

# TRINITY MARINE PRODUCTS, INC.

ASHLAND CITY, TN - MADISONVILLE, LA  
CARUTHERSVILLE, MO - PORT ALLEN, LA

## VAPOR CONTROL SYSTEM (VCS) CALCULATIONS

FOR  
DUAL LOADING AND DISCHARGE  
OF  
SUBCHAPTER "D" & "O" PRODUCTS  
FOR  
**Canal Barge Company**

TRINITY MARINE PRODUCTS TAG No.: 38207

TRINITY - MADISONVILLE HULL No.: 2213-1 Thru 4

USCG MSC PROJECT No.: Pending

October 23, 2013

Prepared By:

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OWNER: Canal Barge Company  
 DESCRIPTION: Single Rake, Double Skin, Inland Tank Barge  
 SIZE: 297'-6"x54'-0"x12'-0"  
 HULL/NAME: 2213-1 Thru 4/CBC 317 - CBC 320

CONTRACT: 38207  
 BY: MEC  
 DATE: 23-Oct-13

VCS SYSTEM INFORMATION

1. GENERAL DESCRIPTION OF VESSEL:

A. TMP HULL NUMBERS: 2213-1 Thru 4  
 B. NAME (S): CBC 317 - CBC 320  
 C. OFFICIAL NUMBER: Pending  
 D. USCG MSC FILE NUMBER: Pending  
 E. DIMENSIONS: 297'-6"x54'-0"x12'-0"  
 F. SERVICE: Rivers, Lakes, Bays and Sounds, Subchapter "D" and "O"  
 G. MAX. ALLOWABLE WORKING PRESSURE: 3.00 psig  
 H. PV VALVE PRESSURE SETTING: 1.50 psig  
 I. PV VALVE VACUUM SETTING: 0.50 psi  
 J. MAX. DISCHARGE RATE: 5000 bbl/hr 468cuft/min  
 K. MAX. LIQUID LOADING RATE: 5000 bbl/hr 468cuft/min

2. VAPOR CONTROL SYSTEM

A. PIPE DIAMETER: 7.981 in  
 B. PIPE LENGTHS: See Trinity Drawing 38207P-06  
 C. P/V VALVE I.C. BERGAN KLPH-6 PV

COMP	MAX FLOW	MAX PRESSURE DROP ACROSS VALVE
I.C. BERGAN KLPH-6 PV	36000bbl/hr @ 1.5psi	0.943psi @ 13350bbl/hr Air
I.C. BERGAN KLPH-6 PV	26000bbl/hr @ 0.5psi	0.530psi @ 5000bbl/hr Air

D. MAX. VAPOR-AIR MIXTURE DENSITY: 0.347 lbs/ft<sup>3</sup>  
 E. DARCY FRICTION FACTOR: 0.014  
 F. VCS CARGOES: SEE TABLE 1  
 G. SPILL VALVE None Installed  
 H. ADDITIONAL INFORMATION:

- 46CFR39.20-1(a)(4) SYSTEM IS DESIGNED WITH SEVERAL LOW POINT CONDENSATE DRAINS.
- 46CFR39.20-1(a)(5) SYSTEM IS ELECTRICALLY BONDED TO THE VESSEL DUE TO WELDED STEEL CONSTRUCTION
- 46CFR39.20-1(c) SYSTEM INCLUDES AN ISOLATION VALVE, MANUALLY OPERATED GATE VALVE, AT EACH FACILITY CONNECTION
- 46CFR39.20-1(d) VAPOR HEADER MARKED AS SHOWN IN TRINITY DWG P-6
- 46CFR39.20-1(e) FACILITY CONNECTION FLANGE FITTED WITH 1/2" STUD 1" LONG AT LOCATION OUTLINED IN REGULATION  
 SYSTEM IS DESIGNED TO ACCOMMODATE INTERNAL VISUAL INSPECTION AS REQUIRED FOR CARRIAGE OF POLYMERIZING CARGOES.

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**VCS CALCULATIONS**

**1. CARGO AUTHORITY:**

The vapor collection system installed on this vessel is designed to carry the cargoes listed in Table 1. These Cargoes are to be listed on the vessel's Certificate of Inspection.

**2. DETERMINING VAPOR AIR MIXTURE DENSITY AND VAPOR GROWTH RATE:**

iso-Pentane has the heaviest vapor-air mixture density. iso-Pentane has the highest vapor growth rate (see Table 1 for Calculations)

**3. THE MAXIMUM LIQUID TRANSFER RATE AS IMPOSED BY THE CAPACITY OF THE CARGO VENTING SYSTEM 46CFR39.30-1:**

**A: PRESSURE DROP FROM TANK TO PV VALVE**

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	K	D (in)	UNIT EQ. LENGTH (FT)	TOTAL EQ. LENGTH (FT)	
Entrance, Projecting	1.00	0.780	7.981	37.05	37.05	
Straight Pipe	10.06		7.981	1.00	10.06	
Tee Branch Con	2.00	1.100	7.981	52.26	104.51	Tank Drop
Tee Run Con	1.00	0.550	7.981	26.13	26.13	177.75
Straight Pipe	105.33		7.981	1.00	105.33	
Tee Branch Div	2.00	1.040	7.981	49.41	98.81	
Tee Run Con	1.00	0.550	7.981	26.13	26.13	
<b>Total</b>					<b>408.03</b>	

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.

Using a 5000 bbl/h liquid transfer rate, the vapor-air mixture and air-equivalent volumetric flow rate for each cargo are given in Table 1. At a setting of 1.5 psig, the I.C. BERGAN KLPH-6 PV has an adequate pressure relieving capacity of air for each cargo listed in Table 1. The maximum pressure in the tank, 1.5 psi, based on a pressure drop of 0.0 psig in piping and 1.5 psig across the PV Valve at 0 bbl air equivalent, does not exceed the cargo tank maximum design working pressure of 3.0 psi.

**Pressure Drop of Air Flow Into Tanks During Discharge**

NAME	$\rho$ @ 115°F (LBS/CUFT)	f	PIPE DIA (FT)	TOTAL EQ. LENGTH (FT)	FLOW RATE (CUFT/SEC)	V (FT/SEC)	PRESSURE DROP (PSI)
Air	0.069	0.014	0.665	408.03	7.80	22.45	0.032

Using a 5000 bbl/h liquid transfer rate as the air flow rate. At a setting of 0.5 psig, the I.C. BERGAN KLPH-6 PV has an adequate pressure relieving capacity of air. The maximum vacuum in the tank, 0.6 psi based on a pressure drop of 0.0 psig in piping and 0.5 psig across the PV Valve at 5000 bbl air, does not exceed the cargo tank maximum design working pressure of 3.0 psi.

**VCS CALCULATIONS (CONT)**

**B: PRESSURE DROP FROM TANK TO FACILITY VAPOR CONNECTION**

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

**TABLE 3**

	PIPE/FITTINGS	QUANTITY	K	D (in)	UNIT EQ. LENGTH (FT)	TOTAL EQ. LENGTH (FT)	
	Tank Drop	177.75		7.891	1.00	177.75	(From Above)
	Straight Pipe	232.736		7.981	1.00	232.74	
	Tee Run Con	2	0.55	7.981	26.13	52.26	
	Tee Run Div	1	0.3	7.981	14.25	14.25	
	Tee Branch Con	1	1.1	7.981	52.26	52.26	
	Tee Branch Div	1	1.04	7.981	49.41	49.41	
	8" Gate Valve	1	0.112	7.981	5.32	5.32	
	45° Wye Branch Div	1	0.351	7.981	16.67	16.67	
<b>Inboard Barge</b>	Straight Pipe	35.875		7.981	1.00	35.88	
	Tee Run Con	1	0.55	7.981	26.13	26.13	
	8" Gate Valve	2	0.112	7.981	5.32	10.64	
	Cargo Hose	20		7.981	1.00	20.00	
	<b>Total</b>					<b>693.300</b>	

Pressure drop at the maximum liquid loading rate of 5000bbl/h from Tank 1 to the Vapor Header Connection for each cargo is given in Table 1.

The largest pressure drop (0.4psi) does not exceed 80 percent of the P/V valve pressure setting (1.2psig).

**4. THE MAXIMUM LIQUID TRANSFER RATE AS IMPOSED BY THE RELIEVING CAPACITY OF THE CARGO TANK SPILL VALVE OR RUPTURE DISK.**

PROTECTION TYPE: Spill Valve  
 MANUFACTURER / MODEL: None Installed

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

SMALLEST TANK:	Tank No. 3
SET POINT OF OVERFILL SHUTDOWN:	10.20* IN ULLAGE FROM GAUGE FLANGE
REMAINING CAPACITY AT SHUTDOWN:	471 CUFT
MAX LOAD RATE:	468 CUFT/MIN
MAX LOAD RATE PER TANK:	5000 BBL/HR
TIME REMAINING FOR SHUTDOWN	1.0 MIN
TIME REQUIRED BY 46CFR39.20-9:	1.0 MIN
MARGIN:	0.0 MIN

\*Note: Setpoint is minimum required setpoint. Actual setting will be done by Owner prior to COI.

The #3 cargo tank has a set point for the overfill shutdown set at 0.85ft BELOW THE FLANGE OF THE GAUGE. The tank capacity above this level is 471cuft. With a liquid transfer rate of 5000 bbl/h per tank based on loading into a single tank only, the person in charge of transfer operations has at least 1 minute to stop the transfer operation before the tank overflows. Thus the VCS meets the requirements of 46CFR 39.20-9.

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TABLE 1 - VAPOR CONTROL SYSTEM CALCULATIONS

CHRIS CODE	NAME	COMP GROUP	SUB CHAP	GRADE	HULL TYPE	VCS CAT	REST.	LIQ SG	VAPOR PRESS	VAPOR SG	VAPOR AIR WEIGHT DENSITY	VAPOR GROWTH RATE	VAPOR FLOW RATE (lbm/hr)	AIR EQUIV FLOW RATE (lbm/hr)	PRESSURE DROP TO PV VALVE IN VCS (LOADING) (psig)	PRESSURE DROP TO SHORE CONN IN VCS (LOADING)* (psig)	
1	ABX	Ammonium bisulfite solution (70% or less)	43	O	NA	III	N/A		0.880	0.330	4.480	1.007	5033	5212	0.039	0.066	
2	ACN	Acrylonitrile	15	O	C	II	4	.50-70(a), .55-1(e)	0.810	5.000	1.800	1.100	5500	6146	1.054	0.091	
3	ADN	Adiponitrile	37	O	E	II	1	No	0.950	0.010	3.730	1.000	5009	5009	0.036	0.060	
4	AEE	Aminoethylalanine	8	O	E	III	1	.55-1(b)	1.030	0.010	3.590	1.000	5001	5009	0.036	0.060	
5	AHO	Anthracene oil (Coal tar fraction)	33	O	NA	II	N/A	No	0.930	0.010	3.590	1.000	5001	5009	0.036	0.060	
6	AMH	Ammonium hydroxide (28% or less NH3)	6	O	NA	III	N/A	.56-1(a), (b), (c), (f), (g)	0.940	10.600	2.640	1.212	6060	8732	0.108	0.184	
7	ATN	Acetonitrile	37	O	C	III	3	No	0.780	0.030	1.410	1.001	5003	5009	0.036	0.060	
8	BAR	Butyl acrylate (all isomers)	14	O	D	III	2	.50-70(a), .50-81(a), (b)	0.880	0.600	4.420	1.012	5060	5375	0.041	0.070	
9	BHA	Benzene or hydrocarbon mixtures (containing Acetylene and 10% Benzene or more)	32	O	NA	III	1	.50-60, .56-1(b), (d), (f), (g)	0.880	0.800	4.000	1.250	6250	6702	0.064	0.108	
10	BHB	Benzene or hydrocarbon mixtures (having 10% Benzene or more)	32	O	NA	III	1	.50-60	0.880	0.800	4.000	1.250	6250	6702	0.064	0.108	
11	BMN	Butyl Methacrylate	14	O	D	III	2	.50-70(a), .50-81(a), (b)	0.880	0.290	4.900	1.006	5029	5206	0.038	0.065	
12	BNZ	Benzene	32	O	C	III	1	.50-60	0.880	4.500	2.800	1.250	6250	7661	0.083	0.141	
13	BTX	Benzene, Toluene, Xylene mixtures (10% Benzene or more)	32	O	B/C	III	1	.50-60	0.840	7.300	2.800	1.250	6250	8418	0.101	0.171	
14	CBT	Carbon tetrachloride	36	O	NA	III	N/A	No	1.590	5.400	5.490	1.108	5540	8761	0.109	0.185	
15	CCH	Cyclohexanone	18	O	D	III	1	.56-1(a), (b)	0.950	0.200	3.400	1.004	5020	5098	0.037	0.063	
16	CCW	Cresote	21	O	E	III	1	No	0.950	0.200	3.400	1.004	5020	5098	0.037	0.063	
17	CHA	Cyclohexylamine	7	O	D	III	1	.56-1(a), (b), (c), (g)	0.870	0.620	3.420	1.012	5062	5295	0.040	0.068	
18	DCM	Dichloromethane	36	O	NA	III	5	No	1.340	19.000	3.000	1.250	6250	12317	0.215	0.366	
19	DEE	2,2'-Dichloroethyl ether	41	O	D	II	1	.55-1(f)	1.220	0.040	4.900	1.001	5032	5032	0.036	0.061	
20	DEN	Diethylamine	7	O	C	III	3	.55-1(c)	0.710	1.000	2.500	1.020	5100	5335	0.040	0.069	
21	DET	Diethylenetriamine	7	O	E	III	1	.55-1(c)	0.950	0.040	3.480	1.001	5004	5023	0.036	0.061	
22	DIA	Diisopropylamine	7	O	C	II	3	.55-1(c)	0.720	3.700	3.500	1.074	5370	6736	0.064	0.109	
23	DIP	Diisopropanolamine	8	O	E	III	1	.55-1(c)	0.980	0.010	4.590	1.000	5001	5010	0.036	0.061	
24	DMB	Dimethylmethanolamine	8	O	D	III	1	.56-1(b), (c)	0.890	0.516	3.030	1.010	5052	5216	0.039	0.066	
25	DMF	Dimethylformamide	10	O	D	III	1	.55-1(e)	0.950	0.300	2.510	1.078	1.006	5030	5104	0.037	0.063
26	DMX	Dichloropropane, Dichloropropane mixtures.	15	O	NA	II	1	No	0.892	9.200	1.550	1.184	5920	6787	0.065	0.111	
27	DNA	Di-n-propylamine	7	O	C	II	3	.55-1(c)	0.740	1.450	3.500	1.029	5145	5696	0.046	0.078	
28	DOT	Dodecyl(dimethyl)amine,	7	O	E	III	N/A	.56-1(b)	0.990	0.010	13.450	1.000	5001	5024	0.036	0.061	
29	DPB	Tetradecyl(dimethyl)amine mixture	36	O	C	III	3	No	1.040	1.800	3.000	1.036	5180	5731	0.047	0.079	
30	DPC	1,1-Dichloropropane	36	O	C	III	3	No	1.040	1.800	3.000	1.036	5180	5731	0.047	0.079	
31	DPP	1,3-Dichloropropane	36	O	C	III	3	No	1.160	2.500	3.890	1.110	5250	6318	0.057	0.096	
32	DPU	1,2-Dichloropropane	15	O	D	II	4	No	1.230	5.500	3.840	1.110	5550	7784	0.086	0.146	
33	DTI	1,3-Dichloropropane	43	O	NA	III	N/A	.56-1(a), (b), (c), (g)	1.180	0.010	5.300	1.000	5001	5012	0.036	0.061	
34	EAC	2,4-Dichlorophenoxyacetic acid, triisopropanolamine salt solution.	14	O	C	III	2	.50-70(a), .50-81(a), (b)	0.930	2.000	3.500	1.040	5200	5953	0.050	0.085	
35	EAI	Ethylhexyl acrylate	14	O	E	III	2	.50-70(a), .50-81(a), (b)	0.800	0.015	6.350	1.000	5002	5018	0.036	0.061	
36	EAN	Ethylamine solution (72% or less)	7	O	A	II	6	.55-1(b)	0.800	15.500	1.560	1.250	6250	8022	0.091	0.155	
37	EBA	N-Ethylbutylamine	7	O	D	III	3	.55-1(b)	0.719	1.598	0.286	1.032	5160	4979	0.035	0.060	
38	ECC	N-Ethylethoxyamine	7	O	D	III	1	.55-1(b)	0.850	0.585	4.400	1.012	5059	5364	0.041	0.069	
39	EDA	Ethylendiamine	7	O	D	III	1	.55-1(c)	0.910	0.900	2.100	1.018	5090	5247	0.039	0.066	
40	EDC	Ethylene dichloride	36	O	C	III	1	No	1.260	4.000	3.420	1.080	5400	6831	0.066	0.112	
41	EGC	Ethylene glycol monoalkyl ethers	40	O	D/E	III	1	No	0.970	0.200	4.720	1.004	5020	5138	0.037	0.064	
42	EGH	Ethylene glycol hexyl ether	40	O	E	III	N/A	No	0.930	0.170	3.100	1.003	5017	5076	0.037	0.062	
43	EGP	Ethylene glycol propyl ether	40	O	E	III	1	No	0.908	0.025	3.600	1.001	5003	5016	0.036	0.061	
44	EPA	2-Ethyl-3-propylacrolein	19	O	E	III	1	No	0.850	0.120	4.350	1.002	5012	5078	0.037	0.062	
45	ETC	Ethylene cyanohydrin	20	O	E	III	1	No	1.040	0.010	2.450	1.000	5001	5007	0.036	0.060	
46	ETM	Ethyl methacrylate	14	O	D/E	III	2	.50-70(a)	0.920	1.000	3.940	1.020	5100	5548	0.044	0.074	
47	GTA	Glutaraldehyde solution (50% or less)	19	O	NA	III	N/A	No	1.124	0.010	3.400	1.000	5001	5009	0.036	0.060	

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48	Hexamethylenediamine solution	7	O	E	III	1	.55-1(c)	1.210	10.500	1.260	0.089	1.210	6050	6545	0.061	0.103
49	Hexamethylenediamine	7	O	C	II	1	.56-1(b), (c)	0.880	5.600	0.104	0.053	1.112	5560	4623	0.030	0.052
50	iso-Decyl acrylate	14	O	E	III	2	.50-70(a), .50-81(a), (b), .55-1(c)	0.890	0.010	7.300	0.076	1.000	5001	5015	0.036	0.061
51	iso-Propylamine	7	O	A	II	5	.55-1(c)	0.690	23.100	2.030	0.243	1.250	6250	11172	0.177	0.301
52	Isoprene	30	O	A	III	7	.50-70(a), .50-81(a), (b)	0.672	11.300	1.772	0.117	1.226	6130	7609	0.082	0.140
53	Kraft pulping liquors (free alkali content 3% or more) (including: Black, Green, or White liquor)	5	O	NA	III	N/A	.50-73, .56-1(a), (c), (g)	0.800	10.060	2.960	0.169	1.201	6006	8950	0.114	0.193
54	Methyl acrylate	14	O	C	III	2	.50-70(a), .50-81(a), (b)	0.950	4.100	3.000	0.115	1.082	5410	6645	0.063	0.106
55	Methylcyclopentadiene dimer	30	O	C	III	1	No	0.941	0.040	0.930	0.076	1.001	5004	5008	0.036	0.060
56	Ethanamine	8	O	E	III	1	.55-1(c)	1.020	0.030	2.100	0.076	1.001	5003	5012	0.036	0.061
57	2-Methyl-5-ethylpyridine	9	O	E	III	1	.55-1(c)	0.920	0.160	4.180	0.079	1.003	5016	5098	0.037	0.063
58	Methyl methacrylate	14	O	C	III	2	.50-70(a), .50-81(a), (b)	0.940	2.020	3.450	0.099	1.040	5202	5948	0.050	0.085
59	iso-Propanolamine	8	O	E	III	1	.55-1(c)	0.960	0.080	2.590	0.077	1.002	5008	5032	0.036	0.061
60	Morpholine	7	O	D	III	1	.55-1(c)	1.000	0.800	3.000	0.084	1.016	5080	5329	0.040	0.068
61	2-Methylpyridine	9	O	D	III	3	.55-1(c)	0.940	2.065	3.200	0.097	1.041	5207	5896	0.049	0.084
62	Mesityl oxide	18	O	D	III	1	No	0.860	0.670	3.500	0.084	1.013	5067	5327	0.040	0.068
63	alpha-Methylstyrene	30	O	D	III	2	.50-70(a), .50-81(a), (b)	0.890	0.400	4.080	0.082	1.008	5040	5232	0.039	0.066
64	Coal tar naphtha solvent	33	O	D	III	1	.50-73	1.410	3.600	2.170	0.096	1.072	5360	6021	0.051	0.087
65	1- or 2-Nitropropane	42	O	D	III	1	.50-81	0.990	1.050	3.060	0.086	1.021	5105	5439	0.042	0.071
66	Propanolamine (iso-, n-)	8	O	E	III	1	.56-1(b), (c)	0.870	1.900	3.520	0.099	1.038	5190	5196	0.050	0.084
67	1,3-Pentadiene	30	O	A	III	7	.50-70(a), .50-81	0.680	17.060	2.360	0.209	1.250	6250	10352	0.152	0.258
68	Polyethylene polyamines	7	O	E	III	1	.55-1(c)	0.994	8.300	4.550	0.215	1.166	5830	9796	0.136	0.231
69	Perchloroethylene	36	O	NA	III	N/A	No	1.620	1.230	5.830	0.104	1.025	5123	5994	0.051	0.087
70	Pyridine	9	O	C	III	1	.55-1(c)	0.980	1.300	2.720	0.087	1.026	5130	5477	0.043	0.072
71	Sodium aluminate solution (45% or less)	5	O	NA	III	N/A	.50-73, .56-1(a), (b), (c)	0.850	0.010	0.010	0.076	1.000	5001	5003	0.036	0.060
72	Sodium chlorate solution (50% or less)	0	O	NA	III	N/A	.50-73	0.850	0.010	0.010	0.076	1.000	5001	5003	0.036	0.060
73	Sodium sulfide, hydrosulfide solution (H2S 15 ppm or less)	0	O	NA	III	1	.50-73, .55-1(b)	1.280	1.510	1.170	0.077	1.030	5151	5196	0.038	0.065
74	Sodium sulfide, hydrosulfide solution (H2S greater than 15 ppm but less than 200 ppm)	0	O	NA	III	N/A	.50-73, .55-1(b)	1.280	1.510	1.170	0.077	1.030	5151	5196	0.038	0.065
75	Sodium sulfide, hydrosulfidesolutions (H2S greater than 200ppm)	0	O	NA	II	N/A	.50-73, .55-1(b)	1.280	1.510	1.170	0.077	1.030	5151	5196	0.038	0.065
76	Styrene monomer	30	O	D	III	2	.50-70(a), .50-81(a), (b)	0.920	0.400	3.600	0.081	1.008	5040	5203	0.038	0.065
77	1,2,4-Trichlorobenzene	36	O	E	III	1	No	1.450	0.010	6.260	0.076	1.000	5001	5013	0.036	0.061
78	Trichloroethylene	36	O	NA	III	1	No	1.470	3.500	4.540	0.134	1.070	5350	7113	0.072	0.122
79	1,1,2-Trichloroethane	36	O	NA	III	1	.50-73, .56-1(a)	1.430	0.010	4.550	0.076	1.000	5001	5010	0.036	0.061
80	1,2,3-Trichloropropane	36	O	E	II	3	.50-73, .56-1(a)	1.390	0.150	5.600	0.079	1.003	5015	5125	0.037	0.063
81	Triethanolamine	8	O	E	III	1	.55-1(b)	1.130	0.010	5.140	0.076	1.000	5001	5011	0.036	0.061
82	1,1,2,2-Tetrachloroethane	36	O	NA	III	N/A	No	1.600	1.000	5.800	0.099	1.020	5100	5811	0.048	0.081
83	Triethylamine	7	O	C	II	3	.55-1(c)	0.730	2.500	3.490	0.105	1.050	5250	6182	0.054	0.092
84	Triethylenetetramine	7	O	E	III	1	.55-1(b)	0.980	0.010	5.040	0.076	1.000	5001	5011	0.036	0.061
85	Tetrahydrofuran	41	O	C	III	1	.50-70(b)	0.890	8.500	1.350	0.090	1.170	5850	6370	0.058	0.098
86	Triphenylborane (10% or less), caustic soda solution	5	O	NA	III	N/A	.56-1(a), (b), (c)	0.870	1.500	3.140	0.091	1.030	5150	5642	0.045	0.077
87	Urea, Ammonium nitrate solution (containing more than 2% NH3)	6	O	NA	III	N/A	.56-1(b)	1.000	0.010	6.800	0.076	1.000	5001	5014	0.036	0.061
88	Vinyl acetate	13	O	C	III	2	.50-70(a), .50-81(a), (b)	0.940	5.800	2.970	0.130	1.116	5580	7293	0.075	0.128
89	Vinyltoluene	13	O	D	III	2	.50-70(a), .50-81, .56-1(a), (b), (c), (g)	0.900	0.120	4.080	0.078	1.002	5012	5073	0.037	0.062
90	Acetophenone	18	D	E	NA	1	NA	1.030	0.600	4.140	0.085	1.012	5060	5350	0.041	0.069
91	Acetone	18	D	C	NA	1	NA	0.790	10.000	2.000	0.123	1.200	6000	7636	0.083	0.141
92	Benzyl alcohol	21	D	E	NA	1	NA	1.050	0.100	3.730	0.077	1.002	5010	5056	0.036	0.062
93	Butyl alcohol (n-)	0	D	D	NA	1	NA	0.810	0.500	2.600	0.080	1.010	5050	5177	0.038	0.065

OWNER: Canal Barge Company  
 DESCRIPTION: Single Rake, Double Skin, Inland Tank Barge  
 SIZE: 297'-6"x54'-0"x12'-0"  
 HULL/NAME: 2213-1 Thru 4/CBC 317 - CBC 320

CONTRACT: 38207  
 BY: MEC  
 DATE: 23-Oct-2013

TABLE 1 - VAPOR CONTROL SYSTEM CALCULATIONS

CHRIS CODE	NAME	COMP GROUP	SUB CHAP	GRADE	HULL TYPE	VCS CAT	REST.	LIQ SG	VAPOR PRESS	VAPOR SG	VAPOR AIR WEIGHT DENSITY	VAPOR GROWTH RATE	VAPOR FLOW RATE (lbm/hr)	AIR EQUIV FLOW RATE (lbm/hr)	PRESSURE DROP TO PV VALVE IN VCS (LOADING)* (psig)	PRESSURE DROP TO SHORE CONN IN VCS (LOADING)* (psig)
94	BAS	0	D	C	NA	1	NA	0.810	1.300	2.600	0.086	1.026	5130	5454	0.042	0.072
95	BAT	0	D	C	NA	1	NA	0.780	2.800	2.600	0.097	1.056	5280	5970	0.051	0.086
96	BAX	34	D	D	NA	1	NA	0.870	0.600	4.000	0.085	1.012	5060	5338	0.040	0.069
97	BPH	34	D	E	NA	1	NA	1.120	0.010	10.800	0.077	1.000	5001	5020	0.036	0.061
98	BUE	32	D	D	NA	1	NA	0.850	0.100	5.110	0.078	1.002	5010	5077	0.037	0.062
99	CHN	20	D	E	NA	1	NA	0.940	0.200	3.500	0.078	1.004	5020	5101	0.037	0.063
100	CHX	31	D	C	NA	1	NA	0.780	4.500	2.900	0.116	1.090	5450	6742	0.064	0.110
101	CLS	22	D	E	NA	1	NA	1.060	0.700	3.900	0.086	1.014	5070	5383	0.041	0.070
102	CMP	32	D	D	NA	1	NA	0.860	0.460	4.620	0.084	1.009	5046	5303	0.040	0.068
103	DA	20	D	E	NA	1	NA	0.940	0.100	4.000	0.078	1.002	5010	5060	0.036	0.062
104	DAX	20	D	E	NA	1	NA	0.830	5.800	2.970	0.130	1.116	5580	7293	0.075	0.128
105	DBL	30	D	C	NA	1	NA	0.720	2.200	3.970	0.107	1.044	5220	6189	0.054	0.092
106	DCE	30	D	D	NA	1	NA	0.740	0.120	5.300	0.079	1.002	5012	5095	0.037	0.063
107	DDB	32	D	E	NA	1	NA	0.860	4.700	8.400	0.240	1.094	5470	9711	0.134	0.227
108	DDO	33	D	E	NA	1	NA	1.070	0.010	5.870	0.076	1.000	5001	5012	0.036	0.061
109	DEB	32	D	D	NA	1	NA	0.870	0.080	4.620	0.078	1.002	5008	5057	0.036	0.062
110	DEG	40	D	E	NA	1	NA	1.120	0.010	3.660	0.076	1.000	5001	5009	0.036	0.060
111	DIK	18	D	D	NA	1	NA	0.810	0.480	4.900	0.085	1.010	5048	5336	0.040	0.069
112	DOP	34	D	E	NA	1	NA	0.990	0.010	13.450	0.077	1.000	5001	5024	0.036	0.061
113	DPG	40	D	E	NA	1	NA	1.030	0.070	4.630	0.077	1.001	5007	5050	0.036	0.061
114	EAL	20	D	C	NA	1	NA	0.790	3.500	1.600	0.086	1.070	5350	5691	0.046	0.078
115	EBT	20	D	D	NA	1	NA	0.830	0.140	3.400	0.078	1.003	5014	5070	0.036	0.062
116	EGL	20	D	E	NA	1	NA	1.130	0.010	2.210	0.076	1.000	5001	5007	0.036	0.060
117	EGY	34	D	E	NA	1	NA	1.130	0.010	1.000	0.076	1.000	5001	5005	0.036	0.060
118	EHX	20	D	E	NA	1	NA	0.830	0.015	4.500	0.076	1.000	5002	5014	0.036	0.061
119	ETA	34	D	C	NA	1	NA	0.900	4.500	3.040	0.119	1.090	5450	6827	0.066	0.112
120	ETB	32	D	C	NA	1	NA	0.870	0.600	3.660	0.084	1.012	5060	5308	0.040	0.068
121	ETG	40	D	E	NA	1	NA	1.020	0.010	6.140	0.076	1.000	5001	5013	0.036	0.061
122	FAL	20	D	E	NA	1	NA	1.290	0.100	3.370	0.077	1.002	5010	5050	0.036	0.061
123	GAT	33	D	C	NA	1	NA	0.760	12.500	3.400	0.217	1.250	6250	10563	0.158	0.269
124	GCR	20	D	E	NA	1	NA	1.260	0.010	3.170	0.076	1.000	5001	5008	0.036	0.060
125	HMX	31	D	C	NA	1	NA	0.680	2.500	3.450	0.105	1.050	5250	6168	0.054	0.092
126	HXG	20	D	E	NA	1	NA	0.920	0.010	4.000	0.076	1.000	5001	5010	0.036	0.061
127	HXN	20	D	D	NA	1	NA	0.820	1.000	3.520	0.088	1.020	5100	5487	0.043	0.073
128	IAC	34	D	C	NA	1	NA	0.880	3.100	3.520	0.113	1.062	5310	6470	0.059	0.101
129	IAL	20	D	D	NA	1	NA	0.810	0.900	2.600	0.083	1.018	5090	5316	0.040	0.068
130	IDA	19	D	E	NA	1	NA	0.830	0.060	5.380	0.077	1.001	5006	5050	0.036	0.061
131	IPA	20	D	C	NA	1	NA	0.790	3.000	2.070	0.091	1.060	5300	5806	0.048	0.081
132	IPH	18	D	E	NA	1	NA	0.930	0.010	4.750	0.076	1.000	5001	5011	0.036	0.061
133	KRS	33	D	D	NA	1	NA	0.810	0.150	4.500	0.079	1.003	5015	5100	0.037	0.063
134	MAC	34	D	D	NA	1	NA	0.860	0.340	5.000	0.083	1.007	5034	5245	0.039	0.066
135	MAL	20	D	C	NA	1	NA	0.790	7.000	1.100	0.079	1.140	5700	5826	0.048	0.082
136	MBE	41	D	C	NA	1	NA	0.740	0.040	3.100	0.077	1.001	5004	5021	0.036	0.061
137	MEK	18	D	C	NA	1	NA	0.800	4.500	2.500	0.108	1.090	5450	6492	0.060	0.102
138	MIK	18	D	C	NA	1	NA	0.800	1.200	3.450	0.090	1.024	5120	5570	0.044	0.075
139	MNS	33	D	D	NA	1	NA	0.750	0.200	4.300	0.079	1.004	5020	5125	0.037	0.063
140	MTT	34	D	D	NA	1	NA	0.920	6.100	2.600	0.122	1.122	5610	7107	0.072	0.122
141	NNP	21	D	E	NA	1	NA	0.940	0.010	7.590	0.076	1.000	5001	5015	0.036	0.061
142	NSS	33	D	D	NA	1	NA	0.780	0.200	0.010	0.075	1.004	5020	4993	0.035	0.060
143	NSV	33	D	D	NA	1	NA	0.870	0.200	3.500	0.078	1.004	5020	5101	0.037	0.063
144	NVM	33	D	C	NA	1	NA	0.770	0.190	0.010	0.075	1.004	5019	4994	0.035	0.060
145	ODS	33	D	D/E	NA	1	NA	0.900	5.800	2.970	0.130	1.116	5580	7293	0.075	0.128

OWNER: Canal Barge Company

DESCRIPTION: Single Rake, Double Skin, Inland Tank Barge

SIZE: 297'-6"x54'-0"x12'-0"

HULL/NAME: 2213-1 Thru 4/CBC 317 - CBC 320

CONTRACT: 38207

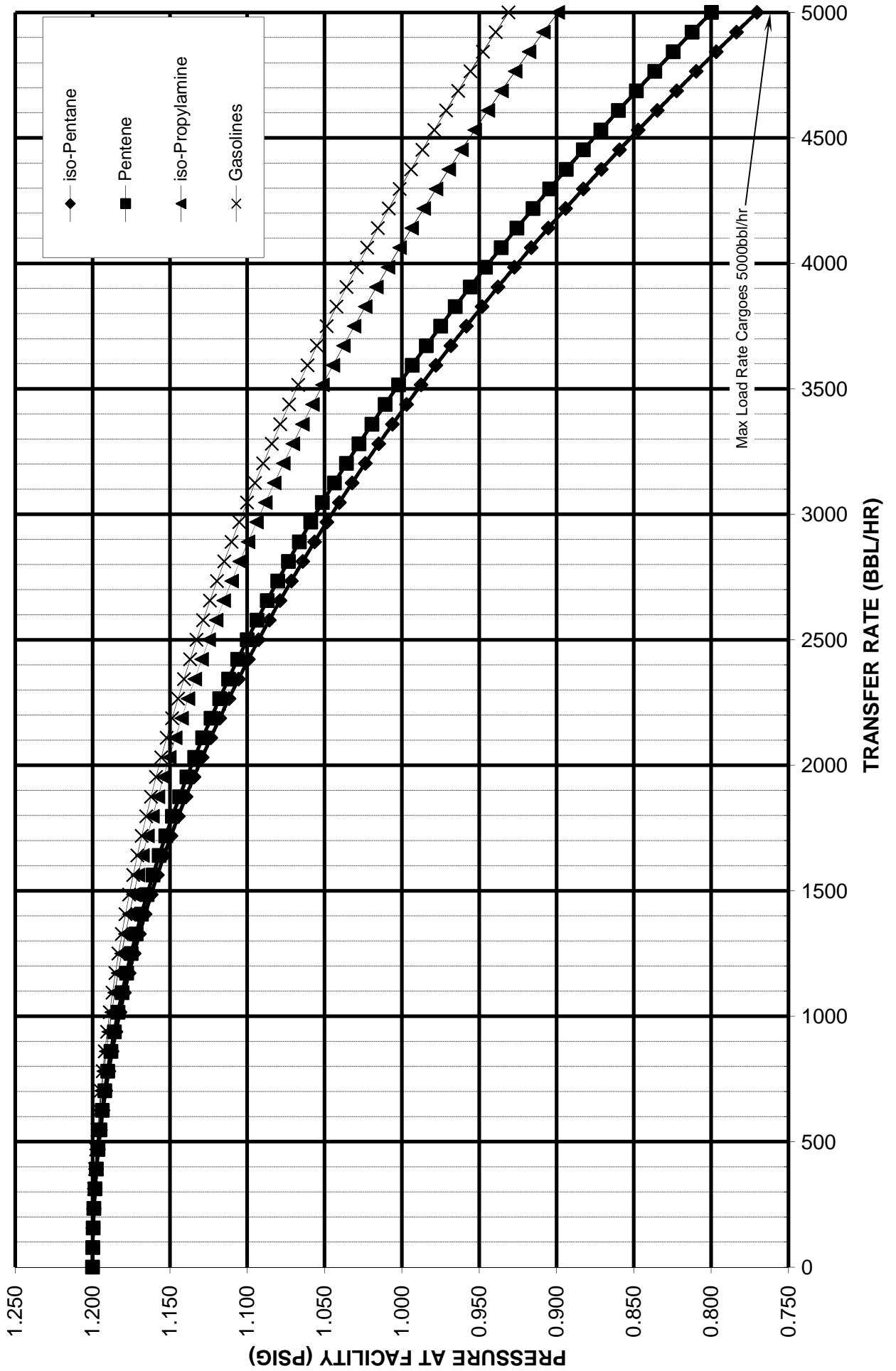
BY: MEC

DATE: 23-Oct-2013

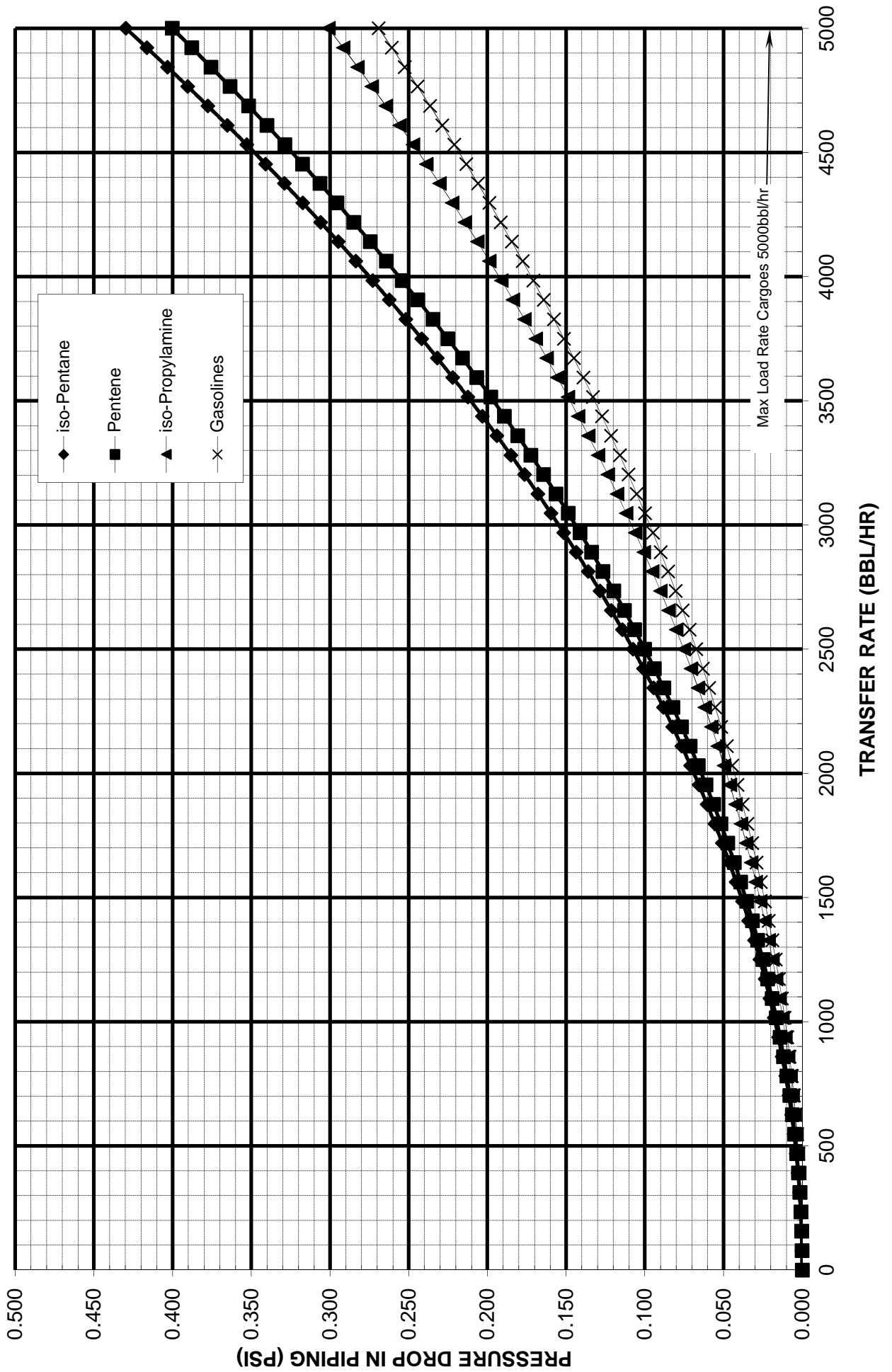
TABLE 1 - VAPOR CONTROL SYSTEM CALCULATIONS

CHRIS CODE	NAME	COMP GROUP	SUB CHAP	GRADE	HULL TYPE	VCS CAT	REST.	LIQ SG	VAPOR PRESS	VAPOR SG	VAPOR AIR WEIGHT DENSITY	VAPOR GROWTH RATE	VAPOR FLOW RATE (lb/d)	AIR EQUIV FLOW RATE (lb/hr)	PRESSURE DROP TO PW VALVE IN VCS (LOADING) (psig)	PRESSURE DROP TO SHORE CONN IN VCS (LOADING)* (psig)
146	OIL	33	D	C/D	NA	1	NA	0.950	5.800	2.970	0.130	1.116	5580	7293	0.075	0.128
147	OSX	33	D	E	NA	1	NA	0.950	0.149	2.970	0.078	1.003	5015	5064	0.036	0.062
148	OTW	33	D	D/E	NA	1	NA	0.880	0.560	8.000	0.095	1.011	5056	5639	0.045	0.077
149	PAL	20	D	C	NA	1	NA	0.800	1.200	2.070	0.082	1.024	5120	5323	0.040	0.068
150	PAT	34	D	C	NA	1	NA	0.870	1.900	3.520	0.099	1.038	5190	5912	0.050	0.084
151	PBY	32	D	D	NA	1	NA	0.860	0.600	4.200	0.085	1.012	5060	5356	0.041	0.069
152	PLB	30	D	E	NA	1	NA	0.910	0.010	0.010	0.076	1.000	5001	5003	0.036	0.060
153	PTE	31	D	A	III	5	NA	0.637	24.945	2.500	0.323	1.250	6250	12883	0.236	0.400
154	PTY	30	D	A	III	5	NA	0.620	27.000	2.480	0.347	1.250	6250	13350	0.253	0.430
156	TCP	34	D	E	NA	1	NA	1.170	0.010	12.700	0.077	1.000	5001	5023	0.036	0.061
155	TEB	32	D	E	NA	1	NA	0.860	0.050	5.600	0.077	1.001	5005	5044	0.036	0.061
157	TEG	40	D	E	NA	1	NA	1.120	0.010	5.170	0.076	1.000	5001	5011	0.036	0.061
158	THN	32	D	E	NA	1	NA	0.980	0.040	4.550	0.077	1.001	5004	5030	0.036	0.061
159	TOL	32	D	C	NA	1	NA	0.870	1.500	3.140	0.091	1.030	5150	5642	0.045	0.077
160	TTG	40	D	E	NA	1	NA	1.130	0.010	6.700	0.076	1.000	5001	5014	0.036	0.061
Max Vapor Density Cargo	PTY iso-Pentane	30	D	A	III	5	NA	0.620	27.000	2.480	0.347	1.250	6250	13350	0.253	0.430
Max Pressure Drop Cargo	PTY iso-Pentane	30	D	A	III	5	NA	0.620	27.000	2.480	0.347	1.250	6250	13350	0.253	0.430

**LIQUID TRANSFER RATE vs FACILITY PRESSURE  
BASED ON PRESSURE DROP FROM  
CARGO TANK #1 TO FACILITY CONNECTION WITH DUAL LOADING**



**LIQUID TRANSFER RATE vs PIPING PRESSURE DROP  
CARGO TANK #1 TO FACILITY CONNECTION WITH DUAL LOADING**





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



1. Vessel Name \_\_\_\_\_  
 Official Number \_\_\_\_\_

Shipyard \_\_\_\_\_  
 Hull # \_\_\_\_\_

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: \_\_\_\_\_ 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** \_\_\_\_\_ bbl/hr loading  
 \_\_\_\_\_ 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 \_\_\_\_\_ lbm/ft3  
 b. Cargo Name \_\_\_\_\_ lbm/ft3

6. **VCS Categories Requested (list):** \_\_\_\_\_

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	_____	_____
b. Most Remote Cargo Tank to VCS Facility Connection	_____	_____
c. $\Delta P$ across P/V valve @ cargoes' Maximum Transfer Rate	_____	_____
d. $\Delta P$ across Vacuum P/V @ MTR or Max. Discharge Rate	_____	_____
e. $\Delta P$ across Spill Valve for Max. Density Cargo at MTR	_____	_____

8. **Pressure Vacuum Valve:**

Manufacturer \_\_\_\_\_  
 Model/Size \_\_\_\_\_  
 CG Approval Number \_\_\_\_\_

**Settings in psig:**  
 Pressure-side \_\_\_\_\_  
 Vacuum-side \_\_\_\_\_

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

9. **VCS Pipe Sizes:**  
 Longitudinal Header \_\_\_\_\_ Inches Transverse Headers \_\_\_\_\_ 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 type="checkbox"/>	_____	Setting in psig	_____
b. Overfill Control Shutdown	<input type="checkbox"/>	_____		
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  $\Delta P$  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](http://www.msc.uscg/hq/msc) for an example.

14. Previous VCS approval letters: \_\_\_\_\_

PORT TANKS SHOWN STBD TANK SIMILAR

TANK LIST

Part	Type	Reference Point		
		Long	Trans	Vert
CT1.P	INTACT TANK	73.83a	11.04p	17.08
CT2.P	INTACT TANK	160.63a	11.04p	17.08
CT3.P	INTACT TANK	247.62a	11.04p	17.08

Distances in FEET.-----

FULL LOAD TANKS AT 100%

TANK STATUS

Trim: zero, Heel: zero

Part	BBLs.	SpGr	Weight (ST)	LCG	TCG	VCG	RefHt
CT1.P	5325.1	1.050	979.90	74.08a	11.86p	9.37	
CT2.P	5195.8	1.050	956.10	161.15a	11.86p	9.37	
CT3.P	4917.3	1.050	904.86	245.33a	11.85p	9.00	
Total Tanks	----->		2,840.86	157.93a	11.86p	9.25	

Distances in FEET.-----

**HIGH LEVEL SETPOINT** AT 0.95 OF FULL LOAD 46CFR39.20-7(c)(1)

TANK STATUS

Trim: zero, Heel: zero

Part	BBLs.	SpGr	Weight (ST)	LCG	TCG	VCG	RefHt
CT1.P	5058.8	1.050	930.90	74.06a	11.93p	9.01	1.28
CT2.P	4936.0	1.050	908.30	161.13a	11.93p	9.01	1.28
CT3.P	4671.3	1.050	859.60	245.75a	11.91p	8.62	1.43
Total Tanks	----->		2,698.80	158.05a	11.92p	8.89	

Distances in FEET.-----

OVERFILL SETPOINT BASED ON 0.985 OF FULL LOAD 46CFR39.30-1(e)(1)

TANK STATUS

Trim: zero, Heel: zero

Part	BBLs.	SpGr	Weight (ST)	LCG	TCG	VCG	RefHt
CT1.P	5245.1	1.050	965.18	74.06a	11.93p	9.26	0.77
CT2.P	5117.7	1.050	941.75	161.13a	11.93p	9.26	0.77
CT3.P	4842.8	1.050	891.16	245.46a	11.91p	8.88	0.82
Total Tanks	----->		2,798.09	157.95a	11.92p	9.14	

Distances in FEET.-----

**OVERFILL SETPOINT** BASED ON 60SEC AT 5000BBL/HR 46CFR39.20-9(b)(2)

TANK STATUS

Trim: zero, Heel: zero

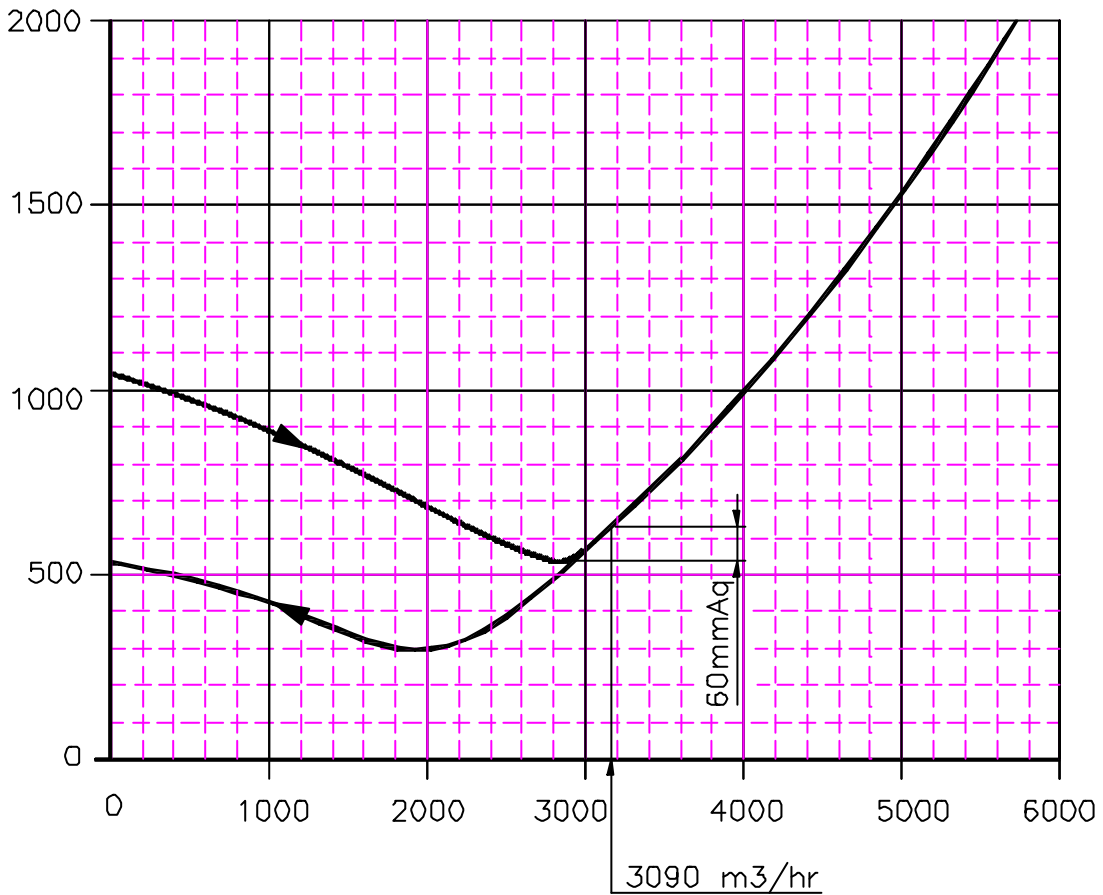
Part	BBLs.	SpGr	Weight (ST)	LCG	TCG	VCG	RefHt
CT1.P	5241.7	1.050	964.55	74.06a	11.93p	9.25	0.78
CT2.P	5112.4	1.050	940.76	161.13a	11.93p	9.25	0.79
CT3.P	4833.4	1.050	889.43	245.48a	11.91p	8.87	0.85
Total Tanks	----->		2,794.74	157.92a	11.92p	9.13	

Distances in FEET.-----

# HIGH VELOCITY VENT VALVE FLOW CAPACITY CURVE

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

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

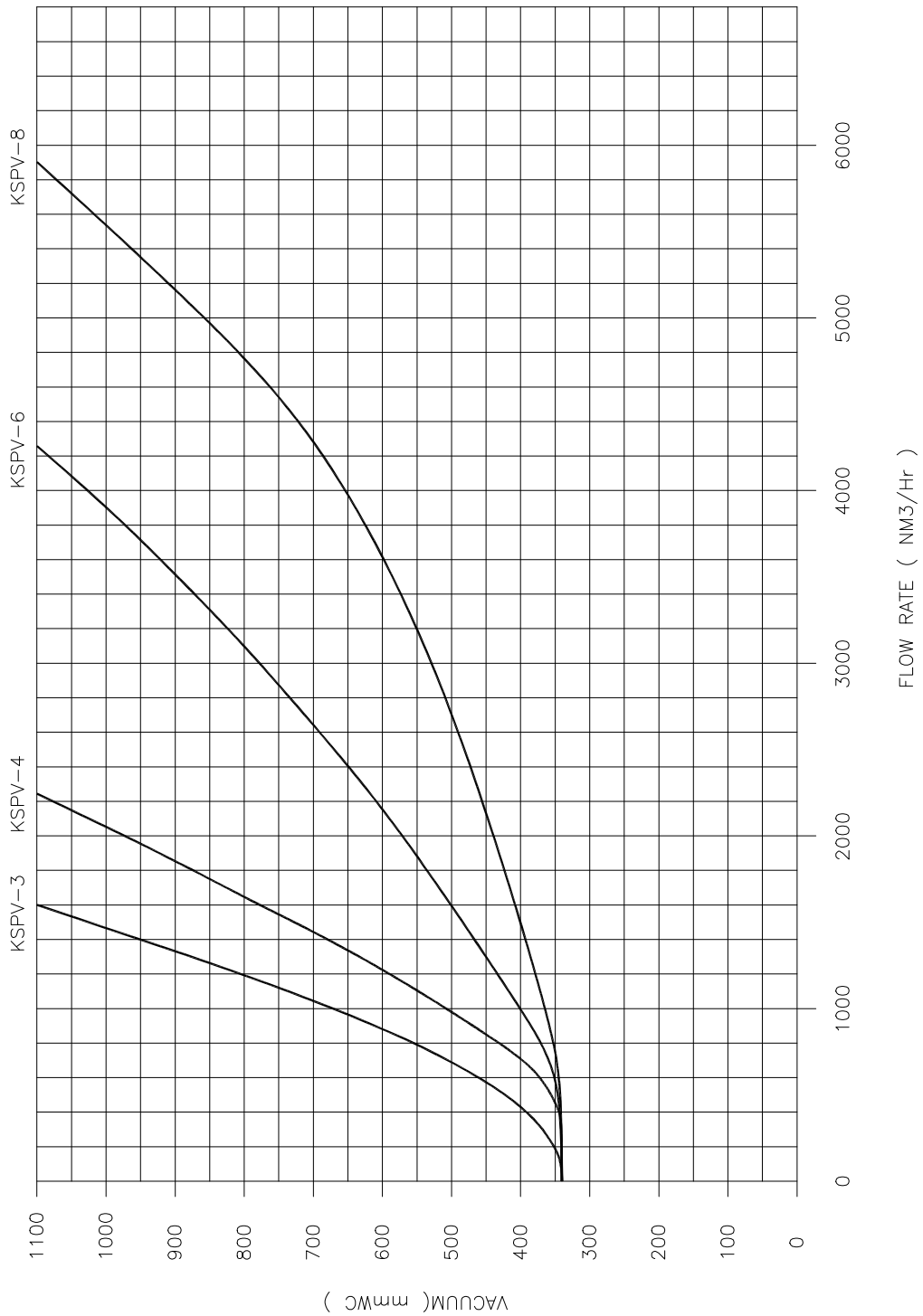


FLOW CAPACITY CURVE, SCM(HStandard cubic meter per hour)  
 (1SCMH = 6.289BBL/hr)

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 <sup>2</sup>	

# FLOW CAPACITY CURVE GRAPH

FLOW TEST PERFORMED ON EQUIPMENT  
USING AIR, AT TEMP. T=15.6°C AND  
AMBIENT PRESSURE P=1.0332 KG/CM<sup>2</sup>.



**TANKTECH**

TITLE *HIGH VELOCITY VACUUM RELIEF VALVE*  
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*KSPV TYPE*