 of 2, Rev 1 "Vapor Piping"
2. Dwg. No. 161201VP-1, SH 2 of 2, Rev 1 "Vapor Piping"
3. Revised Vapor Recovery Calculations
4. VCS Form

Ref: 1. USCG Project P020756
2. MSC letter # C1-1700672 dated February 28, 2017

Dear Commanding Officer:

Your office with reference 2 approved the previous version of subject enclosures.

We have relocated the PV valve close to vent stack and revised the drawings and calculations.

With this letter, we request you to kindly review the enclosures and advise us of your approval with or without comments.

Please do not hesitate to call at 615-364-9598 if you have question.

Thank you,

Chetan Kumaria, PE, MBA

VAPOR COLLECTION SYSTEM CALCULATIONS

FOR

BARGE NAME(s): "CBC 1390" thru "CBC 1399"

**SOUTHWEST SHIPYARD HULL(s): 9768 thru 9777
(MSC PROJECT No. P020756)**

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

CANAL BARGE COMPANY, INC.

**January 29, 2017
Rev. April 17, 2017**

Prepared by:

A handwritten signature in black ink, appearing to read 'Kumaria', with a long horizontal stroke extending to the left.

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

MARINE SOLUTIONS, INC.

Rev. 1 dated April 17, 2017

VCS SYSTEM INFORMATION:

1. GENERAL DESCRIPTION OF VESSEL:

A. NAME (S): CBC 1390 THRU CBC 1399
B. USCG PROJECT NUMBER: P020756
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: 1.5 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'-11 15/16" B-1'-5 7/8" C-44'-11 11/32" D-8'-3 61/64" E-42'-3 43/64"
F- 4'-10 19/32" G-2'-7 3/16" H-43'-11 11/32" I-2'-4 9/16"
J-4'-1 1/4" K-8'-3 7/8"
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 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 highest 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. LENGTH (FT)	TOTAL EQ. LENGTH (FT)
Straight Pipe	1	106.55	106.55
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		422.92

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 (1.695 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 0.511 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 0.511 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 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	161.185	161.185
Entrance	1	37.05	37.05
T Branch	4	39.91	159.64
T Run	6	13.33	79.98
8" Gate Valve	1	5.32	5.32
Total			443.175

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)

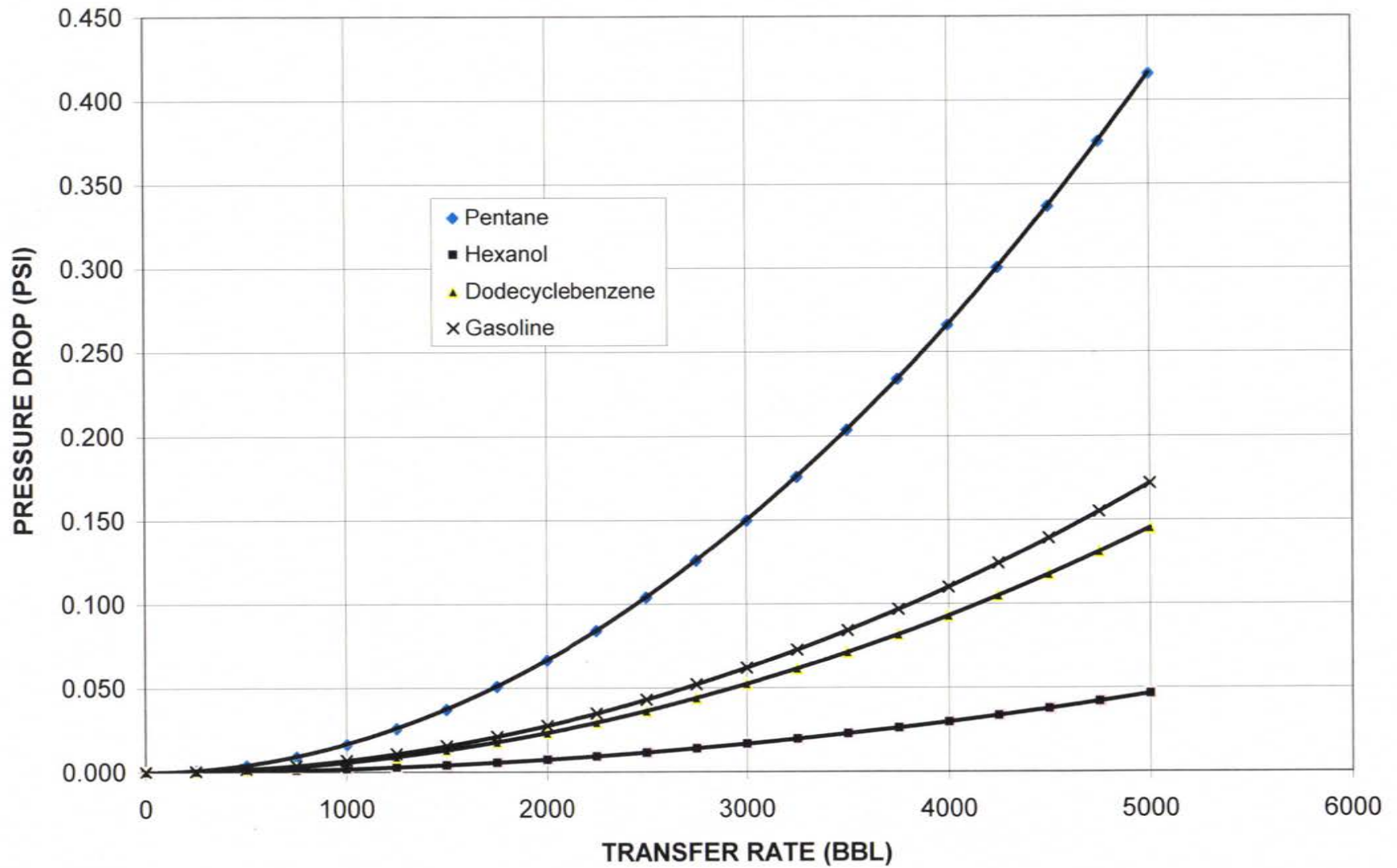
CHRIS CODE	NAME	VCS CAT	LIQ SG	VAPOR PRESS	VAPOR SG	VAPOR AIR WEIGHT DENSITY	VAPOR GROWTH RATE	PRESSURE DROP TO PV VALVE IN VCS (psig) (LOADING)	VAPOR VOLUMETRIC FLOW RATE (bbl/h)	AIR EQUIVALENT VOLUMETRIC FLOW RATE	PRESSURE DROP TO SHORE CONNECTION IN VCS (psig) (LOADING)*	PRESSURE DROP TO PV VALVE IN VCS (psig) (UNLOADING)	PRESSURE DROP TO SHORE CONNECTION IN VCS (psig) (UNLOADING)*
1 ACT	Acetone	1	0.79	10	2	0.123	1.2000	0.042	4200	5340	0.044	0.002	0.002
2 ACP	Acetophenone	1	1.03	0.6	4.14	0.085	1.0120	0.021	3542	3741	0.022	0.001	0.001
19 AAT	Amyl Acetate (iso-)	1	0.88	0.33	4.48	0.081	1.0066	0.020	3523	3645	0.020	0.001	0.001
20 AAI	Amyl Alcohol (iso-, n-, sec-, primary) (See also IAA	1	0.82	0.3	3.04	0.079	1.0060	0.019	3521	3586	0.020	0.001	0.001
21 AAN	Amyl Alcohol (n-)	1	0.82	0.3	3.04	0.079	1.0060	0.019	3521	3586	0.020	0.001	0.001
23 APM	Amyl Alcohol, Primary	1	0.82	0.3	3.04	0.079	1.0060	0.019	3521	3586	0.020	0.001	0.001
24 ASE	Amyl Alcohol, (sec-)	1	0.82	0.3	3.04	0.079	1.0060	0.019	3521	3586	0.020	0.001	0.001
26 IAA	Amyl Alcohol, (iso-)	1	0.82	0.3	3.04	0.079	1.0060	0.019	3521	3586	0.020	0.001	0.001
34 BAL	Benzyl Alcohol	1	1.05	0.1	3.73	0.077	1.0020	0.018	3507	3535	0.019	0.001	0.001
40 BAX	Butyl Acetate (iso-, n-)	1	0.87	0.6	4	0.084	1.0120	0.020	3542	3733	0.021	0.001	0.001
42 BTA	Butyl Acetate (sec-)	1	0.89	1.5	4	0.097	1.0300	0.024	3605	4074	0.026	0.001	0.001
44 IAL	Butyl Alcohol (iso-)	1	0.81	0.9	2.6	0.083	1.0180	0.020	3563	3717	0.021	0.001	0.001
46 BAS	Butyl Alcohol (sec-)	1	0.81	1.3	2.6	0.086	1.0260	0.021	3591	3814	0.022	0.001	0.001
47 BAT	Butyl Alcohol (tert-)	1	0.78	2.8	2.6	0.097	1.0560	0.026	3696	4175	0.027	0.001	0.001
48 BPH	Butyl Benzyl Phthalate	1	1.12	0.01	10.8	0.076	1.0002	0.018	3501	3510	0.019	0.001	0.001
64 CLS	Caprolactam Solutions	1	1.02	0.05	3.9	0.077	1.0010	0.018	3504	3518	0.019	0.001	0.001
70 CUM	Cumene	1	0.86	0.60	4.20	0.085	1.0120	0.021	3542	3745	0.022	0.001	0.001
72 CHX	Cyclohexane	1	0.78	4.5	2.9	0.116	1.0900	0.033	3815	4714	0.034	0.002	0.002
73 CHN	Cyclohexanol	1	0.95	0.15	3.45	0.078	1.0030	0.019	3511	3549	0.019	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	0.020	0.001	0.001
76 CMP	Cymene (para-)	1	0.86	0.11	4.62	0.078	1.0022	0.019	3508	3550	0.019	0.001	0.001
77 DHN	Decahydronaphthalene	1	0.89	0.1	4.76	0.078	1.0020	0.018	3507	3546	0.019	0.001	0.001
78 IDA	Decaldehyde (iso-)	1	0.83	0.01	5	0.076	1.0002	0.018	3501	3504	0.019	0.001	0.001
79 DAL	Decaldehyde (n-)	1	0.83	0	5.01	0.076	1.0000	0.018	3500	3499	0.019	0.001	0.001
81 DCE	Decane	1	0.74	0.12	4.8	0.078	1.0024	0.019	3508	3556	0.019	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	0.019	0.001	0.001
83 ISA	Decyl Alcohol (iso-)	1	0.83	0.01	5.3	0.076	1.0002	0.018	3501	3504	0.019	0.001	0.001
84 DAN	Decyl Alcohol (n-)	1	0.83	0.01	5.3	0.076	1.0002	0.018	3501	3504	0.019	0.001	0.001
85 DBZ	Decylbenzene (n-)	1	0.86	0.01	7.52	0.076	1.0002	0.018	3501	3507	0.019	0.001	0.001
87 DAA	Diacetone Alcohol	1	0.97	0.1	4	0.077	1.0020	0.018	3507	3538	0.019	0.001	0.001
91 DPA	Dibutyl Phthalate (ortho-)	1	1.05	0	9.59	0.076	1.0000	0.018	3500	3499	0.019	0.001	0.001
92 DPT	Dicyclopentadiene, See 1,3-Cyclopentadiene Dimer 2	1	0.98	0.25	4.55	0.080	1.0050	0.019	3518	3612	0.020	0.001	0.001
93 DEB	Diethylbenzene	1	0.87	0.08	4.62	0.077	1.0016	0.018	3506	3536	0.019	0.001	0.001
94 DEG	Diethylene Glycol	1	1.12	0.01	3.66	0.076	1.0002	0.018	3501	3503	0.019	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	0.019	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	0.019	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	0.019	0.001	0.001
111 DBC	Diisobutylcarbinol	1	0.81	0.09	4.97	0.078	1.0018	0.018	3506	3544	0.019	0.001	0.001
112 DBL	Diisobutylene	1	0.72	2	3.86	0.103	1.0400	0.026	3640	4233	0.028	0.001	0.001
113 DIX	Diisobutyl Ketone	1	0.81	0.16	4.9	0.079	1.0032	0.019	3511	3577	0.020	0.001	0.001
119 DIX	Diisopropylbenzene (all isomer)	1	0.86	0.03	5.6	0.077	1.0006	0.018	3502	3516	0.019	0.001	0.001
124 DTL	Dimethyl Phthalate	1	1.19	0	6.69	0.076	1.0000	0.018	3500	3499	0.019	0.001	0.001
130 DOP	Diocetyl Phthalate	1	0.98	0	13.47	0.076	1.0000	0.018	3500	3499	0.019	0.001	0.001
131 DPN	Dipentene	1	0.84	0.1	4.9	0.078	1.0020	0.019	3507	3548	0.019	0.001	0.001
132 DIL	Diphenyl	1	0.99	0.01	5.31	0.076	1.0002	0.018	3501	3504	0.019	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	0.019	0.001	0.001
134 DPE	Diphenyl Ether	1	1.07	0.01	5.87	0.076	1.0002	0.018	3501	3505	0.019	0.001	0.001
136 DPG	Dipropylene Glycol	1	1.03	0.07	4.63	0.077	1.0014	0.018	3505	3531	0.019	0.001	0.001
139 DFF	Distillates: Flashed Feed Stocks	1	0.75	2.3	3.4	0.102	1.0460	0.026	3661	4238	0.028	0.001	0.001
140 DSR	Distillates: Straight Run	1	0.73	2.3	3.4	0.102	1.0460	0.026	3661	4238	0.028	0.001	0.001
145 DOZ	Dodecene (all isomers)	1	0.76	0.02	5.81	0.076	1.0004	0.018	3501	3511	0.019	0.001	0.001
146 DOD	Dodecene	1	0.76	0.02	5.81	0.076	1.0004	0.018	3501	3511	0.019	0.001	0.001
147 DDB	Dodecylbenzene	1	0.86	4.7	8.4	0.239	1.0940	0.068	3829	6791	0.071	0.004	0.004
155 ETG	Ethoxy Triglycol (crude)	1	1.02	0	6.14	0.076	1.0000	0.018	3500	3499	0.019	0.001	0.001
156 ETA	Ethyl Acetate	1	0.9	4.5	3.04	0.119	1.0900	0.034	3815	4774	0.035	0.002	0.002
157 EAA	Ethyl Acetoacetate	1	1.03	0.2	4.48	0.079	1.0040	0.019	3514	3588	0.020	0.001	0.001
158 EAL	Ethyl Alcohol (Ethanol)	1	0.79	3.5	1.6	0.086	1.0700	0.023	3745	3979	0.024	0.001	0.001
160 ETB	Ethyl Benzene	1	0.87	0.6	3.56	0.083	1.0120	0.020	3542	3705	0.021	0.001	0.001
161 EBT	Ethyl Butanol	1	0.83	0.12	3.52	0.077	1.0024	0.018	3508	3540	0.019	0.001	0.001
162 EBR	Ethyl Butyrate	1	0.88	1	4	0.090	1.0200	0.022	3570	3885	0.023	0.001	0.001
163 ECY	Ethyl Cyclohexane	1	0.79	0.5	3.87	0.083	1.0100	0.020	3535	3687	0.021	0.001	0.001
166 EGL	Ethylene Glycol	1	1.19	0.01	2.21	0.076	1.0002	0.018	3501	3501	0.019	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	0.019	0.001	0.001
172	EGY	Ethylene Glycol Diacetate	1	1.1	0.01	5.03	0.076	1.0002	0.018	3501	3504	0.019	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	0.019	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	0.019	0.001	0.001
184	EHA	2-Ethylhexaldehyde, See Octyl Aldehydes	1	0.82	0.17	4.41	0.079	1.0034	0.019	3512	3573	0.020	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	0.019	0.001	0.001
190	EPR	Ethyl Propionate	1	0.89	3.5	1.6	0.086	1.0700	0.023	3745	3979	0.024	0.001	0.001
191	ETE	Ethyl Toulene	1	0.88	0.28	4.15	0.080	1.0056	0.019	3520	3613	0.020	0.001	0.001
194	FAM	Formamide	1	1.13	0.1	1.55	0.076	1.0020	0.018	3507	3512	0.019	0.001	0.001
195	FAL	Furfuryl Alcohol	1	1.13	0.05	3.4	0.077	1.0010	0.018	3504	3515	0.019	0.001	0.001
197	GAK	Gasoline Blended Stocks: Alkylates	1	0.75	12.5	3.4	0.217	1.2500	0.080	4375	7386	0.084	0.004	0.004
198	GRF	Gasoline Blended Stocks: Reformate	1	0.8	12.5	3.4	0.217	1.2500	0.080	4375	7386	0.084	0.004	0.004
199	GAT	Gasolines: Automotive (containing not over 4.23 gr: 1	0.74	12.5	3.4	0.217	1.2500	0.080	4375	7386	0.084	0.004	0.004	
200	GAV	Gasolines: Aviation (containing not over 4.86 grams: 1	0.71	12.5	3.4	0.217	1.2500	0.080	4375	7386	0.084	0.004	0.004	
201	GCS	Gasolines: Casinghead	1	0.67	12.5	3.4	0.217	1.2500	0.080	4375	7386	0.084	0.004	0.004
202	GPL	Gasolines: Polymer	1	0.75	12.5	3.4	0.217	1.2500	0.080	4375	7386	0.084	0.004	0.004
203	GSR	Gasolines: Straight Run	1	0.75	12.5	3.4	0.217	1.2500	0.080	4375	7386	0.084	0.004	0.004
204	GCR	Glycerine	1	1.26	0	3.17	0.076	1.0000	0.018	3500	3499	0.019	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	0.029	0.001	0.001
218	HPT	Heptane (n-)	1	0.68	2.5	3.45	0.105	1.0500	0.027	3675	4313	0.029	0.001	0.001
220	HTX	Heptanol (all isomers)	1	0.82	0.04	4	0.077	1.0008	0.018	3503	3515	0.019	0.001	0.001
221	HTN	Heptanol (all isomers)	1	0.82	0.04	4	0.077	1.0008	0.018	3503	3515	0.019	0.001	0.001
222	HPX	Heptene (all isomers)	2	0.7	2.9	3.4	0.109	1.0580	0.029	3703	4426	0.030	0.002	0.002
223	THE	Heptene (1-)	1	0.7	2.8	3.4	0.107	1.0560	0.028	3696	4395	0.030	0.001	0.002
229	HXS	Hexane (all isomers)	1	0.66	7	3	0.142	1.1400	0.044	3990	5446	0.046	0.002	0.002
230	HXA	Hexane	1	0.66	7	3	0.142	1.1400	0.044	3990	5446	0.046	0.002	0.002
231	HXO	Hexanoic Acid	1	0.93	0.01	4	0.076	1.0002	0.018	3501	3503	0.019	0.001	0.001
232	HXN	Hexanol	1	0.82	1	3.52	0.088	1.0200	0.022	3570	3837	0.023	0.001	0.001
234	HEX	Hexene (all isomers)	2	0.67	8	2.9	0.147	1.1600	0.047	4060	5651	0.049	0.002	0.003
235	HXE	Hexene (1-)	1	0.67	8.2	2.9	0.149	1.1640	0.048	4074	5705	0.050	0.003	0.003
236	HXT	Hexene (2-)	1	0.67	8.2	2.9	0.149	1.1640	0.048	4074	5705	0.050	0.003	0.003
238	HXG	Hexylene Glycol	4	0.92	0.01	1.1	0.076	1.0002	0.018	3501	3500	0.019	0.001	0.001
243	IPH	Isophorone	1	0.93	0.01	4.75	0.076	1.0002	0.018	3501	3504	0.019	0.001	0.001
244	JPO	Jet Fuels: JP-1 (Kerosene)	1	0.8	0.14	4.5	0.078	1.0028	0.019	3510	3561	0.020	0.001	0.001
245	JPT	Jet Fuels: JP-3	1	0.8	8.51	4.5	0.216	1.1702	0.070	4096	6899	0.073	0.004	0.004
246	JPF	Jet Fuels: JP-4	1	0.81	3.4	4	0.124	1.0680	0.033	3738	4770	0.035	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	0.019	0.001	0.001
249	KRS	Kerosene	1	0.81	0.15	4.5	0.078	1.0030	0.019	3511	3566	0.020	0.001	0.001
263	MTT	Methyl Acetate	1	0.92	6.1	2.6	0.122	1.1220	0.036	3927	4970	0.038	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	0.025	0.001	0.001
266	MAC	Methyl Amyl Acetate	1	0.86	0.33	4.97	0.082	1.0066	0.020	3523	3662	0.021	0.001	0.001
267	MAA	Methyl Amyl Alcohol	1	0.81	0.43	3.52	0.081	1.0086	0.020	3530	3645	0.020	0.001	0.001
271	MBK	Methyl n-Butyl Ketone	1	0.81	0.97	3.5	0.087	1.0194	0.022	3568	3825	0.023	0.001	0.001
273	MBU	Methyl Butyrate	1	0.9	1.26	3.53	0.091	1.0252	0.023	3588	3924	0.024	0.001	0.001
274	MEK	Methyl Ethyl Ketone	1	0.8	4.5	2.5	0.108	1.0900	0.030	3815	4539	0.032	0.002	0.002
275	MTF	Methyl Formal (Dimethyl Formal)	1	0.86	15.42	2.6	0.192	1.3084	0.078	4579	7272	0.081	0.004	0.004
276	MHK	Methyl Heptyl Ketone	1	0.83	0.06	4.9	0.077	1.0012	0.018	3504	3528	0.019	0.001	0.001
278	MIK	Methyl Isobutyl Ketone	1	0.8	1.15	3.45	0.089	1.0230	0.022	3581	3878	0.023	0.001	0.001
281	MNA	1-Methyl Napthalene	1	1.02	0.01	4.91	0.076	1.0002	0.018	3501	3504	0.019	0.001	0.001
283	MPN	2-Methyl-1-Pentene	1	0.69	6.3	2.9	0.132	1.1260	0.040	3941	5195	0.042	0.002	0.002
284	MTN	5-Methyl-1-Pentene	1	0.67	8.49	2.9	0.152	1.1698	0.049	4094	5782	0.052	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	0.019	0.001	0.001
288	MNS	Mineral Spirits	1	0.75	0.2	4.3	0.079	1.0040	0.019	3514	3584	0.020	0.001	0.001
289	MRE	Myrcene	1	0.8	0.17	4.7	0.079	1.0034	0.019	3512	3578	0.020	0.001	0.001
295	NSV	Naphtha: Solvent	1	0.87	0.2	3.5	0.078	1.0040	0.019	3514	3567	0.020	0.001	0.001
296	NSS	Naphtha: Stoddard Solvant	1	0.78	0.2	4.3	0.079	1.0040	0.019	3514	3584	0.020	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	0.020	0.001	0.001
300	NAX	Nonane (all isomers)	1	0.72	0.27	4.4	0.080	1.0054	0.019	3519	3616	0.020	0.001	0.001
301	NAN	Nonane	1	0.72	0.27	4.4	0.080	1.0054	0.019	3519	3616	0.020	0.001	0.001
304	NON	Nonene	1	0.73	0.35	4.3	0.081	1.0070	0.020	3525	3647	0.020	0.001	0.001
305	NNS	Nonyl Alcohol (all isomers)	1	0.94	0.1	5	0.078	1.0020	0.019	3507	3549	0.019	0.001	0.001
306	NNN	Nonyl Alcohol	1	0.94	0.1	5	0.078	1.0020	0.019	3507	3549	0.019	0.001	0.001
307	NNI	Nonyl Alcohol (iso-)	1	0.94	0.1	5	0.078	1.0020	0.019	3507	3549	0.019	0.001	0.001
309	NNP	Nonyl Phenol	1	0.95	0.01	7.6	0.076	1.0002	0.018	3501	3507	0.019	0.001	0.001
316	OAX	Octane (all isomers)	1	0.7	0.79	3.9	0.087	1.0158	0.021	3555	3797	0.022	0.001	0.001
317	OAN	Octane	1	0.7	0.79	3.9	0.087	1.0158	0.021	3555	3797	0.022	0.001	0.001
320	OTA	Octanol	1	0.83	0.01	4.48	0.076	1.0002	0.018	3501	3503	0.019	0.001	0.001
322	OTE	Octene (1-)	1	0.72	1	3.86	0.089	1.0200	0.022	3570	3871	0.023	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	0.019	0.001	0.001

325 IOA	Octyl Alcohol	1	0.83	0.01	4.48	0.076	1.0002	0.018	3501	3503	0.019	0.001	0.001
364 OTW	Fuel: No. 2	1	0.88	0.56	8	0.094	1.0112	0.023	3539	3943	0.024	0.001	0.001
366 OFR	Fuel: No. 4	1	0.9	0.15	3.4	0.078	1.0030	0.019	3511	3548	0.019	0.001	0.001
367 OFV	Fuel: No. 5	1	0.94	0.15	3.4	0.078	1.0030	0.019	3511	3548	0.019	0.001	0.001
368 OSX	Fuel: No. 6	1	0.95	0.15	3.4	0.078	1.0030	0.019	3511	3548	0.019	0.001	0.001
382 OIL	OIL, Misc: Crude	1	0.95	0.15	3.4	0.078	1.0030	0.019	3511	3548	0.019	0.001	0.001
383 ODS	OIL, Misc: Diesel	1	0.9	0.69	3.4	0.084	1.0138	0.020	3548	3724	0.021	0.001	0.001
389 OLB	OIL, Misc: Lubricating	1	0.9	0.15	1	0.076	1.0030	0.018	3511	3510	0.019	0.001	0.001
403 ORS	OIL, Misc: Resin	1	1.02	0.15	1	0.076	1.0030	0.018	3511	3510	0.019	0.001	0.001
418 OTB	OIL, Misc: Turbine	1	0.87	0.3	5.4	0.082	1.0060	0.020	3521	3661	0.021	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	0.019	0.001	0.001
433 IPT	Pentane (iso-)	5	0.62	27	2.48	0.346	1.5400	0.195	5390	11501	0.204	0.010	0.011
434 PTA	Pentane (n-)	5	0.63	20.44	2.5	0.264	1.4088	0.124	4931	9191	0.130	0.006	0.007
437 PTE	Pentene (1-)	5	0.64	24.9	2.4	0.309	1.4980	0.164	5243	10568	0.172	0.009	0.009
442 PIN	Pinene	1	0.86	0.35	4.7	0.082	1.0070	0.020	3525	3662	0.021	0.001	0.001
448 PLB	Polybutene	1	0.91	0.01	79.3	0.080	1.0002	0.019	3501	3583	0.020	0.001	0.001
457 PGC	Polypropylene Glycol	1	1.01	0.1	1	0.076	1.0020	0.018	3507	3506	0.019	0.001	0.001
464 IAC	Propyl Acetate (iso-)	1	0.89	1.8	3.52	0.097	1.0360	0.025	3626	4101	0.026	0.001	0.001
465 PAT	Propyl Acetate (n-)	1	0	1.85	3.52	0.098	1.0370	0.025	3630	4118	0.026	0.001	0.001
466 IPA	Propyl Alcohol (iso-)	1	0.79	3	2.07	0.091	1.0600	0.024	3710	4060	0.025	0.001	0.001
467 PAL	Propyl Alcohol (n-)	1	0.8	1.2	2.07	0.082	1.0240	0.020	3584	3722	0.021	0.001	0.001
468 PBZ	Propylbenzene (n-)	1	0.86	0.2	4.14	0.079	1.0040	0.019	3514	3580	0.020	0.001	0.001
469 IPX	Iso-Propylcyclohexane	1	0.8	0.01	4.35	0.076	1.0002	0.018	3501	3503	0.019	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	0.019	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	0.021	0.001	0.001
488 SFL	Sulfolane	1	1.26	0.01	4.14	0.076	1.0002	0.018	3501	3503	0.019	0.001	0.001
493 TTN	Tetradecanol	1	0.82	0	7.39	0.076	1.0000	0.018	3500	3499	0.019	0.001	0.001
494 TTD	1-Tetradecene, See the olefin or Alpha-Olefin Entries	1	0.77	0.01	6.77	0.076	1.0002	0.018	3501	3506	0.019	0.001	0.001
496 TTG	Tetraethylene Glycol	1	1.12	0.01	6.7	0.076	1.0002	0.018	3501	3506	0.019	0.001	0.001
497 THN	Tetrahydronaphthalene	1	0.97	0.04	4.56	0.077	1.0008	0.018	3503	3517	0.019	0.001	0.001
499 TOL	Toluene	1	0.87	1.5	3.14	0.091	1.0300	0.023	3605	3945	0.024	0.001	0.001
502 TCP	Tricresyl Phosphate (less than 1% of the ortho isomer)	1	1.16	0.01	12.69	0.077	1.0002	0.018	3501	3512	0.019	0.001	0.001
503 TRD	Tridecane	1	0.76	0.02	6.4	0.076	1.0004	0.018	3501	3512	0.019	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	0.019	0.001	0.001
506 TDC	1-Tridecene	1	0.77	0.01	6.29	0.076	1.0002	0.018	3501	3505	0.019	0.001	0.001
508 TEB	Triethylbenzene	1	0.86	0.02	5.6	0.076	1.0004	0.018	3501	3510	0.019	0.001	0.001
509 TEG	Triethylene Glycol	1	1.12	0.01	5.17	0.076	1.0002	0.018	3501	3504	0.019	0.001	0.001
519 TRE	Trimethylbenzenes (all isomers)	1	0.89	0.14	4.2	0.078	1.0028	0.019	3510	3557	0.019	0.001	0.001
520 TMB	Trimethyl Benzene (1,2,5-)	1	0.89	0.14	4.14	0.078	1.0028	0.019	3510	3556	0.019	0.001	0.001
521 TMD	Trimethyl Benzene (1,2,3-)	1	0.89	0.14	4.14	0.078	1.0028	0.019	3510	3556	0.019	0.001	0.001
522 TME	Trimethyl Benzene (1,2,4-) (Pseudocumene)	1	0.89	0.14	4.14	0.078	1.0028	0.019	3510	3556	0.019	0.001	0.001
529 TRP	Trixylenyl Phosphate	1	1.16	0	14.2	0.076	1.0000	0.018	3500	3499	0.019	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	0.021	0.001	0.001
547 XLM	Xylene (M-)	1	0.87	0.51	3.66	0.082	1.0102	0.020	3536	3680	0.021	0.001	0.001
548 XLO	Xylene (O-)	1	0.89	0.4	3.66	0.081	1.0080	0.019	3528	3641	0.020	0.001	0.001
549 XLP	Xylene (P-)	1	0.86	0.51	3.66	0.082	1.0102	0.020	3536	3680	0.021	0.001	0.001
550 XYL	Xylenol	1	1.01	0.1	3.66	0.077	1.0020	0.018	3507	3535	0.019	0.001	0.001
551	Zinc Dialkylthiophosphate												
	Max.		1.260	27.000	79.300	0.346	1.540	0.195	5390	11501	0.204	0.010	0.011
	Min.		0.000	0.000	1.000	0.000	1.000	0.018	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)

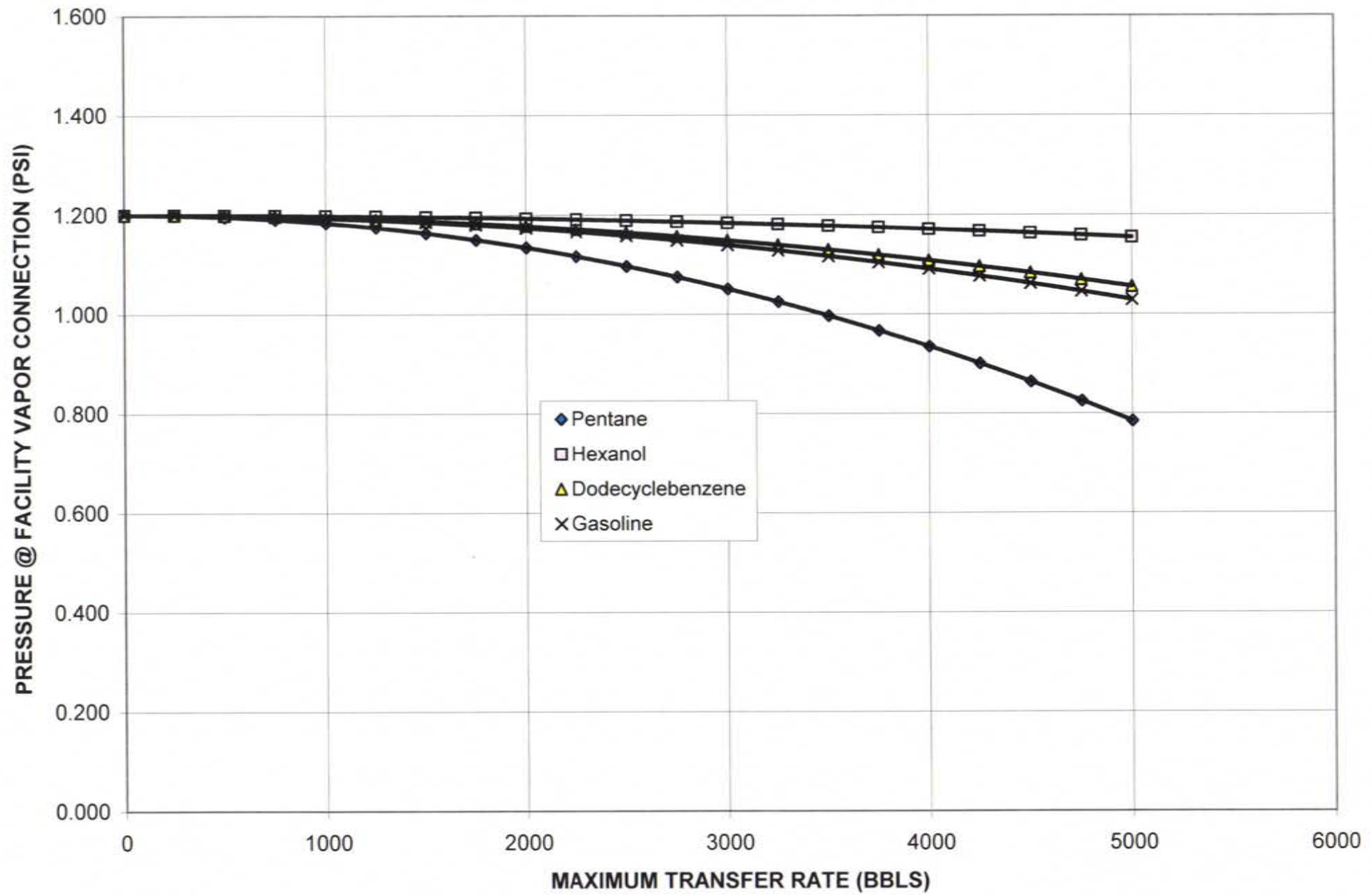
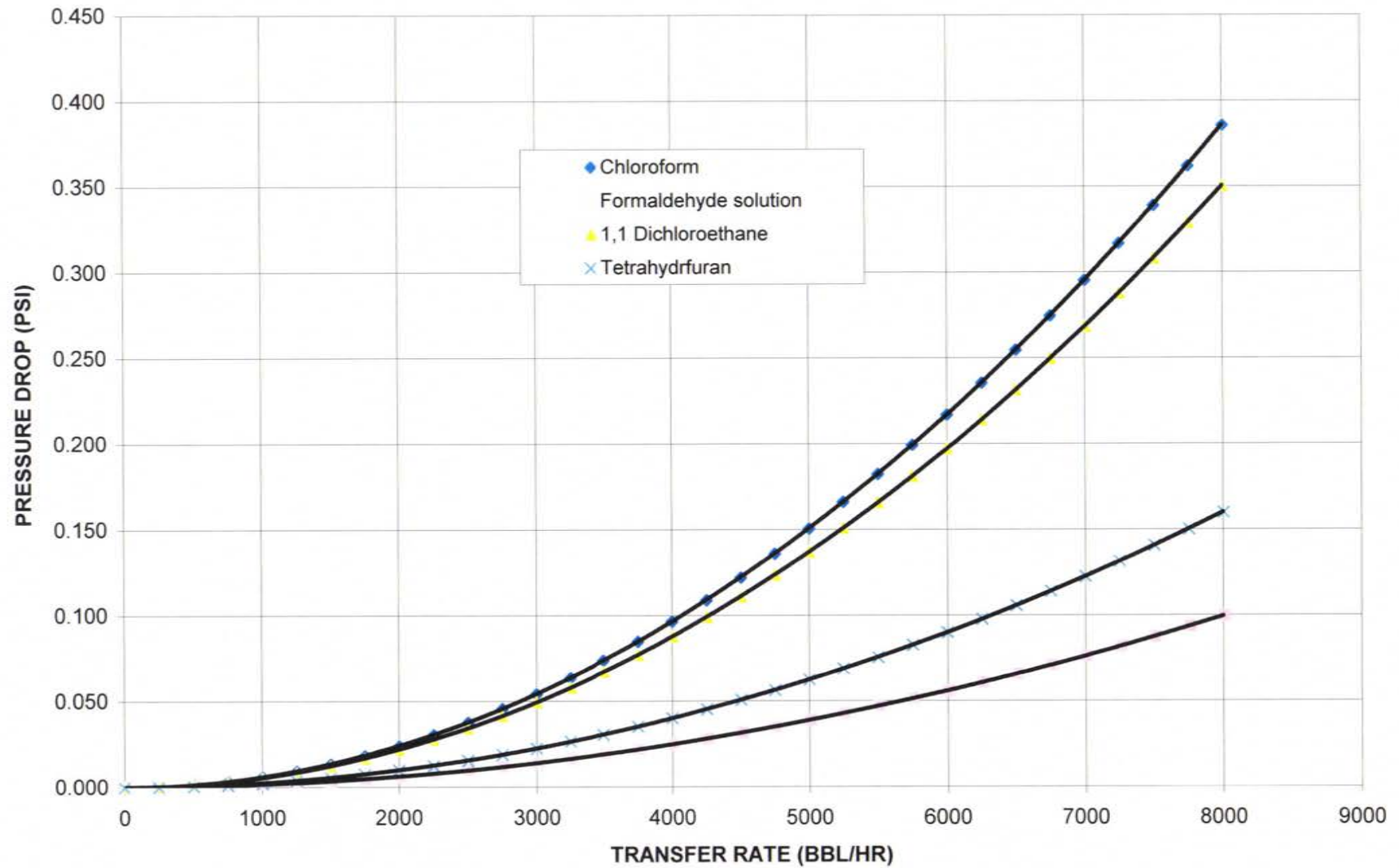


TABLE 4 (SUBCHAPTER "O" CARGOES)

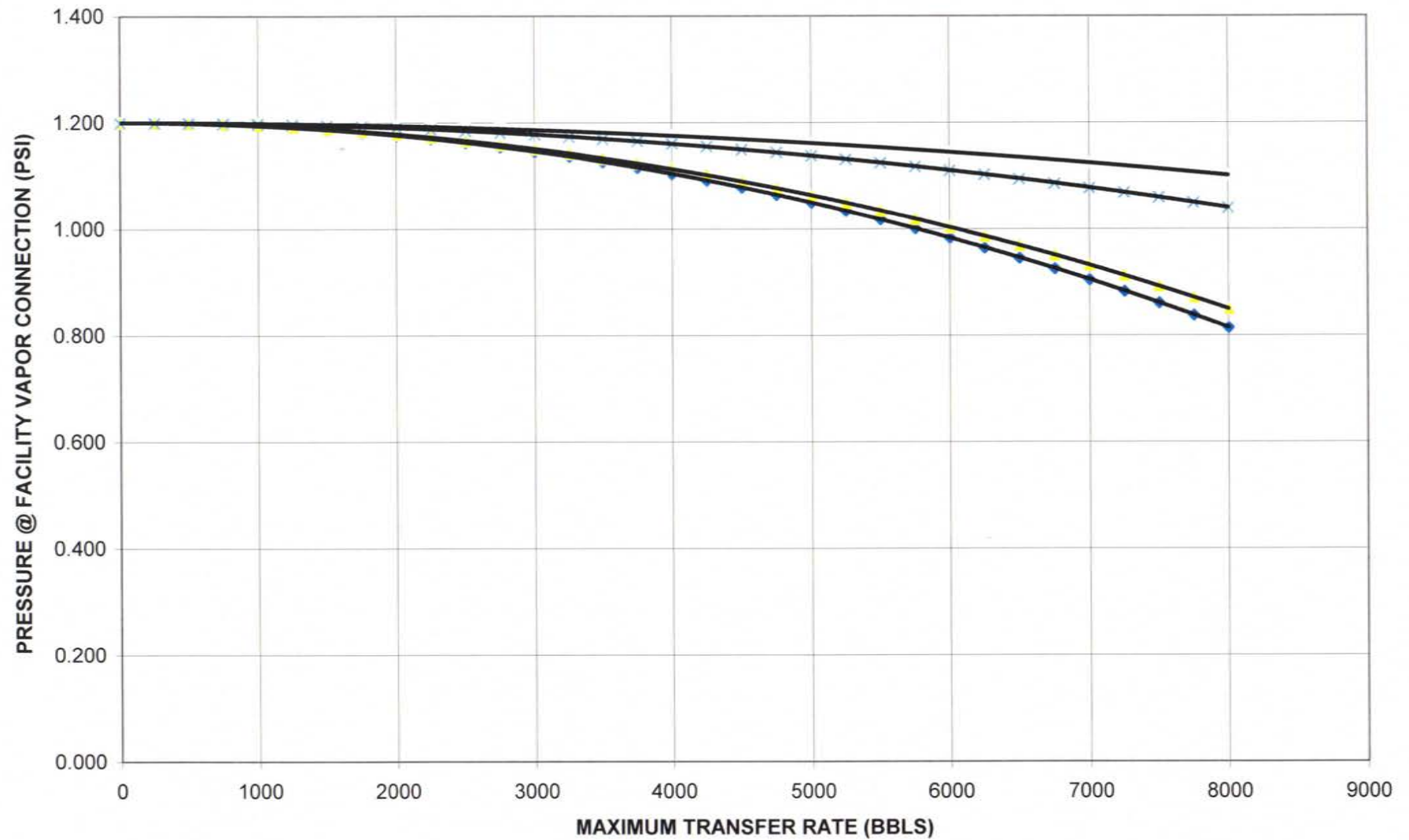
CHRIS CODE	NAME	VCS CAT	LIQ SG	VAPOR PRESS	VAPOR SG	VAPOR AIR WEIGHT DENSITY	VAPOR GROWTH RATE	PRESSURE DROP TO PV VALVE IN VCS(psig) (LOADING)	VAPOR VOLUMETRIC FLOW RATE (bbl/h)	AIR EQUIVALENT VOLUMETRIC FLOW RATE	PRESSURE DROP TO SHORE CONNECTION IN VCS (psig) (LOADING)*	PRESSURE DROP TO PV VALVE IN 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	0.027	3850	4298	0.029	0.001	0.001
2 ADN	Adiponitrile	1	0.95	0.01	3.73	0.076	1.0002	0.018	3501	3503	0.019	0.001	0.001
3 ATN	Acetonitrile	3	0.78	0.03	1.41	0.076	1.0006	0.018	3502	3502	0.019	0.001	0.001
4 BAD	Iso-Butyraldehyde	1	0.80	7.80	2.50	0.131	1.1560	0.041	4046	5308	0.043	0.002	0.002
5 BAR	Butyl acrylate (iso-, n-)	2	0.90	0.60	4.42	0.086	1.0120	0.021	3542	3759	0.022	0.001	0.001
6 BMH	Butyl Methacrylate	2	0.88	0.29	4.9	0.081	1.0058	0.019	3520	3640	0.020	0.001	0.001
7 BNZ	Benzene	1	0.88	4.50	2.80	0.114	1.0900	0.032	3815	4671	0.034	0.002	0.002
8 BTR	n-Butyraldehyde	1	0.80	7.80	2.50	0.131	1.1560	0.041	4046	5308	0.043	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	0.043	4011	5396	0.045	0.002	0.002
10 CCH	Cyclohexanone	1	0.95	0.20	3.40	0.078	1.0040	0.019	3514	3565	0.020	0.001	0.001
11 CHA	Cyclohexylamine	1	0.87	0.62	3.42	0.083	1.0124	0.020	3543	3703	0.021	0.001	0.001
12 CRB	Chlorobenzene	1	1.11	0.80	3.88	0.087	1.0160	0.021	3556	3799	0.022	0.001	0.001
13 CRF	Chloroform	3	1.48	9	4.25	0.213	1.1800	0.070	4130	6916	0.074	0.004	0.004
14 NCT	Coal Tar Naphtha Solvent	1	0.86	0.2	4	0.079	1.0040	0.019	3514	3577	0.020	0.001	0.001
15 CRS	Cresols	1	1.05	0.06	3.72	0.077	1.0012	0.018	3504	3521	0.019	0.001	0.001
16 CTA	Crotonaldehyde	4	0.85	2	2.41	0.089	1.0400	0.023	3640	3943	0.024	0.001	0.001
17 DCH	1,1-Dichloroethane	1	1.18	9.90	3.41	0.188	1.1980	0.064	4193	6592	0.067	0.003	0.004
18 DPP	1,2-Dichloropropane	3	1.16	2.5	3.89	0.110	1.0500	0.029	3675	4418	0.030	0.001	0.002
19 DPU	1,3-Dichloropropene	4	1.23	5.5	3.84	0.149	1.1100	0.044	3885	5443	0.046	0.002	0.002
20 DEN	Diethylamine	3	0.71	1.00	2.50	0.083	1.0200	0.020	3570	3731	0.021	0.001	0.001
21 DIP	Diisopropanolamine	1	0.98	0.01	4.59	0.076	1.0002	0.018	3501	3504	0.019	0.001	0.001
22 DMF	Dimethylformamide	1	0.95	0.30	2.51	0.078	1.0060	0.019	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	0.049	3941	5747	0.051	0.003	0.003
24 EAC	Ethyl acrylate	2	0.93	2.00	3.50	0.099	1.0400	0.025	3640	4163	0.027	0.001	0.001
25 EAI	2-Ethylhexyl acrylate	2	0.89	0.02	6.35	0.076	1.0004	0.018	3501	3512	0.019	0.001	0.001
26 EDC	Ethylene dichloride	1	1.26	4.00	3.42	0.121	1.0800	0.034	3780	4776	0.035	0.002	0.002
27 ETM	Ethyl Methacrylate	2	0.92	1	3.94	0.090	1.0200	0.022	3570	3879	0.023	0.001	0.001
28 EPA	2-Ethyl-3-propylacrolein	1	0.85	0.12	4.5	0.078	1.0024	0.019	3508	3553	0.019	0.001	0.001
29 FFA	Furfural	1	1.20	0.15	3.31	0.078	1.0030	0.019	3511	3547	0.019	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	0.019	0.001	0.001
31 MSO	Mesityl Oxide	1	0.86	0.67	3.5	0.084	1.0134	0.020	3547	3725	0.021	0.001	0.001
32 MAM	Methyl acrylate	2	0.95	4.10	3.00	0.114	1.0820	0.032	3787	4646	0.033	0.002	0.002
33 MBE	Methylcyclopentadiene dimer	1	0.74	0.04	3.10	0.076	1.0008	0.018	3503	3511	0.019	0.001	0.001
34 MMM	Methyl methacrylate	2	0.94	2.02	3.45	0.099	1.0404	0.025	3641	4159	0.027	0.001	0.001
35 MPL	Morpholine	1	1.00	0.80	3.00	0.083	1.0160	0.020	3556	3726	0.021	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	0.022	0.001	0.001
37 PRD	Pyridine	1	0.98	1.30	2.72	0.086	1.0260	0.022	3591	3830	0.023	0.001	0.001
38 STY	Styrene	2	0.92	0.40	3.60	0.081	1.0080	0.019	3528	3638	0.020	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	0.020	0.001	0.001
40 TEN	Triethylamine	3	0.73	2.50	3.49	0.105	1.0500	0.027	3675	4323	0.029	0.001	0.002
41 THF	Tetrahydrofuran	1	0.89	8.50	1.35	0.090	1.1700	0.029	4095	4454	0.031	0.002	0.002
42 VAM	Vinyl acetate	2	0.94	5.80	2.97	0.130	1.1160	0.038	3906	5099	0.040	0.002	0.002
		Max.	1.39	12.5	8.40	0.213	1.198	0.070	4193	6916	0.074	0.004	0.004
		Min.	0.63	0.01	1.03	0.076	1.000	0.018	3501	3502	0.019	0.001	0.001

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

LIQUID TRANSFER RATE vs PRESSURE DROP



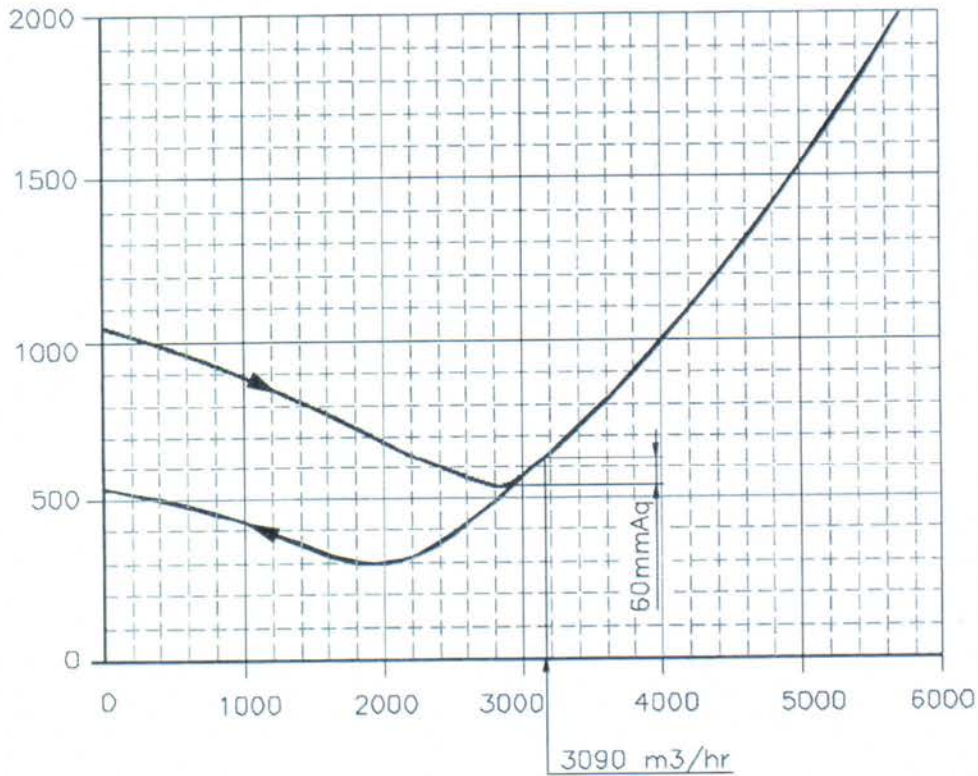
PRESSURE vs MAXIMUM TRANSFER RATE (FOR SUB-CHAPTER "O" CARGOES)



HIGH VELOCITY VENT VALVE FLOW CAPACITY CURVE

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

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

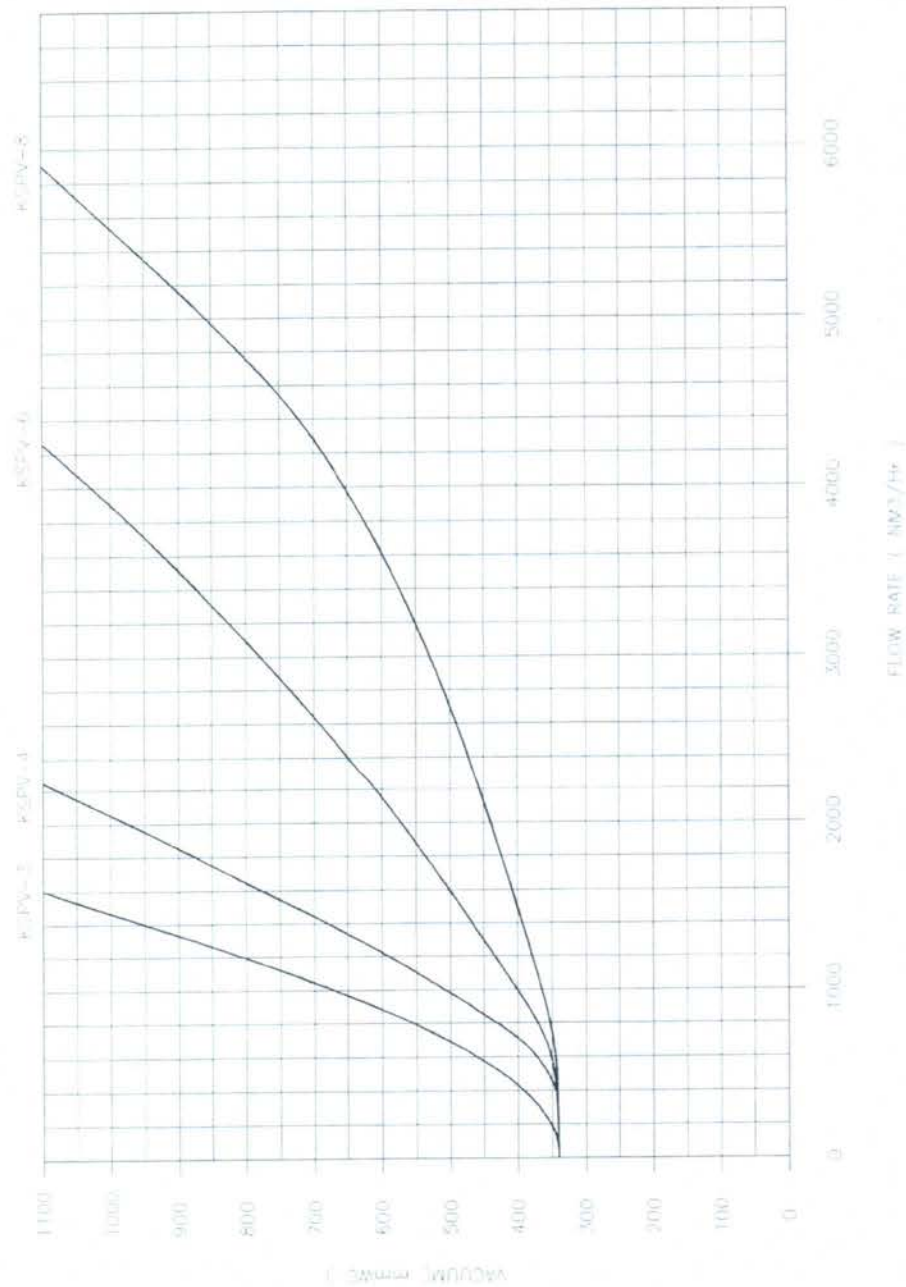


FLOW CAPACITY CURVE, SCMH(Standard cubic meter per hour)
 (1SCMH = 6.289BBL/hr)

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℃ AND AMBIENT PRESSURE P=1.0332Kg/cm ²	

FLOW CAPACITY CURVE GRAPH

FLOW TEST PERFORMED ON EQUIPMENT
USING AIR, AT TEMP. $T=15.6^{\circ}\text{C}$ AND
AMBIENT PRESSURE $P=1.0332 \text{ KG/CM}^2$



TANKTECH

TITLE HIGH VELOCITY VACUUM RELIEF VALVE
KSPV TYPE



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



Vessel Name	CBC 1390 thru CBC 1399	Shipyard	Southwest Shipyard
Coast Guard Number	CG1429762, CG1429764, CG1429765, CG1429767, CG1429768, CG1429769, CG1429771, CG1432241, CG1432242, CG1432243	Hull Number	9768 thru 9777

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 ☒	Flush Deck ☐
3. Authorized Maximum Cargo Transfer Rate(s)	3,500 bbl/hr loading (max 2 tanks simultaneously)		
	800 bbl/hr discharging		
4. Authorized Maximum Vapor-Air Mixture Density	0.346 lbm/ft ³		
5. Authorized VCS Categories	1 through 5		

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

a. Cargo Name Pentane (all isomers) [PTY]

7. Pressure Vacuum Valve:

Manufacturer	Bergan
Size	KLPH-6
CG Approval	162.017/144/3

Settings in psig:

Pressure-side	1.5
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	9337 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	☒	Type	Bergan	Meets ASTM F1271	Setting in psig N/A
b. Overfill Control Shutdown	☒	Type	Bergan		
c. Spill Valve	☐	Type	N/A		
d. Rupture Disk	☐	Type	N/A		

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

11. Instructions/Guidelines for the OCMI:

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

In accordance with 46 CFR Part 39, excluding part 39.4000, this vessel's vapor collection system has been inspected to the plans approved by MSC Letter C1-1700672 dated February 28, 2017, and has been found acceptable for the collection of bulk liquid cargo vapors annotated with "Yes" in the CAA's VCS column of the vessel's Cargo Authority Attachment. The VCS system has been approved with a pressure side 1.5 psig P/V valve with Coast Guard Approval 162,017/144/3. The cargo tank top is suitable for a maximum allowable working pressure (MAWP) of 3.5 psi. When the vessel is carrying cargoes containing greater than 0.5% benzene, the person in charge is responsible for ensuring the provisions of 46 US Code of Federal Regulations Part 197, Subpart C are applied.

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

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

VCS Approval Letter	MSC Letter C1-1700672 dated February 28, 2017	MSC Plan Reviewer	LT M. P. Comerford
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