

Vapor Collection System Pressure Drop Calculations

for

Hull 455

for

Raymond and Associates, LLC.

rev. 1

12 April, 2012

Prepared by: The Shearer Group, Inc
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Vessel Information:

Builder: Raymond and Associates, LLC
Hull #: 455
O.N. 1237980
Owner: Harley Marine Gulf, LLC
Name: "Paige Katherine"
Length: 297.5 ft
Breadth: 54.0 ft
Depth: 12.0 ft
Classification: n/a
Service: Rivers, Lakes, Bays, Sounds
Cargo: Subchapter D

Vapor System Information:

Pipe:

Header: 8" schedule 40
Manifold: 8" schedule 40

Notes:

All tanks are to be connected to the main header and PV valve during cargo loading or discharge. Port and Starboard tanks to be loaded simultaneously.

High-Velocity P-V Valve:

ERL SUPERAC MODEL II

Pressure Setting:			1.5 psi	
Vacuum Setting:			0.5 psi	
Flow Capacity:	16436 BBL/hr	@	2.23 psi	loading (pressure)
	10673 BBL/hr	@	0.49 psi	discharge (vacuum)

Maximum Liquid Loading Rate:

5000 BBL/hr

Maximum Discharge Rate:

5000 BBL/hr

Maximum Vapor-Air Mixture Density:

0.347 lb/ft³ for Subchapter D

Summary of Calculations:

1. Cargo Authority

The vapor collection system on this barge is designed to carry the cargoes listed in the accompanying List of Allowable Cargoes.

These calculations estimate the flow characteristics for a number of cargoes in terms of a suitable flowrate for the vapor collection and overpressure protection system only. These calculations do not assess additional carriage considerations which may exist for the listed cargoes (e.g. IBC & USCG requirements) based on other characteristics of the cargoes - toxicity, pollution potential, pressure and temperature restrictions, and other hazardous characteristics which may affect vessel outfit, equipment, and operations.

The VCS cargoes shall be listed on the barge's Certificate of Inspection, pending carriage authority from USCG.

2. Vapor-Air Mixture Density and Vapor Growth Rate

The maximum vapor-air mixture density, estimated in accordance with USCG "Industry Guidelines for Determining the Maximum Liquid Transfer Rate for A Tank Vessel Transferring a Flammable or Combustible Cargo Using a Vapor Control System (USCG Guidelines) is:

0.347 lb/ft³ for a 50/50 mixture of air and **Subchapter O/D products**

The vapor growth rate is calculated in accordance with the USCG Guidelines, as $R = 1 + 0.25 (VP/12.5)$; however, a minimum of 1.25 is used in all loading cases, in accordance with ABS SBR 5-2-3/7.5.2(d) and 46 CFR 39.30-1(b)(2) as stipulated for crude oil, benzene, and gasoline blends.

See the accompanying List of Allowable Cargoes or specific data on vapor-air mixture density and vapor growth rates for various cargoes.

3. Maximum Liquid Transfer Rate as Imposed by the Capacity of the Cargo Tank Venting Systems (46 CFR 39.20-11 & 39.30-1(d))

Design Cargo S.G.: 1.05
Deck Design Pressure/Vacuum: 3.00 psig

LOADING:

Tank #1 presents the longest equivalent pipe run to the high-velocity P-V valve. Using friction factors appropriate to the applicable pipe sizes, the maximum pressure drop through the vapor control piping at the maximum liquid transfer rate of

5000 BBL/hr is:

The air-equivalent flowrate through the P-V valve is: 0.343 psi for a 50/50 mix of air and **Subchapter D products**
16436 BBL/hr
The pressure drop across the P-V valve at this flowrate is: 2.23 psi
The total pressure drop: 2.57 psi ≤ the design pressure of 3.00 psi

DISCHARGE:

The maximum pressure drop through the vapor piping at the maximum discharge rate of 5000 BBL/hr is:

The air-equivalent flowrate through the P-V valve is: 0.147 psi for a 50/50 mix of air and **Subchapter D products**
10673 BBL/hr (a density adjustment is conservatively used to provide for fouling)
The pressure drop across the P-V valve at this flowrate is: 0.49 psi
The total pressure drop: 0.64 psi ≤ the design pressure of 3.00 psi

4. Maximum Liquid Transfer Rate as Imposed by the Spill Valves (46 CFR 39.20-9(c)(3))

No spill valves are installed on the vessel.

5. Maximum Liquid Transfer Rate as Imposed by the Set Point of the High-Level Alarm (46 CFR 39.20-7(c)(1) and -9(b)(2))

High Level Alarm Set Point:

Cargo Height: 12.83 ft (Approx) Tank #1 at 95% load, per 46 CFR 39.30-1(e)(1) and ABS SBR 5-2-3/7.19.2
High-Level Sensor Height: 12.83 ft (corresponds to 95% load)
Cargo Volume above Sensor: 836 BBL
Maximum Tank Loading Rate: 2500 BBL/hr per tank
Time to Overfill: 1203.8 sec

6. Maximum Liquid Transfer Rate as Imposed by the Pressure Drop to the Facility Vapor Connection (46 CFR 39.30-1(d)(3))

The pressure drop through the most restrictive path (Tank #1) to the facility vapor connection shall not exceed 80% of the P-V valve setting. Pressure Drop calculations for each cargo at 25%, 50%, 75% and 100% of maximum loading rate are attached. From this data, a plot of allowable pressure at the facility vapor connection versus liquid loading rate is generated.

Curves are provided for representative cargoes, including:

the heaviest: Pentane (iso-) with a Vapor-Air mixture density of 0.347 lb/ft³
and the lightest: with a mixture density of 0.076 lb/ft³

as well as intermediate cargoes.

The maximum allowable backpressure at the FVC is: 0.524 PSIG for the highest density cargo at the maximum loading rate.

The operator shall monitor pressure at the facility vapor connection and adjust the loading rate when necessary, for the particular cargo being loaded, in order to maintain cargo tank pressure within acceptable limits.

Pipe Length and Valve & Fitting Equivalent Lengths:

Pipe sizes, nominal (in): 8
 Pipe ID (in): 7.981
 Pipe ID (ft): 0.665
 Pipe Flow Area (in²): 50.03
 Reynold's Number: Varies (see attached sheets)
 f, friction factor, pipe: Varies (see attached sheets)
 f_v, friction factor (fittings): 0.014

Friction Factors for Clean Commercial Steel Pipe, Crane 410 Table A-25, function of Reynold's Number, pipe condition, and pipe diameter (see attached sheets)

Pipe Friction Data for Clean Commercial Steel Pipe (Turbulent Flow), Crane 410, Table A-25

CONDITION #1 - Relief through P/V Valve during loading or discharge

From #1 Cargo Tank to P/V Valve (per 46 CFR 39.30 - 1(d)(1)&(2) and ABS SBR 5-2-3/7.5.2(a)&(b))

PIPE

Description	ID (in)	Length (ft)
Straight Pipe	7.981	125.38

L_{8"} PIPE: 125.38 ft

VALVES & FITTINGS

Description	ID (in)	Qty	L _{eq} /D = K/f _t ¹	K ²	L _{eq} ³
Entrance	7.981	1	56	0.78	37.055
T-Branch	7.981	2	60		39.905
T-Run	7.981	2	20	0.28	13.302
90° Elbow	7.981	1	30	0.42	19.953
Butterfly Valve	7.981	1	45	0.63	29.929
8x6 reducer (sudden)	7.981	1	49	0.69	32.844

Total K	Total L _{eq}
0.78	37.05
1.68	79.81
0.56	26.60
0.42	19.95
0.63	29.93
0.69	32.84

L_{EQ8"} VALVES & FITTINGS: 226.19 ft

CONDITION #2 - Vapor Collection via Shore Connection

From #1 Cargo Tank to Shore Connection (per 46 CFR 39.30 - 1(d)(3) and ABS SBR 5-2-3/7.5.2(c))

PIPE

Description	ID (in)	Length (ft)
Straight Pipe	7.981	221.944

L_{8"} PIPE: 221.94 ft

Vapor Recovery Hose ⁴	6.065	50.000
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L_{6"} HOSE: 50.000 ft

VALVES & FITTINGS

Description	ID (in)	Qty	L _{eq} /D = K/f _t ¹	K ²	L _{eq} ³
Entrance	7.981	1	56	0.78	37.055
T-Branch	7.981	2	60		39.905
T-Run	7.981	4	20	0.28	13.302
90° Elbow	7.981	1	30	0.42	19.953
45° Elbow	7.981	4	16	0.22	10.641
Butterfly Valve	7.981	1	45	0.63	29.929
8x6 reducer (60°)	7.981	1	35	0.49	23.224

Total K	Total L _{eq}
0.78	37.05
1.68	79.81
1.12	53.21
0.42	19.95
0.90	42.57
0.63	29.93
0.49	23.22

L_{EQ8"} VALVES & FITTINGS: 285.74 ft

- 1) L_{eq}/D and K determined from "K" Factor table, sheets 1-4, Crane 410 pp A-26 thru A-29 for valves & fittings based on turbulent flow friction factor.
- 2) K calculated from tabular L_{eq}/D and ft values where applicable: $K = f_t (L_{eq}/D)$ or directly from tabular data, where given.
- 3) Valve or fitting equivalent length based on pipe ID: $L_{eq} = (L_{eq}/D) \times D$ or L_{eq} = KD/f_t when taken directly from tabular data.
- 4) Hose friction factor assumed similar to Sch 40 clean commercial steel pipe, based on available manufacturer information.

SUBCHAPTER "D" CARGOES

	CHRIS CODE	PRODUCT	LIQ SG	VAPOR PRESS @ 115F (psia)	VAPOR SG	VAPOR AIR WEIGHT DENSITY ¹ (lb/ft ³)	VAPOR GROWTH RATE ²	DENSITY CORRECTION FACTOR ³	Loading		Discharge	
									VAPOR FLOW RATE (BBL/hr)	AIR EQUIVALENT FLOW RATE (BBL/hr)	VAPOR FLOW RATE (BBL/hr)	AIR EQUIVALENT FLOW RATE (BBL/hr)
1	ACT	Acetone	0.79	10.0	2.00	0.123	1.25	1.27	6250	7949	5000	6359
2	ACP	Acetophenone	1.03	0.60	4.14	0.085	1.25	1.06	6250	6604	5000	5283
19	AAT	Amyl Acetate (iso-)	0.88	0.33	4.48	0.082	1.25	1.03	6250	6468	5000	5174
20	AAI	Amyl Alcohol (iso-, no, sec-, primary) (See also IAA)	0.82	0.30	3.04	0.079	1.25	1.02	6250	6367	5000	5094
21	AAN	Amyl Alcohol (n.)	0.82	0.30	3.04	0.079	1.25	1.02	6250	6367	5000	5094
23	APM	Amyl Alcohol, Primary	0.82	0.30	3.04	0.079	1.25	1.02	6250	6367	5000	5094
24	ASE	Amyl Alcohol, (sec-)	0.82	0.30	3.04	0.079	1.25	1.02	6250	6367	5000	5094
26	IAA	Amyl Alcohol, (iso-)	0.82	0.30	3.04	0.079	1.25	1.02	6250	6367	5000	5094
34	BAL	Benzyl Alcohol	1.05	0.10	3.73	0.077	1.25	1.01	6250	6303	5000	5042
40	BAX	Butyl Acetate (iso-, n-)	0.87	0.60	4.00	0.085	1.25	1.05	6250	6588	5000	5271
42	BTA	Butyl Acetate (sec-)	0.89	1.50	4.00	0.097	1.25	1.13	6250	7065	5000	5652
44	IAL	Butyl Alcohol (iso-)	0.81	0.90	2.60	0.083	1.25	1.04	6250	6522	5000	5218
46	BAS	Butyl Alcohol (sec-)	0.81	1.30	2.60	0.086	1.25	1.06	6250	6639	5000	5311
47	BAT	Butyl Alcohol (tert-)	0.78	2.80	2.60	0.097	1.25	1.13	6250	7062	5000	5649
48	BPH	Butyl Benzyl Phthalate	1.12	0.01	10.80	0.077	1.25	1.00	6250	6269	5000	5015
58	BUE	Butyl Toluene	0.85	0.10	5.11	0.078	1.25	1.01	6250	6329	5000	5063
64	CLS	Caprolactam Solutions	1.02	0.05	3.90	0.077	1.25	1.00	6250	6278	5000	5022
70	CUM	Cumene	0.86	0.60	4.20	0.085	1.25	1.06	6250	6610	5000	5288
72	CHX	Cyclohexane	0.78	4.50	2.90	0.116	1.25	1.24	6250	7726	5000	6180
73	CHN	Cyclohexanol	0.95	0.15	3.45	0.078	1.25	1.01	6250	6321	5000	5056
74	CPD	1,3-Cyclopentadiene dimer (molten)	0.69	0.25	4.55	0.080	1.25	1.03	6250	6419	5000	5135
76	CMP	Cymene (para-)	0.86	0.11	4.62	0.078	1.25	1.01	6250	6326	5000	5061
77	DHN	Decahydronaphthalene	0.89	0.10	4.76	0.078	1.25	1.01	6250	6322	5000	5058
78	IDA	Decaldehyde (iso-)	0.83	0.01	5.00	0.076	1.25	1.00	6250	6258	5000	5006
79	DAL	Decaldehyde (n-)	0.83	0.00	5.01	0.076	1.25	1.00	6250	6250	5000	5000
81	DCE	Decane	0.74	0.12	4.80	0.078	1.25	1.01	6250	6337	5000	5070
82	DAX	Decyl Alcohol (all isomers) (Decanol)	0.83	0.01	5.30	0.076	1.25	1.00	6250	6258	5000	5007
83	ISA	Decyl Alcohol (iso-)	0.83	0.01	5.30	0.076	1.25	1.00	6250	6258	5000	5007
84	DAN	Decyl Alcohol (n-)	0.83	0.01	5.30	0.076	1.25	1.00	6250	6258	5000	5007
85	DBZ	Decylbenzene (n-)	0.86	0.01	7.52	0.076	1.25	1.00	6250	6263	5000	5010
87	DAA	Diacetone Alcohol	0.97	0.10	4.00	0.078	1.25	1.01	6250	6308	5000	5046
91	DPA	Dibutyl Phthalate (ortho-)	1.05	0.00	9.59	0.076	1.25	1.00	6250	6250	5000	5000
92	DPT	Dicyclopentadiene, See 1,3-Cyclopentadiene Dimer (mo	0.98	0.25	4.55	0.080	1.25	1.03	6250	6419	5000	5135
93	DEB	Diethylbenzene	0.87	0.08	4.62	0.077	1.25	1.01	6250	6306	5000	5045
94	DEG	Diethylene Glycol	1.12	0.01	3.66	0.076	1.25	1.00	6250	6255	5000	5004
95	DME	Diethylene Glycol Butyl Ether	0.95	0.01	5.50	0.076	1.25	1.00	6250	6259	5000	5007
100	DGA	Diethylene Glycol Ethyl Ether Acetate	0.99	0.02	4.62	0.076	1.25	1.00	6250	6264	5000	5011
101	DGM	Diethylene Glycol Methyl Ether	1.03	0.03	4.14	0.077	1.25	1.00	6250	6268	5000	5015
111	DBC	Diisobutylcarbinol	0.81	0.09	4.97	0.078	1.25	1.01	6250	6319	5000	5055
112	DBL	Diisobutylene	0.72	2.00	3.86	0.103	1.25	1.16	6250	7270	5000	5816
113	DIX	Diisobutyl Ketone	0.81	0.16	4.90	0.079	1.25	1.02	6250	6369	5000	5095
119	DIX	Diisopropylbenzene (all isomer)	0.86	0.03	5.60	0.077	1.25	1.00	6250	6277	5000	5021
124	DTL	Dimethyl Phthalate	1.19	0.00	6.69	0.076	1.25	1.00	6250	6250	5000	5000
128	DIF	Dinonyl Phthalate	0.97	0.01	14.40	0.077	1.25	1.00	6250	6276	5000	5021
130	DOP	Diocetyl Phthalate	0.98	0.00	13.47	0.076	1.25	1.00	6250	6250	5000	5000
131	DPN	Dipentene	0.84	0.10	4.90	0.078	1.25	1.01	6250	6325	5000	5060
132	DIL	Diphenyl	0.99	0.01	5.31	0.076	1.25	1.00	6250	6258	5000	5007
133	DDO	Diphenyl, Diphenyl Ether Mixture	1.07	0.01	5.86	0.076	1.25	1.00	6250	6259	5000	5008
134	DPE	Diphenyl Ether	1.07	0.01	5.87	0.076	1.25	1.00	6250	6259	5000	5008
136	DPG	Dipropylene Glycol	1.03	0.07	4.63	0.077	1.25	1.01	6250	6299	5000	5039
139	DFF	Distillates: Flashed Feed Stocks	0.75	2.30	3.40	0.102	1.25	1.16	6250	7237	5000	5790
140	DSR	Distillates: Straight Run	0.73	2.30	3.40	0.102	1.25	1.16	6250	7237	5000	5790
145	DOZ	Dodecene (all isomers)	0.76	0.02	5.81	0.077	1.25	1.00	6250	6269	5000	5015
146	DOD	Dodecane	0.76	0.02	5.81	0.077	1.25	1.00	6250	6269	5000	5015
147	DDB	Dodecylbenzene	0.86	4.70	8.40	0.240	1.25	1.77	6250	11088	5000	8870
155	ETG	Ethoxy Triglycol (crude)	1.02	0.00	6.14	0.076	1.25	1.00	6250	6250	5000	5000
156	ETA	Ethyl Acetate	0.90	4.50	3.04	0.119	1.25	1.25	6250	7823	5000	6259
157	EAA	Ethyl Acetoacetate	1.03	0.20	4.48	0.079	1.25	1.02	6250	6383	5000	5106
158	EAL	Ethyl Alcohol (Ethanol)	0.79	3.50	1.60	0.086	1.25	1.06	6250	6643	5000	5314
160	ETB	Ethyl Benzene	0.87	0.60	3.56	0.083	1.25	1.05	6250	6540	5000	5232
161	EBT	Ethyl Butanol	0.83	0.12	3.52	0.078	1.25	1.01	6250	6308	5000	5047
162	EBR	Ethyl Butyrate	0.88	1.00	4.00	0.090	1.25	1.09	6250	6804	5000	5443
163	ECY	Ethyl Cyclohexane	0.79	0.50	3.87	0.083	1.25	1.04	6250	6521	5000	5217
166	EGL	Ethylene Glycol	1.19	0.01	2.21	0.076	1.25	1.00	6250	6252	5000	5002
169	EMA	Ethylene Glycol Butyl Ether Acetate	0.94	0.05	5.52	0.077	1.25	1.01	6250	6294	5000	5035
172	EGY	Ethylene Glycol Diacetate	1.10	0.01	5.03	0.076	1.25	1.00	6250	6258	5000	5006
178	EME	Ethylene Glycol Methyl Ether	1.10	0.01	4.80	0.076	1.25	1.00	6250	6257	5000	5006
180	EPE	Ethylene Glycol Phenyl Ether	1.10	0.01	4.80	0.076	1.25	1.00	6250	6257	5000	5006
184	EHA	2-Ethylhexaldehyde, See Octyl Aldehydes	0.82	0.17	4.41	0.079	1.25	1.02	6250	6361	5000	5089
186	EHX	2-Ethylhexanol, see Octanol (all isomers)	0.84	0.02	4.50	0.076	1.25	1.00	6250	6264	5000	5011
190	EPR	Ethyl Propionate	0.89	3.50	1.60	0.086	1.25	1.06	6250	6643	5000	5314
191	ETE	Ethyl Toluene	0.88	0.28	4.15	0.080	1.25	1.03	6250	6418	5000	5134
194	FAM	Formamide	1.13	0.10	1.55	0.076	1.25	1.00	6250	6261	5000	5009
195	FAL	Furfuryl Alcohol	1.13	0.05	3.40	0.077	1.25	1.00	6250	6273	5000	5019
197	GAK	Gasoline Blended Stocks: Alkylates	0.75	12.5	3.40	0.217	1.25	1.69	6250	10555	5000	8444
198	GRF	Gasoline Blended Stocks: Reformate	0.80	12.5	3.40	0.217	1.25	1.69	6250	10555	5000	8444
199	GAT	Gasolines: Automotive (containing not over 4.23 grams	0.74	12.5	3.40	0.217	1.25	1.69	6250	10555	5000	8444
200	GAV	Gasolines: Aviation (containing not over 4.86 grams lead	0.71	12.5	3.40	0.217	1.25	1.69	6250	10555	5000	8444
201	GCS	Gasolines: Casinghead	0.67	12.5	3.40	0.217	1.25	1.69	6250	10555	5000	8444
202	GPL	Gasolines: Polymer	0.75	12.5	3.40	0.217	1.25	1.69	6250	10555	5000	8444
203	GSR	Gasolines: Straight Run	0.75	12.5	3.40	0.217	1.25	1.69	6250	10555	5000	8444
204	GCR	Glycerine	1.26	0.00	3.17	0.076	1.25	1.00	6250	6250	5000	5000

217	HMX	Heptane (all isomers) (Methylhexane)	0.68	2.50	3.45	0.105	1.25	1.17	6250	7337	5000	5870
218	HPT	Heptane (n-)	0.68	2.50	3.45	0.105	1.25	1.17	6250	7337	5000	5870
219	HEP	Heptonic Acid	0.92	0.01	4.49	0.076	1.25	1.00	6250	6257	5000	5005
220	HTX	Heptanol (all isomers)	0.82	0.04	4.00	0.077	1.25	1.00	6250	6273	5000	5019
221	HTN	Heptanol (all isomers)	0.82	0.04	4.00	0.077	1.25	1.00	6250	6273	5000	5019
222	HPX	Heptene (all isomers)	0.70	2.90	3.40	0.109	1.25	1.20	6250	7473	5000	5979
223	THE	Heptene (1-)	0.70	2.80	3.40	0.108	1.25	1.19	6250	7434	5000	5948
224	HPE	Heptyl Acetate	0.88	0.10	5.50	0.078	1.25	1.01	6250	6336	5000	5069
229	HXS	Hexane (all isomers)	0.66	7.00	3.00	0.142	1.25	1.37	6250	8534	5000	6827
230	HXA	Hexane	0.66	7.00	3.00	0.142	1.25	1.37	6250	8534	5000	6827
231	HXO	Hexanoic Acid	0.93	0.01	4.00	0.076	1.25	1.00	6250	6256	5000	5005
232	HXN	Hexanol	0.82	1.00	3.52	0.088	1.25	1.07	6250	6719	5000	5375
234	HEX	Hexene (all isomers)	0.67	8.00	2.90	0.148	1.25	1.39	6250	8702	5000	6961
235	HXE	Hexene (1-)	0.67	8.20	2.90	0.149	1.25	1.40	6250	8754	5000	7004
236	HXT	Hexene (2-)	0.67	8.20	2.90	0.149	1.25	1.40	6250	8754	5000	7004
238	HXG	Hexylene Glycol	0.92	0.01	1.10	0.076	1.25	1.00	6250	6250	5000	5000
243	IPH	isophorone	0.93	0.01	4.75	0.076	1.25	1.00	6250	6257	5000	5006
244	JPO	Jet Fuels: JP-1 (Kerosene)	0.80	0.14	4.50	0.078	1.25	1.02	6250	6344	5000	5075
245	JPT	Jet Fuels: JP-3	0.80	8.51	4.50	0.216	1.25	1.68	6250	10531	5000	8425
246	JPF	Jet Fuels: JP-4	0.81	3.40	4.00	0.124	1.25	1.28	6250	7979	5000	6383
247	JPV	Jet Fuels: JP-5 (Kerosene, heavy)	0.82	0.10	4.00	0.078	1.25	1.01	6250	6308	5000	5046
249	KRS	Kerosene	0.81	0.15	4.50	0.079	1.25	1.02	6250	6351	5000	5080
263	MTT	Methyl Acetate	0.92	6.10	2.60	0.122	1.25	1.27	6250	7912	5000	6330
265	MAL	Methyl Alcohol (See Methanol)	0.79	6.63	1.10	0.079	1.25	1.02	6250	6377	5000	5101
266	MAC	Methyl Amyl Acetate	0.86	0.33	4.97	0.082	1.25	1.04	6250	6498	5000	5198
267	MAA	Methyl Amyl Alcohol	0.81	0.43	3.52	0.081	1.25	1.03	6250	6456	5000	5165
271	MBK	Methyl n-Butyl Ketone	0.81	0.97	3.50	0.088	1.25	1.07	6250	6702	5000	5361
273	MBU	Methyl Butyrate	0.90	1.26	3.53	0.091	1.25	1.09	6250	6838	5000	5470
274	MEK	Methyl Ethyl Ketone	0.80	4.50	2.50	0.108	1.25	1.19	6250	7439	5000	5951
275	MTF	Methyl Formal (Dimethyl Formal)	0.86	15.4	2.60	0.208	1.31	1.65	6542	10805	5000	8258
276	MHK	Methyl Heptyl Ketone	0.83	0.06	4.90	0.077	1.25	1.01	6250	6295	5000	5036
278	MIK	Methyl Isobutyl Ketone	0.80	1.15	3.45	0.089	1.25	1.08	6250	6772	5000	5418
281	MNA	1-Methyl Napthalene	1.02	0.01	4.91	0.076	1.25	1.00	6250	6258	5000	5006
283	MPN	2-Methyl-1-Pentene	0.69	6.30	2.90	0.132	1.25	1.32	6250	8242	5000	6594
284	MTN	5-Methyl-1-Pentene	0.67	8.49	2.90	0.152	1.25	1.41	6250	8830	5000	7064
286	MBE	Methyl Tert-Butyl Ether (MTBE)	0.74	0.04	3.10	0.077	1.25	1.00	6250	6266	5000	5013
288	MNS	Mineral Spirits	0.75	0.20	4.30	0.079	1.25	1.02	6250	6376	5000	5101
289	MRE	Myrcene	0.80	0.17	4.70	0.079	1.25	1.02	6250	6370	5000	5096
295	NSV	Naphtha: Solvent	0.87	0.20	3.50	0.078	1.25	1.02	6250	6346	5000	5077
296	NSS	Naphtha: Stoddard Solvant	0.78	0.20	4.30	0.079	1.25	1.02	6250	6376	5000	5101
297	NVM	Naphtha: Vamish Maker's and Painters (75%)	0.77	0.19	4.30	0.079	1.25	1.02	6250	6370	5000	5096
300	NAX	Nonane (all isomers)	0.72	0.27	4.40	0.080	1.25	1.03	6250	6425	5000	5140
301	NAN	Nonane	0.72	0.27	4.40	0.080	1.25	1.03	6250	6425	5000	5140
304	NON	Nonene	0.73	0.35	4.30	0.082	1.25	1.04	6250	6469	5000	5175
305	NNS	Nonyl Alcohol (all isomers)	0.94	0.10	5.00	0.078	1.25	1.01	6250	6327	5000	5061
306	NNN	Nonyl Alcohol	0.94	0.10	5.00	0.078	1.25	1.01	6250	6327	5000	5061
307	NNI	Nonyl Alcohol (iso-)	0.94	0.10	5.00	0.078	1.25	1.01	6250	6327	5000	5061
309	NNP	Nonyl Phenol	0.95	0.01	7.60	0.076	1.25	1.00	6250	6263	5000	5010
316	OAX	Octane (all isomers)	0.70	0.79	3.90	0.087	1.25	1.07	6250	6677	5000	5342
317	OAN	Octane	0.70	0.79	3.90	0.087	1.25	1.07	6250	6677	5000	5342
318	OAA	Octanoic Acid (all isomers)	0.91	0.01	5.00	0.076	1.25	1.00	6250	6258	5000	5006
319	OCX	Octanol (all isomers)	0.83	0.01	4.48	0.076	1.25	1.00	6250	6257	5000	5005
320	OTA	Octanol	0.83	0.01	4.48	0.076	1.25	1.00	6250	6257	5000	5005
321	OTX	Octene (all isomers) 2	0.72	0.90	3.90	0.088	1.25	1.08	6250	6735	5000	5388
322	OTE	Octene (1-)	0.72	1.00	3.86	0.090	1.25	1.08	6250	6779	5000	5424
324	OCX	Octyl Alcohol (iso-,n-) (all isomers), See Octanol (all isomers)	0.83	0.01	4.48	0.076	1.25	1.00	6250	6257	5000	5005
325	IOA	Octyl Alcohol	0.83	0.01	4.48	0.076	1.25	1.00	6250	6257	5000	5005
364	OTW	Fuel: NO.2	0.88	0.56	8.00	0.095	1.25	1.11	6250	6965	5000	5572
366	OFR	Fuel: NO.4	0.90	0.15	3.40	0.078	1.25	1.01	6250	6319	5000	5055
367	OFV	Fuel: No.5	0.94	0.15	3.40	0.078	1.25	1.01	6250	6319	5000	5055
366	OSX	Fuel: NO.6	0.95	0.15	3.40	0.078	1.25	1.01	6250	6319	5000	5055
382	OIL	Oil, Mlse: Crude	0.95	0.15	3.40	0.078	1.25	1.01	6250	6319	5000	5055
383	ODS	Oil, Mlse: Diesel	0.90	0.69	3.40	0.084	1.25	1.05	6250	6562	5000	5249
389	OLB	Oil, Mlse: Lubricating	0.90	0.15	1.00	0.076	1.25	1.00	6250	6250	5000	5000
403	ORS	Oil, Mlse: Resin	1.02	0.15	1.00	0.076	1.25	1.00	6250	6250	5000	5000
418	OTB	Oil, Mlse: Turbine	0.87	0.30	5.40	0.082	1.25	1.04	6250	6500	5000	5200
429	PDC	Pentadecanol, See Alcohols (C13 and above)	0.83	0.01	7.88	0.076	1.25	1.00	6250	6263	5000	5011
432	PTY	Pentane (all isomers)	0.63	21.00	2.48	0.270	1.42	1.88	7100	13366	5000	9412
433	IPT	Pentane (iso-)	0.62	27.00	2.48	0.347	1.54	2.13	7700	16436	5000	10673
434	PTA	Pentane (n-)	0.63	20.44	2.50	0.265	1.41	1.86	7044	13135	5000	9323
436	PTX	Pentene (all isomers)	0.64	24.90	2.40	0.310	1.50	2.02	7490	15104	5000	10082
437	PTE	Pentene (1-)	0.64	24.90	2.40	0.310	1.50	2.02	7490	15104	5000	10082
442	PIN	Pinene	0.86	0.35	4.70	0.082	1.25	1.04	6250	6495	5000	5196
448	PLB	Polybutene	0.91	0.01	79.30	0.080	1.25	1.02	6250	6399	5000	5120
457	PGC	Polypropylene Glycol	1.01	0.10	1.00	0.076	1.25	1.00	6250	6250	5000	5000
458	PGM	Polypropylene Glycol Methyl Ether	0.92	0.80	3.11	0.084	1.25	1.05	6250	6568	5000	5254
464	IAC	Propyl Acetate (iso-)	0.89	1.80	3.52	0.097	1.25	1.13	6250	7071	5000	5657
465	PAT	Propyl Acetate (n-)	0.00	1.85	3.52	0.098	1.25	1.13	6250	7093	5000	5674
466	IPA	Propyl Alcohol (iso-)	0.79	3.00	2.07	0.091	1.25	1.09	6250	6841	5000	5473
467	PAL	Propyl Alcohol (n-)	0.80	1.20	2.07	0.082	1.25	1.04	6250	6493	5000	5194
468	PBZ	Propylbenzene (n-)	0.86	0.20	4.14	0.079	1.25	1.02	6250	6370	5000	5096
469	IPX	iso-Propylcyclohexane	0.80	0.01	4.35	0.076	1.25	1.00	6250	6257	5000	5005
473	PPG	Propylene Glycol (1,2-Propandiol)	1.04	0.01	2.62	0.076	1.25	1.00	6250	6253	5000	5003
476	PME	Propylene Glycol Methyl Ether	0.92	0.70	3.11	0.083	1.25	1.04	6250	6529	5000	5223
478	PTT	Propylene Tetramer	0.29	0.02	1.00	0.076	1.25	1.00	6250	6250	5000	5000
468	SFL	Sulfolane	1.26	0.01	4.14	0.076	1.25	1.00	6250	6256	5000	5005
493	TTN	Tetradecanol	0.82	0.00	7.39	0.076	1.25	1.00	6250	6250	5000	5000
494	TTD	1-Tetradecene, See the olefin or Alpha-Olefin Entries	0.77	0.01	6.77	0.076	1.25	1.00	6250	6261	5000	5009
496	TTG	Tetraethylene Glycol	1.12	0.01	6.70	0.076	1.25	1.00	6250	6261	5000	5009
497	THN	Tetrahydronaphthalene	0.97	0.04	4.56	0.077	1.25	1.00	6250	6278	5000	5022

499	TOL	Toluene	0.87	1.50	3.14	0.091	1.25	1.09	6250	6841	5000	5473
502	TCP	Tricresyl Phosphate (less than 1% of the ortho isomer)	1.16	0.01	12.69	0.077	1.25	1.00	6250	6273	5000	5018
503	TRD	Tridecane	0.76	0.02	6.40	0.077	1.25	1.00	6250	6271	5000	5017
505	TDN	Tridecanol, See Alcohols (C13 and above)	0.85	0.01	6.91	0.076	1.25	1.00	6250	6261	5000	5009
506	TDC	l-Tridecene	0.77	0.01	6.29	0.076	1.25	1.00	6250	6260	5000	5008
508	TEB	Triethylbenzene	0.86	0.02	5.60	0.077	1.25	1.00	6250	6268	5000	5014
509	TEG	Triethylene Glycol	1.12	0.01	5.17	0.076	1.25	1.00	6250	6258	5000	5007
519	TRE	Trimethylbenzenes (all isomers)	0.89	0.14	4.20	0.078	1.25	1.01	6250	6336	5000	5069
520	TMB	Trimethyl Benzene (1,2,5-)	0.89	0.14	4.14	0.078	1.25	1.01	6250	6334	5000	5067
521	TMD	Trimethyl Benzene (1,2,3-)	0.89	0.14	4.14	0.078	1.25	1.01	6250	6334	5000	5067
522	TME	Trimethyl Benzene (1,2,4-) (Pseudocumene)	0.89	0.14	4.14	0.078	1.25	1.01	6250	6334	5000	5067
529	TRP	Trixylenyl Phosphate	1.16	0.00	14.20	0.076	1.25	1.00	6250	6250	5000	5000
533	UDC	Undecene (1-)	0.75	0.05	5.32	0.077	1.25	1.01	6250	6292	5000	5033
534	UND	Undecyl Alcohol	0.84	0.01	5.94	0.076	1.25	1.00	6250	6260	5000	5008
546	XLX	Xylenes (Ortho-, meta-, para-)	0.89	0.51	3.66	0.083	1.25	1.04	6250	6507	5000	5205
547	XML	Xylene (M-)	0.87	0.51	3.66	0.083	1.25	1.04	6250	6507	5000	5205
548	XLO	Xylene (O-)	0.89	0.40	3.66	0.081	1.25	1.03	6250	6452	5000	5162
549	XLP	Xylene (P-)	0.86	0.51	3.66	0.083	1.25	1.04	6250	6507	5000	5205
550	XYL	Xylenol	1.01	0.10	3.66	0.077	1.25	1.01	6250	6301	5000	5041
551		Zinc Dialkyldithiophosphate										

Note: All product data extracted from Chemical Hazard Response Information System (CHRIS), Chemical Data Guide for Bulk Shipment by Water, or best available petroleum vendor data, where omitted.

- Based on a dry air density of: **0.076 lb/ft³** and 50%-50% mixture of vapor and air at P-V set pressure of **16.20 PSIA** and T = **115 F**
 $\rho_{v-a} = (SG_v V_v + V_a) / (0.0047(P_v/V))$ where $V_v = P_v/P_t$ and $V_a = (P_t - P_v)/P_t$, and $P_t = P_{atm}$ (see USCG VCS Guidelines Rev 10-01, 7/15/01)
 (note: vapor-air density and vapor growth rate calculations for Pentane (vapor pressure > 14.7 PSIA) are per USCG Guidelines)
- Vapor Growth Rate, $R = 1 + 0.25 (VP/12.5)$ but not less than 1.25, in accordance with ABS SBR 5-2-3/7.5.2(d) and 46 CFR 39.30-1(b)(2) for loading. No growth rate or density correction is required for discharge (vacuum) relieving capacity per USCG guidance. Density correction has been maintained for conservatism and as a provision for fouling.
- Density Correction Factor, $F = (\rho_{v-a}/\rho_a)^{1/2}$ per ABS SBR 5-2-3/7.5.2(d)

Pressure Drop through VCS - From #1 Cargo Tank to P/V Valve (per 46 CFR 39.30-1(d)(1)&(2) and ABS SBR 5-2-3/7.5.2(a)&(b))

Pipe sizes, nominal: 8 in
 Pipe ID: 7.981 in
 Pipe Flow Area: 50.03 in²
 Vapor Dynamic Viscosity: 0.019 centipoise (estimated, based on air @ 115F, Crane 410, Table A-5)

PIPE LENGTH

Length (ft): 125.375 ft (Condition 1)
 f, friction factor (pipe): Varies with Reynold's Number (see table below)

VALVE & FITTING EQUIVALENT LENGTH

Equivalent Length (ft): 226.19 ft (Condition 1)
 f_v, friction factor, turbulent flow (fittings): 0.014 constant, for each pipe size

Loading (Pressure) Condition:

Cargo	Vapor-Air Mix Density (lb/ft ³)	Vapor Flow Rate		Reynold's Number		Friction Factor		Vapor Velocity		Head Loss			Component ΔP			ΔP			
		BBL/hr	ft ³ /s	8" Pipe	8" Pipe	8" Pipe	8" Pipe	8" Pipe	8" Pipe	8" Pipe	8" Fittings	8" Pipe	8" Fittings	TOTAL					
1	0.123	6250	9.75		179807		0.0175		28.1			40.44	58.21				0.0346	0.0498	0.0844
2	0.085	6250	9.75		124102		0.0185		28.1			42.62	58.21				0.0252	0.0344	0.0595
19	0.082	6250	9.75		119053		0.0186		28.1			42.89	58.21				0.0243	0.0330	0.0572
20	0.079	6250	9.75		115371		0.0187		28.1			43.10	58.21				0.0236	0.0319	0.0556
21	0.079	6250	9.75		115371		0.0187		28.1			43.10	58.21				0.0236	0.0319	0.0556
23	0.079	6250	9.75		115371		0.0187		28.1			43.10	58.21				0.0236	0.0319	0.0556
24	0.079	6250	9.75		115371		0.0187		28.1			43.10	58.21				0.0236	0.0319	0.0556
26	0.079	6250	9.75		115371		0.0187		28.1			43.10	58.21				0.0236	0.0319	0.0556
34	0.077	6250	9.75		113045		0.0188		28.1			43.23	58.21				0.0232	0.0313	0.0545
40	0.085	6250	9.75		123525		0.0185		28.1			42.65	58.21				0.0251	0.0342	0.0592
42	0.097	6250	9.75		142057		0.0181		28.1			41.78	58.21				0.0282	0.0393	0.0675
44	0.083	6250	9.75		121054		0.0186		28.1			42.78	58.21				0.0246	0.0335	0.0581
46	0.086	6250	9.75		125447		0.0185		28.1			42.55	58.21				0.0254	0.0347	0.0601
47	0.097	6250	9.75		141920		0.0181		28.1			41.78	58.21				0.0282	0.0393	0.0675
48	0.077	6250	9.75		111843		0.0188		28.1			43.30	58.21				0.0230	0.0310	0.0540
58	0.078	6250	9.75		113992		0.0187		28.1			43.18	58.21				0.0234	0.0316	0.0550
64	0.077	6250	9.75		112166		0.0188		28.1			43.28	58.21				0.0231	0.0310	0.0541
70	0.085	6250	9.75		124349		0.0185		28.1			42.60	58.21				0.0252	0.0344	0.0596
72	0.116	6250	9.75		169855		0.0177		28.1			40.75	58.21				0.0329	0.0470	0.0799
73	0.078	6250	9.75		113693		0.0187		28.1			43.19	58.21				0.0234	0.0315	0.0548
74	0.080	6250	9.75		117262		0.0187		28.1			42.99	58.21				0.0240	0.0325	0.0564
76	0.078	6250	9.75		113904		0.0187		28.1			43.18	58.21				0.0234	0.0315	0.0549
77	0.078	6250	9.75		113752		0.0187		28.1			43.19	58.21				0.0234	0.0315	0.0549
78	0.076	6250	9.75		111445		0.0188		28.1			43.33	58.21				0.0230	0.0308	0.0538
79	0.076	6250	9.75		111171		0.0188		28.1			43.34	58.21				0.0229	0.0308	0.0537
81	0.078	6250	9.75		114301		0.0187		28.1			43.16	58.21				0.0235	0.0316	0.0551
82	0.076	6250	9.75		111466		0.0188		28.1			43.33	58.21				0.0230	0.0309	0.0538
83	0.076	6250	9.75		111466		0.0188		28.1			43.33	58.21				0.0230	0.0309	0.0538
84	0.076	6250	9.75		111466		0.0188		28.1			43.33	58.21				0.0230	0.0309	0.0538
85	0.076	6250	9.75		111618		0.0188		28.1			43.32	58.21				0.0230	0.0309	0.0539
87	0.078	6250	9.75		113230		0.0188		28.1			43.22	58.21				0.0233	0.0313	0.0546
91	0.076	6250	9.75		111171		0.0188		28.1			43.34	58.21				0.0229	0.0308	0.0537
92	0.080	6250	9.75		117262		0.0187		28.1			42.99	58.21				0.0240	0.0325	0.0564
93	0.077	6250	9.75		113158		0.0188		28.1			43.22	58.21				0.0233	0.0313	0.0546
94	0.076	6250	9.75		111353		0.0188		28.1			43.33	58.21				0.0229	0.0308	0.0538
95	0.076	6250	9.75		111480		0.0188		28.1			43.33	58.21				0.0230	0.0309	0.0538
100	0.076	6250	9.75		111668		0.0188		28.1			43.31	58.21				0.0230	0.0309	0.0539
101	0.077	6250	9.75		111817		0.0188		28.1			43.31	58.21				0.0230	0.0310	0.0540
111	0.078	6250	9.75		113623		0.0187		28.1			43.20	58.21				0.0233	0.0315	0.0548
112	0.103	6250	9.75		150431		0.0180		28.1			41.44	58.21				0.0296	0.0416	0.0713
113	0.079	6250	9.75		115454		0.0187		28.1			43.09	58.21				0.0237	0.0320	0.0556
119	0.077	6250	9.75		112118		0.0188		28.1			43.29	58.21				0.0231	0.0310	0.0541
124	0.076	6250	9.75		111171		0.0188		28.1			43.34	58.21				0.0229	0.0308	0.0537
128	0.077	6250	9.75		112091		0.0188		28.1			43.29	58.21				0.0231	0.0310	0.0541
130	0.076	6250	9.75		111171		0.0188		28.1			43.34	58.21				0.0229	0.0308	0.0537
131	0.078	6250	9.75		113848		0.0187		28.1			43.18	58.21				0.0234	0.0315	0.0549
132	0.076	6250	9.75		111467		0.0188		28.1			43.33	58.21				0.0230	0.0309	0.0538
133	0.076	6250	9.75		111504		0.0188		28.1			43.32	58.21				0.0230	0.0309	0.0538
134	0.076	6250	9.75		111505		0.0188		28.1			43.32	58.21				0.0230	0.0309	0.0538

288	0.079	6250	9.75		115701			0.0187		28.1				43.08	58.21					0.0237	0.0320	0.0557
289	0.079	6250	9.75		115488			0.0187		28.1				43.09	58.21					0.0237	0.0320	0.0556
295	0.078	6250	9.75		114603			0.0187		28.1				43.14	58.21					0.0235	0.0317	0.0552
296	0.079	6250	9.75		115701			0.0187		28.1				43.08	58.21					0.0237	0.0320	0.0557
297	0.079	6250	9.75		115474			0.0187		28.1				43.09	58.21					0.0237	0.0320	0.0556
300	0.080	6250	9.75		117472			0.0186		28.1				42.98	58.21					0.0240	0.0325	0.0565
301	0.080	6250	9.75		117472			0.0186		28.1				42.98	58.21					0.0240	0.0325	0.0565
304	0.082	6250	9.75		119098			0.0186		28.1				42.88	58.21					0.0243	0.0330	0.0573
305	0.078	6250	9.75		113916			0.0187		28.1				43.18	58.21					0.0234	0.0315	0.0549
306	0.078	6250	9.75		113916			0.0187		28.1				43.18	58.21					0.0234	0.0315	0.0549
307	0.078	6250	9.75		113916			0.0187		28.1				43.18	58.21					0.0234	0.0315	0.0549
309	0.076	6250	9.75		111624			0.0188		28.1				43.32	58.21					0.0230	0.0309	0.0539
316	0.087	6250	9.75		126895			0.0184		28.1				42.47	58.21					0.0256	0.0351	0.0608
317	0.087	6250	9.75		126895			0.0184		28.1				42.47	58.21					0.0256	0.0351	0.0608
318	0.076	6250	9.75		111445			0.0188		28.1				43.33	58.21					0.0230	0.0308	0.0538
319	0.076	6250	9.75		111410			0.0188		28.1				43.33	58.21					0.0230	0.0308	0.0538
320	0.076	6250	9.75		111410			0.0188		28.1				43.33	58.21					0.0230	0.0308	0.0538
321	0.088	6250	9.75		129085			0.0184		28.1				42.37	58.21					0.0260	0.0357	0.0617
322	0.090	6250	9.75		130801			0.0183		28.1				42.28	58.21					0.0263	0.0362	0.0625
324	0.076	6250	9.75		111410			0.0188		28.1				43.33	58.21					0.0230	0.0308	0.0538
325	0.076	6250	9.75		111410			0.0188		28.1				43.33	58.21					0.0230	0.0308	0.0538
364	0.095	6250	9.75		138076			0.0182		28.1				41.95	58.21					0.0275	0.0382	0.0658
366	0.078	6250	9.75		113642			0.0187		28.1				43.20	58.21					0.0233	0.0315	0.0548
367	0.078	6250	9.75		113642			0.0187		28.1				43.20	58.21					0.0233	0.0315	0.0548
366	0.078	6250	9.75		113642			0.0187		28.1				43.20	58.21					0.0233	0.0315	0.0548
382	0.078	6250	9.75		113642			0.0187		28.1				43.20	58.21					0.0233	0.0315	0.0548
383	0.084	6250	9.75		122537			0.0185		28.1				42.70	58.21					0.0249	0.0339	0.0588
389	0.076	6250	9.75		111171			0.0188		28.1				43.34	58.21					0.0229	0.0308	0.0537
403	0.076	6250	9.75		111171			0.0188		28.1				43.34	58.21					0.0229	0.0308	0.0537
418	0.082	6250	9.75		120231			0.0186		28.1				42.82	58.21					0.0245	0.0333	0.0578
429	0.076	6250	9.75		111643			0.0188		28.1				43.32	58.21					0.0230	0.0309	0.0539
432	0.270	7100	11.07		447519			0.0159		31.9				47.27	75.12					0.0885	0.1407	0.2293
433	0.347	7700	12.01		624005			0.0155		34.6				54.16	88.36					0.1305	0.2128	0.3433
434	0.265	7044	10.99		435634			0.0159		31.6				46.63	73.94					0.0857	0.1359	0.2216
436	0.310	7490	11.68		541719			0.0156		33.6				51.79	83.60					0.1113	0.1797	0.2910
437	0.310	7490	11.68		541719			0.0156		33.6				51.79	83.60					0.1113	0.1797	0.2910
442	0.082	6250	9.75		120059			0.0186		28.1				42.83	58.21					0.0245	0.0332	0.0577
448	0.080	6250	9.75		116545			0.0187		28.1				43.03	58.21					0.0238	0.0323	0.0561
457	0.076	6250	9.75		111171			0.0188		28.1				43.34	58.21					0.0229	0.0308	0.0537
458	0.084	6250	9.75		122757			0.0185		28.1				42.69	58.21					0.0249	0.0340	0.0589
464	0.097	6250	9.75		142304			0.0181		28.1				41.77	58.21					0.0283	0.0394	0.0677
465	0.098	6250	9.75		143169			0.0181		28.1				41.73	58.21					0.0284	0.0396	0.0680
466	0.091	6250	9.75		133203			0.0183		28.1				42.17	58.21					0.0267	0.0369	0.0636
467	0.082	6250	9.75		119984			0.0186		28.1				42.84	58.21					0.0244	0.0332	0.0577
468	0.079	6250	9.75		115481			0.0187		28.1				43.09	58.21					0.0237	0.0320	0.0556
469	0.076	6250	9.75		111401			0.0188		28.1				43.33	58.21					0.0230	0.0308	0.0538
473	0.076	6250	9.75		111282			0.0188		28.1				43.34	58.21					0.0229	0.0308	0.0537
476	0.083	6250	9.75		121308			0.0186		28.1				42.76	58.21					0.0247	0.0336	0.0582
478	0.076	6250	9.75		111171			0.0188		28.1				43.34	58.21					0.0229	0.0308	0.0537
468	0.076	6250	9.75		111386			0.0188		28.1				43.33	58.21					0.0230	0.0308	0.0538
493	0.076	6250	9.75		111171			0.0188		28.1				43.34	58.21					0.0229	0.0308	0.0537
494	0.076	6250	9.75		111567			0.0188		28.1				43.32	58.21					0.0230	0.0309	0.0539
496	0.076	6250	9.75		111562			0.0188		28.1				43.32	58.21					0.0230	0.0309	0.0539
497	0.077	6250	9.75		112148			0.0188		28.1				43.29	58.21					0.0231	0.0310	0.0541
499	0.091	6250	9.75		133203			0.0183		28.1				42.17	58.21					0.0267	0.0369	0.0636
502	0.077	6250	9.75		111973			0.0188		28.1				43.30	58.21					0.0231	0.0310	0.0540
503	0.077	6250	9.75		111912			0.0188		28.1				43.30	58.21					0.0230	0.0310	0.0540
505	0.076	6250	9.75		111576			0.0188		28.1				43.32	58.21					0.0230	0.0309	0.0539
506	0.076	6250	9.75		111534			0.0188		28.1				43.32	58.21					0.0230	0.0309	0.0539
508	0.077	6250	9.75		111802			0.0188		28.1				43.31	58.21					0.0230	0.0309	0.0540
509	0.076	6250	9.75		111457			0.0188		28.1				43.33	58.21					0.0230	0.0309	0.0538
519	0.078	6250	9.75		114246			0.0187		28.1				43.16	58.21					0.0234	0.0316	0.0551
520	0.078	6250	9.75		114188			0.0187		28.1				43.16	58.21					0.0234	0.0316	0.0550
521	0.078	6250	9.75		114188			0.0187		28.1				43.16	58.21					0.0234	0.0316	0.0550
522	0.078	6250	9.75		114188			0.0187		28.1				43.16	58.21					0.0234	0.0316	0.0550
529	0.076	6250	9.75		111171			0.0188		28.1				43.34	58.21					0.0229	0.0308	0.0537
533	0.077	6250	9.75		112653			0.0188		28.1				43.25	58.21					0.0232	0.0312	0.0544
534	0.076	6250	9.75		111510			0.0188		28.1				43.32	58.21					0.0230	0.0309	0.0538
546	0.083	6250	9.75		120482			0.0186		28.1				42.81	58.21					0.0245	0.0334	0.0579

547	0.083	6250	9.75		120482			0.0186			28.1					42.81	58.21					0.0245	0.0334	0.0579
548	0.081	6250	9.75		118474			0.0186			28.1					42.92	58.21					0.0242	0.0328	0.0570
549	0.083	6250	9.75		120482			0.0186			28.1					42.81	58.21					0.0245	0.0334	0.0579
550	0.077	6250	9.75		112997			0.0188			28.1					#REF!	58.21					0.0232	0.0313	0.0545

- Notes: 1) Vapor flow rate used in loading condition is vapor equivalent loading rate including vapor growth rate
2) Air equivalent flow rate derived from maximum liquid discharge rate and a density correction factor for conservatism (see list of allowable cargoes for details)

MAX ΔP:	0.3433
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Maximum design pressure of tank: 3.00 psi

Loading (Pressure) Summary:

Cargo	Piping ΔP	Vapor Flowrate	Air Equivalent Flowrate		ΔP across P-V ¹		Total Vapor ΔP thru P-V system
	psi	BBL/hr	BBL/hr	ft ³ /hr	kPa	psi	psi
Acetone	0.084	6250	7949	44632	n/a	2.23	2.314
Acetophenone	0.060	6250	6604	37079	n/a	2.23	2.290
Amyl Acetate (iso-)	0.057	6250	6468	36317	n/a	2.23	2.287
Amyl Alcohol (iso-, no, sec-, primary) (See also IAA)	0.056	6250	6367	35751	n/a	2.23	2.286
Amyl Alcohol (n.)	0.056	6250	6367	35751	n/a	2.23	2.286
Amyl Alcohol, Primary	0.056	6250	6367	35751	n/a	2.23	2.286
Amyl Alcohol, (sec-)	0.056	6250	6367	35751	n/a	2.23	2.286
Amyl Alcohol, (iso-)	0.056	6250	6367	35751	n/a	2.23	2.286
Benzyl Alcohol	0.055	6250	6303	35389	n/a	2.23	2.285
Butyl Acetate (iso- n-)	0.059	6250	6588	36993	n/a	2.23	2.289
Butyl Acetate (sec-)	0.068	6250	7065	39671	n/a	2.23	2.298
Butyl AlCOhol (iso-)	0.058	6250	6522	36621	n/a	2.23	2.288
Butyl AlCOhol (sec-)	0.060	6250	6639	37279	n/a	2.23	2.290
Butyl Alcohol (tert-)	0.067	6250	7062	39652	n/a	2.23	2.297
Butyl Benzyl Phthalate	0.054	6250	6269	35200	n/a	2.23	2.284
Butyl Toluene	0.055	6250	6329	35537	n/a	2.23	2.285
Caprolactam Solutions	0.054	6250	6278	35251	n/a	2.23	2.284
Cumene	0.060	6250	6610	37116	n/a	2.23	2.290
Cyclohexane	0.080	6250	7726	43379	n/a	2.23	2.310
Cyclohexanol	0.055	6250	6321	35490	n/a	2.23	2.285
1,3-Cyclopentadiene dimer (molten)	0.056	6250	6419	36043	n/a	2.23	2.286
Cymene (para-)	0.055	6250	6326	35523	n/a	2.23	2.285
Decahydronaphthalene	0.055	6250	6322	35499	n/a	2.23	2.285
Decaldehyde (iso-)	0.054	6250	6258	35137	n/a	2.23	2.284
Decaldehyde (n-)	0.054	6250	6250	35094	n/a	2.23	2.284
Decane	0.055	6250	6337	35585	n/a	2.23	2.285
Decyl Alcohol (all isomers) (Decanol)	0.054	6250	6258	35141	n/a	2.23	2.284
Decyl Alcohol (iso-)	0.054	6250	6258	35141	n/a	2.23	2.284
Decyl Alcohol (n-)	0.054	6250	6258	35141	n/a	2.23	2.284
Decylbenzene (n-)	0.054	6250	6263	35165	n/a	2.23	2.284
Diacetone Alcohol	0.055	6250	6308	35418	n/a	2.23	2.285
Dibutyl Phthalate (ortho-)	0.054	6250	6250	35094	n/a	2.23	2.284
Dicyclopentadlene, See 1,3-Cyclopentadlene Dimer (mo	0.056	6250	6419	36043	n/a	2.23	2.286
Diethybenzene	0.055	6250	6306	35406	n/a	2.23	2.285
Diethylene Glycol	0.054	6250	6255	35123	n/a	2.23	2.284
Diethylene Glycol Butyl Ether	0.054	6250	6259	35143	n/a	2.23	2.284
Diethylene Glycol Ethyl Ether Acetate	0.054	6250	6264	35172	n/a	2.23	2.284
Diethylene Glycol Methyl Ether	0.054	6250	6268	35196	n/a	2.23	2.284
Diisobutylcarblnol	0.055	6250	6319	35479	n/a	2.23	2.285
Diisobutylene	0.071	6250	7270	40823	n/a	2.23	2.301
Diisobutyl Ketone	0.056	6250	6369	35764	n/a	2.23	2.286
Diisopropylbenzene (all isomer)	0.054	6250	6277	35243	n/a	2.23	2.284
Dimethyl Phthalate	0.054	6250	6250	35094	n/a	2.23	2.284
Dinonyl Phthalate	0.054	6250	6276	35239	n/a	2.23	2.284
Diocetyl Phthalate	0.054	6250	6250	35094	n/a	2.23	2.284
Dipentene	0.055	6250	6325	35514	n/a	2.23	2.285
Diphenyl	0.054	6250	6258	35141	n/a	2.23	2.284
Diphenyl, Diphenyl Ether Mixture	0.054	6250	6259	35147	n/a	2.23	2.284
Diphenyl Ether	0.054	6250	6259	35147	n/a	2.23	2.284
Dipropylene GLYCOL	0.054	6250	6299	35368	n/a	2.23	2.284
Distillates: Flashed Feed Stocks	0.071	6250	7237	40637	n/a	2.23	2.301
Distillates: Straight Run	0.071	6250	7237	40637	n/a	2.23	2.301
Dodecene (all isomers)	0.054	6250	6269	35198	n/a	2.23	2.284

Dodecene	0.054	6250	6269	35198	n/a	2.23	2.284
Dodecylbenzene	0.159	6250	11088	62259	n/a	2.23	2.389
Ethoxy Triglycol (crude)	0.054	6250	6250	35094	n/a	2.23	2.284
Ethyl Acetate	0.082	6250	7823	43928	n/a	2.23	2.312
Ethyl Acetoacetate	0.056	6250	6383	35840	n/a	2.23	2.286
Ethyl Alcohol (Ethanol)	0.060	6250	6643	37300	n/a	2.23	2.290
Ethyl Benzene	0.058	6250	6540	36720	n/a	2.23	2.288
Ethyl Butanol	0.055	6250	6308	35420	n/a	2.23	2.285
Ethyl Butyrate	0.063	6250	6804	38206	n/a	2.23	2.293
Ethyl Cyclohexane	0.058	6250	6521	36616	n/a	2.23	2.288
Ethylene Glycol	0.054	6250	6252	35107	n/a	2.23	2.284
Ethylene Glycol Butyl Ether Acetate	0.054	6250	6294	35338	n/a	2.23	2.284
Ethylene Glycol Diacetate	0.054	6250	6258	35138	n/a	2.23	2.284
Ethylene Glycol Methyl Ether	0.054	6250	6257	35135	n/a	2.23	2.284
Ethylene Glycol Phenyl Ether	0.054	6250	6257	35135	n/a	2.23	2.284
2-Ethylhexaldehyde, See Octyl Aldehydes	0.055	6250	6361	35717	n/a	2.23	2.285
2-Ethylhexanol , see Octanol (all isomers)	0.054	6250	6264	35170	n/a	2.23	2.284
Ethyl Propionate	0.060	6250	6643	37300	n/a	2.23	2.290
Ethyl Toulene	0.056	6250	6418	36037	n/a	2.23	2.286
Formamide	0.054	6250	6261	35154	n/a	2.23	2.284
Furfuryl Alcohol	0.054	6250	6273	35224	n/a	2.23	2.284
Gasoline Blended Stocks: Alkylates	0.145	6250	10555	59268	n/a	2.23	2.375
Gasoline Blended Stocks: Reformate	0.145	6250	10555	59268	n/a	2.23	2.375
Gasolines: Automotive (containing not over 4.23 grams	0.145	6250	10555	59268	n/a	2.23	2.375
Gasolines: Aviation (containing not over 4.86 grams lead	0.145	6250	10555	59268	n/a	2.23	2.375
Gasolines: Casinghead	0.145	6250	10555	59268	n/a	2.23	2.375
Gasolines: Polymer	0.145	6250	10555	59268	n/a	2.23	2.375
Gasolines: Straight Run	0.145	6250	10555	59268	n/a	2.23	2.375
Glycerine	0.054	6250	6250	35094	n/a	2.23	2.284
Heptane (all isomers) (Methylhexane)	0.073	6250	7337	41199	n/a	2.23	2.303
Heptane (n-)	0.073	6250	7337	41199	n/a	2.23	2.303
Heptonic Acid	0.054	6250	6257	35132	n/a	2.23	2.284
Heptanol (all isomers)	0.054	6250	6273	35224	n/a	2.23	2.284
Heptanol (all isomers)	0.054	6250	6273	35224	n/a	2.23	2.284
Heptene (all isomers)	0.075	6250	7473	41962	n/a	2.23	2.305
Heptene (1-)	0.074	6250	7434	41744	n/a	2.23	2.304
Heptyl Acetate	0.055	6250	6336	35578	n/a	2.23	2.285
Hexane (all isomers)	0.097	6250	8534	47918	n/a	2.23	2.327
Hexane	0.097	6250	8534	47918	n/a	2.23	2.327
Hexanoic Acid	0.054	6250	6256	35127	n/a	2.23	2.284
Hexanol	0.061	6250	6719	37725	n/a	2.23	2.291
Hexene (all isomers)	0.100	6250	8702	48861	n/a	2.23	2.330
Hexene (1-)	0.101	6250	8754	49156	n/a	2.23	2.331
Hexene (2-)	0.101	6250	8754	49156	n/a	2.23	2.331
Hexylene Glycol	0.054	6250	6250	35095	n/a	2.23	2.284
isophorone	0.054	6250	6257	35135	n/a	2.23	2.284
Jet Fuels: JP-1 (Kerosene)	0.055	6250	6344	35621	n/a	2.23	2.285
Jet Fuels: JP-3	0.144	6250	10531	59130	n/a	2.23	2.374
Jet Fuels: JP-4	0.085	6250	7979	44802	n/a	2.23	2.315
Jet Fuels: JP-5 (Kerosene, heavy)	0.055	6250	6308	35418	n/a	2.23	2.285
Kerosene	0.055	6250	6351	35658	n/a	2.23	2.285
Methyl Acetate	0.084	6250	7912	44427	n/a	2.23	2.314
Methyl Alcohol (See Methanol)	0.056	6250	6377	35805	n/a	2.23	2.286
Methyl Amyl Acetate	0.058	6250	6498	36486	n/a	2.23	2.288
Methyl Amyl Alcohol	0.057	6250	6456	36249	n/a	2.23	2.287
Methyl n-Butyl Ketone	0.061	6250	6702	37630	n/a	2.23	2.291
Methyl Butyrate	0.064	6250	6838	38393	n/a	2.23	2.294
Methyl Ethyl Ketone	0.074	6250	7439	41771	n/a	2.23	2.304
Methyl Formal (Dimethyl Formal)	0.152	6542	10805	60671	n/a	2.23	2.382
Methyl Heptyl Ketone	0.054	6250	6295	35347	n/a	2.23	2.284

Methyl Isobutyl Ketone	0.062	6250	6772	38024	n/a	2.23	2.292
1-Methyl Naphthalene	0.054	6250	6258	35136	n/a	2.23	2.284
2-Methyl-1-Pentene	0.090	6250	8242	46279	n/a	2.23	2.320
5-Methyl-1-Pentene	0.103	6250	8830	49580	n/a	2.23	2.333
Methyl Tert-Butyl Ether (MTBE)	0.054	6250	6266	35185	n/a	2.23	2.284
Mineral Spirits	0.056	6250	6376	35802	n/a	2.23	2.286
Myrcene	0.056	6250	6370	35769	n/a	2.23	2.286
Naphtha: Solvent	0.055	6250	6346	35632	n/a	2.23	2.285
Naphtha: Stoddard Solvant	0.056	6250	6376	35802	n/a	2.23	2.286
Naphtha: VamlsH Maker's and Painters (75%)	0.056	6250	6370	35767	n/a	2.23	2.286
Nonane (all isomers)	0.057	6250	6425	36075	n/a	2.23	2.287
Nonane	0.057	6250	6425	36075	n/a	2.23	2.287
Nonene	0.057	6250	6469	36324	n/a	2.23	2.287
Nonyl Alcohol (all isomers)	0.055	6250	6327	35525	n/a	2.23	2.285
Nonyl Alcohol	0.055	6250	6327	35525	n/a	2.23	2.285
Nonyl Alcohol (iso-)	0.055	6250	6327	35525	n/a	2.23	2.285
Nonyl Phenol	0.054	6250	6263	35165	n/a	2.23	2.284
Octane (all isomers)	0.061	6250	6677	37494	n/a	2.23	2.291
Octane	0.061	6250	6677	37494	n/a	2.23	2.291
Octanoic Acid (all isomers)	0.054	6250	6258	35137	n/a	2.23	2.284
Octanol (all isomers)	0.054	6250	6257	35132	n/a	2.23	2.284
Octanol	0.054	6250	6257	35132	n/a	2.23	2.284
Octene (all isomers) 2	0.062	6250	6735	37816	n/a	2.23	2.292
Octene (1-)	0.063	6250	6779	38067	n/a	2.23	2.293
Octyl Alcohol (iso-,n.) (all isomers), See Octanol (all isomers)	0.054	6250	6257	35132	n/a	2.23	2.284
Octyl Alcohol	0.054	6250	6257	35132	n/a	2.23	2.284
Fuel: NO.2	0.066	6250	6965	39111	n/a	2.23	2.296
Fuel: NO.4	0.055	6250	6319	35482	n/a	2.23	2.285
Fuel: No.5	0.055	6250	6319	35482	n/a	2.23	2.285
Fuel: NO.6	0.055	6250	6319	35482	n/a	2.23	2.285
OIL, Mise: Crude	0.055	6250	6319	35482	n/a	2.23	2.285
Oil, Mise: Diesel	0.059	6250	6562	36844	n/a	2.23	2.289
OIL, Mise: Lubricating	0.054	6250	6250	35094	n/a	2.23	2.284
OIL, Mise: Resin	0.054	6250	6250	35094	n/a	2.23	2.284
Oil, Mise: Turbine	0.058	6250	6500	36496	n/a	2.23	2.288
Pentadecanol, See Alcohols (C13 and above)	0.054	6250	6263	35169	n/a	2.23	2.284
Pentane (all isomers)	0.229	7100	13366	75047	n/a	2.23	2.459
Pentane (iso-)	0.343	7700	16436	92286	n/a	2.23	2.573
Pentane (n-)	0.222	7044	13135	73751	n/a	2.23	2.452
Pentene (all isomers)	0.291	7490	15104	84806	n/a	2.23	2.521
Pentene (1-)	0.291	7490	15104	84806	n/a	2.23	2.521
Pinene	0.058	6250	6495	36470	n/a	2.23	2.288
Polybutene	0.056	6250	6399	35932	n/a	2.23	2.286
Polypropylene Glycol	0.054	6250	6250	35094	n/a	2.23	2.284
Polypropylene Glycol Methyl Ether	0.059	6250	6568	36877	n/a	2.23	2.289
Propyl Acetate (iso-)	0.068	6250	7071	39705	n/a	2.23	2.298
Propyl Acetate (n-)	0.068	6250	7093	39826	n/a	2.23	2.298
Propyl Alcohol (iso-)	0.064	6250	6841	38415	n/a	2.23	2.294
Propyl Alcohol (n-)	0.058	6250	6493	36459	n/a	2.23	2.288
Propylbenzene (n-)	0.056	6250	6370	35768	n/a	2.23	2.286
iso-Propylcyclohexane	0.054	6250	6257	35130	n/a	2.23	2.284
Propylene Glycol (1,2-Propandiol)	0.054	6250	6253	35112	n/a	2.23	2.284
Propylene Glycol Methyl Ether	0.058	6250	6529	36659	n/a	2.23	2.288
Propylene Tetramer	0.054	6250	6250	35094	n/a	2.23	2.284
Sulfolane	0.054	6250	6256	35128	n/a	2.23	2.284
Tetradecanol	0.054	6250	6250	35094	n/a	2.23	2.284
1-Tetradecene, See the olefin or Alpha-Olefin Entries	0.054	6250	6261	35157	n/a	2.23	2.284
Tetraethylene Glycol	0.054	6250	6261	35156	n/a	2.23	2.284
Tetrahydronaphthalene	0.054	6250	6278	35248	n/a	2.23	2.284
Toluene	0.064	6250	6841	38415	n/a	2.23	2.294

Tricresyl Phosphate (less than 1% of the ortho isomer)	0.054	6250	6273	35220	n/a	2.23	2.284
Tridecane	0.054	6250	6271	35211	n/a	2.23	2.284
Tridecanol , See Alcohols (C13 and above)	0.054	6250	6261	35158	n/a	2.23	2.284
l-Tridecene	0.054	6250	6260	35151	n/a	2.23	2.284
Triethylbenzene	0.054	6250	6268	35194	n/a	2.23	2.284
Triethylene Glycol	0.054	6250	6258	35139	n/a	2.23	2.284
Trimethylbenzenes (all isomers)	0.055	6250	6336	35576	n/a	2.23	2.285
Trimethyl Benzene (1,2,5-)	0.055	6250	6334	35567	n/a	2.23	2.285
Trimethyl Benzene (1,2,3-)	0.055	6250	6334	35567	n/a	2.23	2.285
Trimethyl Benzene (1,2,4-) (Pseudocumene)	0.055	6250	6334	35567	n/a	2.23	2.285
Trixylenyl Phosphate	0.054	6250	6250	35094	n/a	2.23	2.284
Undecene (1-)	0.054	6250	6292	35327	n/a	2.23	2.284
Undecyl Alcohol	0.054	6250	6260	35148	n/a	2.23	2.284
Xylenes (Ortho-, meta-, para-)	0.058	6250	6507	36534	n/a	2.23	2.288
Xylene (M-)	0.058	6250	6507	36534	n/a	2.23	2.288
Xylene (O-)	0.057	6250	6452	36228	n/a	2.23	2.287
Xylene (P-)	0.058	6250	6507	36534	n/a	2.23	2.288
Xylenol	0.055	6250	6301	35381	n/a	2.23	2.285
Zinc Dialkyldithiophosphate	0.000	0	0	0	n/a	2.23	2.230

Cargo with the highest pressure drop is:

Pentane (iso-)	Max ΔP =	2.57 psi	<	3.00 psi	OK
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Notes: 1) See ERL flow curve "180U172B"

Pressure Drop through VCS - From #1 Cargo Tank to P/V Valve (per 46 CFR 39.30-1(d)(1)&(2) and ABS SBR 5-2-3/7.5.2(a)&(b))

Discharge (Vacuum) Condition:

Cargo	Vapor-Air Mix. Density (lb/ft ³)	Vapor Flow Rate		Reynold's Number		Friction Factor		Vapor Velocity		Head Loss			Component ΔP			ΔP	
		BBL/hr	ft ³ /s		8" Pipe		8" Pipe		8" Pipe		8" Pipe	8" Fittings		8" Pipe	8" Fittings	TOTAL	
										ft	ft		psi	psi	psi		
1	0.123	5000	7.8		143846		0.0181		22.4						0.0228	0.0319	0.0547
2	0.085	5000	7.8		99282		0.0191		22.4						0.0167	0.0220	0.0387
19	0.082	5000	7.8		95242		0.0193		22.4						0.0161	0.0211	0.0372
20	0.079	5000	7.8		92297		0.0194		22.4						0.0157	0.0204	0.0361
21	0.079	5000	7.8		92297		0.0194		22.4						0.0157	0.0204	0.0361
23	0.079	5000	7.8		92297		0.0194		22.4						0.0157	0.0204	0.0361
24	0.079	5000	7.8		92297		0.0194		22.4						0.0157	0.0204	0.0361
26	0.079	5000	7.8		92297		0.0194		22.4						0.0157	0.0204	0.0361
34	0.077	5000	7.8		90436		0.0194		22.4						0.0154	0.0200	0.0354
40	0.085	5000	7.8		98820		0.0192		22.4						0.0166	0.0219	0.0385
42	0.097	5000	7.8		113646		0.0187		22.4						0.0187	0.0252	0.0438
44	0.083	5000	7.8		96844		0.0192		22.4						0.0163	0.0214	0.0378
46	0.086	5000	7.8		100358		0.0191		22.4						0.0168	0.0222	0.0390
47	0.097	5000	7.8		113536		0.0187		22.4						0.0187	0.0251	0.0438
48	0.077	5000	7.8		89475		0.0195		22.4						0.0153	0.0198	0.0351
58	0.078	5000	7.8		91193		0.0194		22.4						0.0155	0.0202	0.0357
64	0.077	5000	7.8		89733		0.0195		22.4						0.0153	0.0199	0.0352
70	0.085	5000	7.8		99479		0.0191		22.4						0.0167	0.0220	0.0387
72	0.116	5000	7.8		135884		0.0182		22.4						0.0217	0.0301	0.0518
73	0.078	5000	7.8		90955		0.0194		22.4						0.0155	0.0201	0.0356
74	0.080	5000	7.8		93810		0.0193		22.4						0.0159	0.0208	0.0367
76	0.078	5000	7.8		91123		0.0194		22.4						0.0155	0.0202	0.0357
77	0.078	5000	7.8		91001		0.0194		22.4						0.0155	0.0202	0.0357
78	0.076	5000	7.8		89156		0.0195		22.4						0.0152	0.0197	0.0350
79	0.076	5000	7.8		88937		0.0195		22.4						0.0152	0.0197	0.0349
81	0.078	5000	7.8		91440		0.0194		22.4						0.0156	0.0202	0.0358
82	0.076	5000	7.8		89173		0.0195		22.4						0.0152	0.0197	0.0350
83	0.076	5000	7.8		89173		0.0195		22.4						0.0152	0.0197	0.0350
84	0.076	5000	7.8		89173		0.0195		22.4						0.0152	0.0197	0.0350
85	0.076	5000	7.8		89295		0.0195		22.4						0.0153	0.0198	0.0350
87	0.078	5000	7.8		90584		0.0194		22.4						0.0154	0.0201	0.0355
91	0.076	5000	7.8		88937		0.0195		22.4						0.0152	0.0197	0.0349
92	0.080	5000	7.8		93810		0.0193		22.4						0.0159	0.0208	0.0367
93	0.077	5000	7.8		90527		0.0194		22.4						0.0154	0.0200	0.0355
94	0.076	5000	7.8		89083		0.0195		22.4						0.0152	0.0197	0.0350
95	0.076	5000	7.8		89184		0.0195		22.4						0.0152	0.0197	0.0350
100	0.076	5000	7.8		89334		0.0195		22.4						0.0153	0.0198	0.0350
101	0.077	5000	7.8		89454		0.0195		22.4						0.0153	0.0198	0.0351
111	0.078	5000	7.8		90899		0.0194		22.4						0.0155	0.0201	0.0356
112	0.103	5000	7.8		120345		0.0186		22.4						0.0196	0.0267	0.0463
113	0.079	5000	7.8		92363		0.0194		22.4						0.0157	0.0205	0.0361
119	0.077	5000	7.8		89694		0.0195		22.4						0.0153	0.0199	0.0352
124	0.076	5000	7.8		88937		0.0195		22.4						0.0152	0.0197	0.0349
128	0.077	5000	7.8		89672		0.0195		22.4						0.0153	0.0199	0.0352
130	0.076	5000	7.8		88937		0.0195		22.4						0.0152	0.0197	0.0349
131	0.078	5000	7.8		91078		0.0194		22.4						0.0155	0.0202	0.0357
132	0.076	5000	7.8		89173		0.0195		22.4						0.0152	0.0197	0.0350
133	0.076	5000	7.8		89203		0.0195		22.4						0.0152	0.0198	0.0350
134	0.076	5000	7.8		89204		0.0195		22.4						0.0152	0.0198	0.0350
136	0.077	5000	7.8		90332		0.0194		22.4						0.0154	0.0200	0.0354
139	0.102	5000	7.8		119247		0.0186		22.4						0.0195	0.0264	0.0459
140	0.102	5000	7.8		119247		0.0186		22.4						0.0195	0.0264	0.0459
145	0.077	5000	7.8		89465		0.0195		22.4						0.0153	0.0198	0.0351
146	0.077	5000	7.8		89465		0.0195		22.4						0.0153	0.0198	0.0351
147	0.240	5000	7.8		279911		0.0166		22.4						0.0408	0.0620	0.1028
155	0.076	5000	7.8		88937		0.0195		22.4						0.0152	0.0197	0.0349
156	0.119	5000	7.8		139343		0.0182		22.4						0.0222	0.0309	0.0531
157	0.079	5000	7.8		92758		0.0194		22.4						0.0157	0.0205	0.0363
158	0.086	5000	7.8		100468		0.0191		22.4						0.0168	0.0222	0.0391
160	0.083	5000	7.8		97371		0.0192		22.4						0.0164	0.0216	0.0380
161	0.078	5000	7.8		90597		0.0194		22.4						0.0154	0.0201	0.0355
162	0.090	5000	7.8		105409		0.0190		22.4						0.0175	0.0233	0.0409

163	0.083	5000	7.8		96816		0.0192		22.4			28.4	37.3				0.0163	0.0214	0.0378
166	0.076	5000	7.8		89003		0.0195		22.4			28.8	37.3				0.0152	0.0197	0.0349
169	0.077	5000	7.8		90178		0.0195		22.4			28.7	37.3				0.0154	0.0200	0.0354
172	0.076	5000	7.8		89158		0.0195		22.4			28.8	37.3				0.0152	0.0197	0.0350
178	0.076	5000	7.8		89145		0.0195		22.4			28.8	37.3				0.0152	0.0197	0.0350
180	0.076	5000	7.8		89145		0.0195		22.4			28.8	37.3				0.0152	0.0197	0.0350
184	0.079	5000	7.8		92120		0.0194		22.4			28.6	37.3				0.0157	0.0204	0.0361
186	0.076	5000	7.8		89321		0.0195		22.4			28.7	37.3				0.0153	0.0198	0.0350
190	0.086	5000	7.8		100468		0.0191		22.4			28.2	37.3				0.0168	0.0222	0.0391
191	0.080	5000	7.8		93780		0.0193		22.4			28.5	37.3				0.0159	0.0208	0.0367
194	0.076	5000	7.8		89239		0.0195		22.4			28.7	37.3				0.0152	0.0198	0.0350
195	0.077	5000	7.8		89596		0.0195		22.4			28.7	37.3				0.0153	0.0198	0.0351
197	0.217	5000	7.8		253665		0.0168		22.4			24.8	37.3				0.0374	0.0562	0.0936
198	0.217	5000	7.8		253665		0.0168		22.4			24.8	37.3				0.0374	0.0562	0.0936
199	0.217	5000	7.8		253665		0.0168		22.4			24.8	37.3				0.0374	0.0562	0.0936
200	0.217	5000	7.8		253665		0.0168		22.4			24.8	37.3				0.0374	0.0562	0.0936
201	0.217	5000	7.8		253665		0.0168		22.4			24.8	37.3				0.0374	0.0562	0.0936
202	0.217	5000	7.8		253665		0.0168		22.4			24.8	37.3				0.0374	0.0562	0.0936
203	0.217	5000	7.8		253665		0.0168		22.4			24.8	37.3				0.0374	0.0562	0.0936
204	0.076	5000	7.8		88937		0.0195		22.4			28.8	37.3				0.0152	0.0197	0.0349
217	0.105	5000	7.8		122569		0.0185		22.4			27.3	37.3				0.0199	0.0271	0.0471
218	0.105	5000	7.8		122569		0.0185		22.4			27.3	37.3				0.0199	0.0271	0.0471
219	0.076	5000	7.8		89128		0.0195		22.4			28.8	37.3				0.0152	0.0197	0.0350
220	0.077	5000	7.8		89596		0.0195		22.4			28.7	37.3				0.0153	0.0198	0.0351
221	0.077	5000	7.8		89596		0.0195		22.4			28.7	37.3				0.0153	0.0198	0.0351
222	0.109	5000	7.8		127154		0.0184		22.4			27.2	37.3				0.0205	0.0282	0.0487
223	0.108	5000	7.8		125836		0.0185		22.4			27.2	37.3				0.0204	0.0279	0.0482
224	0.078	5000	7.8		91408		0.0194		22.4			28.6	37.3				0.0156	0.0202	0.0358
229	0.142	5000	7.8		165810		0.0177		22.4			26.2	37.3				0.0258	0.0367	0.0625
230	0.142	5000	7.8		165810		0.0177		22.4			26.2	37.3				0.0258	0.0367	0.0625
231	0.076	5000	7.8		89101		0.0195		22.4			28.8	37.3				0.0152	0.0197	0.0350
232	0.088	5000	7.8		102774		0.0190		22.4			28.1	37.3				0.0172	0.0228	0.0399
234	0.148	5000	7.8		172399		0.0176		22.4			26.0	37.3				0.0267	0.0382	0.0648
235	0.149	5000	7.8		174485		0.0176		22.4			26.0	37.3				0.0269	0.0386	0.0656
236	0.149	5000	7.8		174485		0.0176		22.4			26.0	37.3				0.0269	0.0386	0.0656
238	0.076	5000	7.8		88942		0.0195		22.4			28.8	37.3				0.0152	0.0197	0.0349
243	0.076	5000	7.8		89143		0.0195		22.4			28.8	37.3				0.0152	0.0197	0.0350
244	0.078	5000	7.8		91627		0.0194		22.4			28.6	37.3				0.0156	0.0203	0.0359
245	0.216	5000	7.8		252484		0.0168		22.4			24.8	37.3				0.0373	0.0559	0.0932
246	0.124	5000	7.8		144944		0.0181		22.4			26.7	37.3				0.0230	0.0321	0.0551
247	0.078	5000	7.8		90584		0.0194		22.4			28.7	37.3				0.0154	0.0201	0.0355
249	0.079	5000	7.8		91819		0.0194		22.4			28.6	37.3				0.0156	0.0203	0.0359
263	0.122	5000	7.8		142528		0.0181		22.4			26.7	37.3				0.0226	0.0316	0.0542
265	0.079	5000	7.8		92577		0.0194		22.4			28.6	37.3				0.0157	0.0205	0.0362
266	0.082	5000	7.8		96130		0.0193		22.4			28.4	37.3				0.0162	0.0213	0.0375
267	0.081	5000	7.8		94887		0.0193		22.4			28.5	37.3				0.0160	0.0210	0.0371
271	0.088	5000	7.8		102252		0.0191		22.4			28.1	37.3				0.0171	0.0226	0.0397
273	0.091	5000	7.8		106441		0.0189		22.4			27.9	37.3				0.0177	0.0236	0.0412
274	0.108	5000	7.8		126000		0.0184		22.4			27.2	37.3				0.0204	0.0279	0.0483
275	0.208	5000	7.8		242611		0.0169		22.4			24.9	37.3				0.0360	0.0537	0.0897
276	0.077	5000	7.8		90222		0.0195		22.4			28.7	37.3				0.0154	0.0200	0.0354
278	0.089	5000	7.8		104407		0.0190		22.4			28.0	37.3				0.0174	0.0231	0.0405
281	0.076	5000	7.8		89151		0.0195		22.4			28.8	37.3				0.0152	0.0197	0.0350
283	0.132	5000	7.8		154663		0.0179		22.4			26.4	37.3				0.0243	0.0343	0.0585
284	0.152	5000	7.8		177511		0.0176		22.4			25.9	37.3				0.0274	0.0393	0.0667
286	0.077	5000	7.8		89398		0.0195		22.4			28.7	37.3				0.0153	0.0198	0.0351
288	0.079	5000	7.8		92561		0.0194		22.4			28.6	37.3				0.0157	0.0205	0.0362
289	0.079	5000	7.8		92390		0.0194		22.4			28.6	37.3				0.0157	0.0205	0.0362
295	0.078	5000	7.8		91682		0.0194		22.4			28.6	37.3				0.0156	0.0203	0.0359
296	0.079	5000	7.8		92561		0.0194		22.4			28.6	37.3				0.0157	0.0205	0.0362
297	0.079	5000	7.8		92379		0.0194		22.4			28.6	37.3				0.0157	0.0205	0.0362
300	0.080	5000	7.8		93977		0.0193		22.4			28.5	37.3				0.0159	0.0208	0.0367
301	0.080	5000	7.8		93977		0.0193		22.4			28.5	37.3				0.0159	0.0208	0.0367
304	0.082	5000	7.8		95279		0.0193		22.4			28.4	37.3				0.0161	0.0211	0.0372
305	0.078	5000	7.8		91133		0.0194		22.4			28.6	37.3				0.0155	0.0202	0.0357
306	0.078	5000	7.8		91133		0.0194		22.4			28.6	37.3				0.0155	0.0202	0.0357
307	0.078	5000	7.8		91133		0.0194		22.4			28.6	37.3				0.0155	0.0202	0.0357
309	0.076	5000	7.8		89299		0.0195		22.4			28.7	37.3				0.0153	0.0198	0.0350
316	0.087	5000	7.8		101516		0.0191		22.4			28.1	37.3				0.0170	0.0225	0.0395

317	0.087	5000	7.8		101516		0.0191		22.4										0.0170	0.0225	0.0395
318	0.076	5000	7.8		89156		0.0195		22.4										0.0152	0.0197	0.0350
319	0.076	5000	7.8		89128		0.0195		22.4										0.0152	0.0197	0.0350
320	0.076	5000	7.8		89128		0.0195		22.4										0.0152	0.0197	0.0350
321	0.088	5000	7.8		103268		0.0190		22.4										0.0172	0.0229	0.0401
322	0.090	5000	7.8		104641		0.0190		22.4										0.0174	0.0232	0.0406
324	0.076	5000	7.8		89128		0.0195		22.4										0.0152	0.0197	0.0350
325	0.076	5000	7.8		89128		0.0195		22.4										0.0152	0.0197	0.0350
364	0.095	5000	7.8		110461		0.0188		22.4										0.0182	0.0245	0.0427
366	0.078	5000	7.8		90913		0.0194		22.4										0.0155	0.0201	0.0356
367	0.078	5000	7.8		90913		0.0194		22.4										0.0155	0.0201	0.0356
366	0.078	5000	7.8		90913		0.0194		22.4										0.0155	0.0201	0.0356
382	0.078	5000	7.8		90913		0.0194		22.4										0.0155	0.0201	0.0356
383	0.084	5000	7.8		98030		0.0192		22.4										0.0165	0.0217	0.0382
389	0.076	5000	7.8		88937		0.0195		22.4										0.0152	0.0197	0.0349
403	0.076	5000	7.8		88937		0.0195		22.4										0.0152	0.0197	0.0349
418	0.082	5000	7.8		96185		0.0192		22.4										0.0162	0.0213	0.0375
429	0.076	5000	7.8		89314		0.0195		22.4										0.0153	0.0198	0.0350
432	0.270	5000	7.8		315154		0.0164		22.4										0.0454	0.0698	0.1152
433	0.347	5000	7.8		405198		0.0160		22.4										0.0570	0.0897	0.1467
434	0.265	5000	7.8		309224		0.0165		22.4										0.0446	0.0685	0.1131
436	0.310	5000	7.8		361628		0.0162		22.4										0.0514	0.0801	0.1315
437	0.310	5000	7.8		361628		0.0162		22.4										0.0514	0.0801	0.1315
442	0.082	5000	7.8		96047		0.0193		22.4										0.0162	0.0213	0.0375
448	0.080	5000	7.8		93236		0.0193		22.4										0.0158	0.0206	0.0365
457	0.076	5000	7.8		88937		0.0195		22.4										0.0152	0.0197	0.0349
458	0.084	5000	7.8		98205		0.0192		22.4										0.0165	0.0217	0.0383
464	0.097	5000	7.8		113843		0.0187		22.4										0.0187	0.0252	0.0439
465	0.098	5000	7.8		114535		0.0187		22.4										0.0188	0.0254	0.0442
466	0.091	5000	7.8		106563		0.0189		22.4										0.0177	0.0236	0.0413
467	0.082	5000	7.8		95987		0.0193		22.4										0.0162	0.0213	0.0375
468	0.079	5000	7.8		92385		0.0194		22.4										0.0157	0.0205	0.0362
469	0.076	5000	7.8		89121		0.0195		22.4										0.0152	0.0197	0.0350
473	0.076	5000	7.8		89026		0.0195		22.4										0.0152	0.0197	0.0349
476	0.083	5000	7.8		97047		0.0192		22.4										0.0164	0.0215	0.0378
478	0.076	5000	7.8		88937		0.0195		22.4										0.0152	0.0197	0.0349
468	0.076	5000	7.8		89109		0.0195		22.4										0.0152	0.0197	0.0350
493	0.076	5000	7.8		88937		0.0195		22.4										0.0152	0.0197	0.0349
494	0.076	5000	7.8		89253		0.0195		22.4										0.0153	0.0198	0.0350
496	0.076	5000	7.8		89250		0.0195		22.4										0.0152	0.0198	0.0350
497	0.077	5000	7.8		89719		0.0195		22.4										0.0153	0.0199	0.0352
499	0.091	5000	7.8		106563		0.0189		22.4										0.0177	0.0236	0.0413
502	0.077	5000	7.8		89579		0.0195		22.4										0.0153	0.0198	0.0351
503	0.077	5000	7.8		89530		0.0195		22.4										0.0153	0.0198	0.0351
505	0.076	5000	7.8		89261		0.0195		22.4										0.0153	0.0198	0.0350
506	0.076	5000	7.8		89227		0.0195		22.4										0.0152	0.0198	0.0350
508	0.077	5000	7.8		89442		0.0195		22.4										0.0153	0.0198	0.0351
509	0.076	5000	7.8		89166		0.0195		22.4										0.0152	0.0197	0.0350
519	0.078	5000	7.8		91397		0.0194		22.4										0.0156	0.0202	0.0358
520	0.078	5000	7.8		91350		0.0194		22.4										0.0155	0.0202	0.0358
521	0.078	5000	7.8		91350		0.0194		22.4										0.0155	0.0202	0.0358
522	0.078	5000	7.8		91350		0.0194		22.4										0.0155	0.0202	0.0358
529	0.076	5000	7.8		88937		0.0195		22.4										0.0152	0.0197	0.0349
533	0.077	5000	7.8		90123		0.0195		22.4										0.0154	0.0200	0.0353
534	0.076	5000	7.8		89208		0.0195		22.4										0.0152	0.0198	0.0350
546	0.083	5000	7.8		96386		0.0192		22.4										0.0163	0.0213	0.0376
547	0.083	5000	7.8		96386		0.0192		22.4										0.0163	0.0213	0.0376
548	0.081	5000	7.8		94779		0.0193		22.4										0.0160	0.0210	0.0370
549	0.083	5000	7.8		96386		0.0192		22.4										0.0163	0.0213	0.0376
550	0.077	5000	7.8		90397		0.0194		22.4										0.0154	0.0200	0.0354

- Notes: 1) Vapor flow rate used in discharge condition is liquid discharge rate, per USCG guidance 7/15/01
2) Air equivalent flow rate derived from maximum liquid discharge rate and a density correction factor for conservatism (see list of allowable cargoes for details)

MAX ΔP:	0.1467
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Maximum design pressure of deck: 3.00 psi

Discharge (Vacuum) Summary:

Cargo	Piping ΔP	Vapor Flowrate ¹	Air Equivalent Flowrate ²		ΔP across P-V ³		Total Vapor ΔP thru P-V system
	psi	BBL/hr	BBL/hr	ft ³ /hr	kPa	psi	psi
Acetone	0.055	5000	6359	35705	n/a	0.50	0.555
Acetophenone	0.039	5000	5283	29663	n/a	0.50	0.539
Amyl Acetate (iso-)	0.037	5000	5174	29054	n/a	0.50	0.537
Amyl Alcohol (iso-, no, sec-, primary) (See also IAA)	0.036	5000	5094	28601	n/a	0.50	0.536
Amyl Alcohol (n.)	0.036	5000	5094	28601	n/a	0.50	0.536
Amyl Alcohol, Primary	0.036	5000	5094	28601	n/a	0.50	0.536
Amyl Alcohol, (sec-)	0.036	5000	5094	28601	n/a	0.50	0.536
Amyl Alcohol, (iso-)	0.036	5000	5094	28601	n/a	0.50	0.536
Benzyl Alcohol	0.035	5000	5042	28311	n/a	0.50	0.535
Butyl Acetate (iso-, n-)	0.038	5000	5271	29594	n/a	0.50	0.538
Butyl Acetate (sec-)	0.044	5000	5652	31737	n/a	0.50	0.544
Butyl Alcohol (iso-)	0.038	5000	5218	29297	n/a	0.50	0.538
Butyl Alcohol (sec-)	0.039	5000	5311	29824	n/a	0.50	0.539
Butyl Alcohol (tert-)	0.044	5000	5649	31721	n/a	0.50	0.544
Butyl Benzyl Phthalate	0.035	5000	5015	28160	n/a	0.50	0.535
Butyl Toluene	0.036	5000	5063	28429	n/a	0.50	0.536
Caprolactam Solutions	0.035	5000	5022	28201	n/a	0.50	0.535
Cumene	0.039	5000	5288	29693	n/a	0.50	0.539
Cyclohexane	0.052	5000	6180	34703	n/a	0.50	0.552
Cyclohexanol	0.036	5000	5056	28392	n/a	0.50	0.536
1,3-Cyclopentadiene dimer (molten)	0.037	5000	5135	28834	n/a	0.50	0.537
Cymene (para-)	0.036	5000	5061	28418	n/a	0.50	0.536
Decahydronaphthalene	0.036	5000	5058	28399	n/a	0.50	0.536
Decaldehyde (iso-)	0.035	5000	5006	28110	n/a	0.50	0.535
Decaldehyde (n-)	0.035	5000	5000	28075	n/a	0.50	0.535
Decane	0.036	5000	5070	28468	n/a	0.50	0.536
Decyl Alcohol (all isomers) (Decanol)	0.035	5000	5007	28112	n/a	0.50	0.535
Decyl Alcohol (iso-)	0.035	5000	5007	28112	n/a	0.50	0.535
Decyl Alcohol (n-)	0.035	5000	5007	28112	n/a	0.50	0.535
Decylbenzene (n-)	0.035	5000	5010	28132	n/a	0.50	0.535
Diacetone Alcohol	0.035	5000	5046	28334	n/a	0.50	0.535
Dibutyl Phthalate (ortho-)	0.035	5000	5000	28075	n/a	0.50	0.535
Dicyclopentadiene, See 1,3-Cyclopentadiene Dimer (mo	0.037	5000	5135	28834	n/a	0.50	0.537
Diethylbenzene	0.035	5000	5045	28325	n/a	0.50	0.535
Diethylene Glycol	0.035	5000	5004	28098	n/a	0.50	0.535
Diethylene Glycol Butyl Ether	0.035	5000	5007	28114	n/a	0.50	0.535
Diethylene Glycol Ethyl Ether Acetate	0.035	5000	5011	28138	n/a	0.50	0.535
Diethylene Glycol Methyl Ether	0.035	5000	5015	28157	n/a	0.50	0.535
Diisobutylcarbinol	0.036	5000	5055	28383	n/a	0.50	0.536
Diisobutylene	0.046	5000	5816	32659	n/a	0.50	0.546
Diisobutyl Ketone	0.036	5000	5095	28611	n/a	0.50	0.536
Diisopropylbenzene (all isomer)	0.035	5000	5021	28195	n/a	0.50	0.535
Dimethyl Phthalate	0.035	5000	5000	28075	n/a	0.50	0.535
Dinonyl Phthalate	0.035	5000	5021	28191	n/a	0.50	0.535
Diethyl Phthalate	0.035	5000	5000	28075	n/a	0.50	0.535
Dipentene	0.036	5000	5060	28411	n/a	0.50	0.536
Diphenyl	0.035	5000	5007	28113	n/a	0.50	0.535
Diphenyl, Diphenyl Ether Mixture	0.035	5000	5008	28117	n/a	0.50	0.535
Diphenyl Ether	0.035	5000	5008	28117	n/a	0.50	0.535
Dipropylene GLYCOL	0.035	5000	5039	28295	n/a	0.50	0.535
Distillates: Flashed Feed Stocks	0.046	5000	5790	32509	n/a	0.50	0.546
Distillates: Straight Run	0.046	5000	5790	32509	n/a	0.50	0.546

Dodecene (all isomers)	0.035	5000	5015	28159	n/a	0.50	0.535
Dodecene	0.035	5000	5015	28159	n/a	0.50	0.535
Dodecylbenzene	0.103	5000	8870	49807	n/a	0.50	0.603
Ethoxy Triglycol (crude)	0.035	5000	5000	28075	n/a	0.50	0.535
Ethyl Acetate	0.053	5000	6259	35142	n/a	0.50	0.553
Ethyl Acetoacetate	0.036	5000	5106	28672	n/a	0.50	0.536
Ethyl Alcohol (Ethanol)	0.039	5000	5314	29840	n/a	0.50	0.539
Ethyl Benzene	0.038	5000	5232	29376	n/a	0.50	0.538
Ethyl Butanol	0.036	5000	5047	28336	n/a	0.50	0.536
Ethyl Butyrate	0.041	5000	5443	30565	n/a	0.50	0.541
Ethyl Cyclohexane	0.038	5000	5217	29293	n/a	0.50	0.538
Ethylene Glycol	0.035	5000	5002	28086	n/a	0.50	0.535
Ethylene Glycol Butyl Ether Acetate	0.035	5000	5035	28270	n/a	0.50	0.535
Ethylene Glycol Diacetate	0.035	5000	5006	28110	n/a	0.50	0.535
Ethylene Glycol Methyl Ether	0.035	5000	5006	28108	n/a	0.50	0.535
Ethylene Glycol Phenyl Ether	0.035	5000	5006	28108	n/a	0.50	0.535
2-Ethylhexaldehyde, See Octyl Aldehydes	0.036	5000	5089	28573	n/a	0.50	0.536
2-Ethylhexanol , see Octanol (all isomers)	0.035	5000	5011	28136	n/a	0.50	0.535
Ethyl Propionate	0.039	5000	5314	29840	n/a	0.50	0.539
Ethyl Toulene	0.037	5000	5134	28830	n/a	0.50	0.537
Formamide	0.035	5000	5009	28123	n/a	0.50	0.535
Furfuryl Alcohol	0.035	5000	5019	28179	n/a	0.50	0.535
Gasoline Blended Stocks: Alkylates	0.094	5000	8444	47415	n/a	0.50	0.594
Gasoline Blended Stocks: Reformate	0.094	5000	8444	47415	n/a	0.50	0.594
Gasolines: Automotive (containing not over 4.23 grams	0.094	5000	8444	47415	n/a	0.50	0.594
Gasolines: Aviation (containing not over 4.86 grams lead	0.094	5000	8444	47415	n/a	0.50	0.594
Gasolines: Casinghead	0.094	5000	8444	47415	n/a	0.50	0.594
Gasolines: Polymer	0.094	5000	8444	47415	n/a	0.50	0.594
Gasolines: Straight Run	0.094	5000	8444	47415	n/a	0.50	0.594
Glycerine	0.035	5000	5000	28075	n/a	0.50	0.535
Heptane (all isomers) (Methylhexane)	0.047	5000	5870	32959	n/a	0.50	0.547
Heptane (n-)	0.047	5000	5870	32959	n/a	0.50	0.547
Heptonic Acid	0.035	5000	5005	28105	n/a	0.50	0.535
Heptanol (all isomers)	0.035	5000	5019	28179	n/a	0.50	0.535
Heptanol (all isomers)	0.035	5000	5019	28179	n/a	0.50	0.535
Heptene (all isomers)	0.049	5000	5979	33570	n/a	0.50	0.549
Heptene (1-)	0.048	5000	5948	33395	n/a	0.50	0.548
Heptyl Acetate	0.036	5000	5069	28463	n/a	0.50	0.536
Hexane (all isomers)	0.063	5000	6827	38334	n/a	0.50	0.563
Hexane	0.063	5000	6827	38334	n/a	0.50	0.563
Hexanoic Acid	0.035	5000	5005	28101	n/a	0.50	0.535
Hexanol	0.040	5000	5375	30180	n/a	0.50	0.540
Hexene (all isomers)	0.065	5000	6961	39089	n/a	0.50	0.565
Hexene (1-)	0.066	5000	7004	39324	n/a	0.50	0.566
Hexene (2-)	0.066	5000	7004	39324	n/a	0.50	0.566
Hexylene Glycol	0.035	5000	5000	28076	n/a	0.50	0.535
isophorone	0.035	5000	5006	28108	n/a	0.50	0.535
Jet Fuels: JP-1 (Kerosene)	0.036	5000	5075	28497	n/a	0.50	0.536
Jet Fuels: JP-3	0.093	5000	8425	47304	n/a	0.50	0.593
Jet Fuels: JP-4	0.055	5000	6383	35841	n/a	0.50	0.555
Jet Fuels: JP-5 (Kerosene, heavy)	0.035	5000	5046	28334	n/a	0.50	0.535
Kerosene	0.036	5000	5080	28527	n/a	0.50	0.536
Methyl Acetate	0.054	5000	6330	35541	n/a	0.50	0.554
Methyl Alcohol (See Methanol)	0.036	5000	5101	28644	n/a	0.50	0.536
Methyl Amyl Acetate	0.038	5000	5198	29189	n/a	0.50	0.538
Methyl Amyl Alcohol	0.037	5000	5165	28999	n/a	0.50	0.537
Methyl n-Butyl Ketone	0.040	5000	5361	30104	n/a	0.50	0.540
Methyl Butyrate	0.041	5000	5470	30714	n/a	0.50	0.541
Methyl Ethyl Ketone	0.048	5000	5951	33417	n/a	0.50	0.548
Methyl Formal (Dimethyl Formal)	0.090	5000	8258	46370	n/a	0.50	0.590

Methyl Heptyl Ketone	0.035	5000	5036	28277	n/a	0.50	0.535
Methyl Isobutyl Ketone	0.041	5000	5418	30419	n/a	0.50	0.541
1-Methyl Naphthalene	0.035	5000	5006	28109	n/a	0.50	0.535
2-Methyl-1-Pentene	0.059	5000	6594	37023	n/a	0.50	0.559
5-Methyl-1-Pentene	0.067	5000	7064	39664	n/a	0.50	0.567
Methyl Tert-Butyl Ether (MTBE)	0.035	5000	5013	28148	n/a	0.50	0.535
Mineral Spirits	0.036	5000	5101	28642	n/a	0.50	0.536
Myrcene	0.036	5000	5096	28615	n/a	0.50	0.536
Naphtha: Solvent	0.036	5000	5077	28505	n/a	0.50	0.536
Naphtha: Stoddard Solvant	0.036	5000	5101	28642	n/a	0.50	0.536
Naphtha: VamIsh Maker's and Painters (75%)	0.036	5000	5096	28614	n/a	0.50	0.536
Nonane (all isomers)	0.037	5000	5140	28860	n/a	0.50	0.537
Nonane	0.037	5000	5140	28860	n/a	0.50	0.537
Nonene	0.037	5000	5175	29059	n/a	0.50	0.537
Nonyl Alcohol (all isomers)	0.036	5000	5061	28420	n/a	0.50	0.536
Nonyl Alcohol	0.036	5000	5061	28420	n/a	0.50	0.536
Nonyl Alcohol (iso-)	0.036	5000	5061	28420	n/a	0.50	0.536
Nonyl Phenol	0.035	5000	5010	28132	n/a	0.50	0.535
Octane (all isomers)	0.039	5000	5342	29995	n/a	0.50	0.539
Octane	0.039	5000	5342	29995	n/a	0.50	0.539
Octanoic Acid (all isomers)	0.035	5000	5006	28110	n/a	0.50	0.535
Octanol (all isomers)	0.035	5000	5005	28105	n/a	0.50	0.535
Octanol	0.035	5000	5005	28105	n/a	0.50	0.535
Octene (all isomers) 2	0.040	5000	5388	30253	n/a	0.50	0.540
Octene (1-)	0.041	5000	5424	30453	n/a	0.50	0.541
Octyl Alcohol (iso-,n.) (all isomers), See Octanol (all isomers)	0.035	5000	5005	28105	n/a	0.50	0.535
Octyl Alcohol	0.035	5000	5005	28105	n/a	0.50	0.535
Fuel: NO.2	0.043	5000	5572	31289	n/a	0.50	0.543
Fuel: NO.4	0.036	5000	5055	28386	n/a	0.50	0.536
Fuel: No.5	0.036	5000	5055	28386	n/a	0.50	0.536
Fuel: NO.6	0.036	5000	5055	28386	n/a	0.50	0.536
OIL, Mise: Crude	0.036	5000	5055	28386	n/a	0.50	0.536
Oil, Mise: Diesel	0.038	5000	5249	29476	n/a	0.50	0.538
OIL, Mise: Lubricating	0.035	5000	5000	28075	n/a	0.50	0.535
OIL, Mise: Resin	0.035	5000	5000	28075	n/a	0.50	0.535
Oil, Mise: Turbine	0.038	5000	5200	29197	n/a	0.50	0.538
Pentadecanol, See Alcohols (C13 and above)	0.035	5000	5011	28135	n/a	0.50	0.535
Pentane (all isomers)	0.115	5000	9412	52850	n/a	0.50	0.615
Pentane (iso-)	0.147	5000	10673	59926	n/a	0.50	0.647
Pentane (n-)	0.113	5000	9323	52350	n/a	0.50	0.613
Pentene (all isomers)	0.131	5000	10082	56613	n/a	0.50	0.631
Pentene (1-)	0.131	5000	10082	56613	n/a	0.50	0.631
Pinene	0.037	5000	5196	29176	n/a	0.50	0.537
Polybutene	0.036	5000	5120	28746	n/a	0.50	0.536
Polypropylene Glycol	0.035	5000	5000	28075	n/a	0.50	0.535
Polypropylene Glycol Methyl Ether	0.038	5000	5254	29502	n/a	0.50	0.538
Propyl Acetate (iso-)	0.044	5000	5657	31764	n/a	0.50	0.544
Propyl Acetate (n-)	0.044	5000	5674	31861	n/a	0.50	0.544
Propyl Alcohol (iso-)	0.041	5000	5473	30732	n/a	0.50	0.541
Propyl Alcohol (n-)	0.037	5000	5194	29167	n/a	0.50	0.537
Propylbenzene (n-)	0.036	5000	5096	28614	n/a	0.50	0.536
iso-Propylcyclohexane	0.035	5000	5005	28104	n/a	0.50	0.535
Propylene Glycol (1,2-Propandiol)	0.035	5000	5003	28089	n/a	0.50	0.535
Propylene Glycol Methyl Ether	0.038	5000	5223	29327	n/a	0.50	0.538
Propylene Tetramer	0.035	5000	5000	28075	n/a	0.50	0.535
Sulfolane	0.035	5000	5005	28102	n/a	0.50	0.535
Tetradecanol	0.035	5000	5000	28075	n/a	0.50	0.535
1-Tetradecene, See the olefin or Alpha-Olefin Entries	0.035	5000	5009	28125	n/a	0.50	0.535
Tetraethylene Glycol	0.035	5000	5009	28125	n/a	0.50	0.535
Tetrahydronaphthalene	0.035	5000	5022	28198	n/a	0.50	0.535

Toluene	0.041	5000	5473	30732	n/a	0.50	0.541
Tricresyl Phosphate (less than 1% of the ortho isomer)	0.035	5000	5018	28176	n/a	0.50	0.535
Tridecane	0.035	5000	5017	28169	n/a	0.50	0.535
Tridecanol , See Alcohols (C13 and above)	0.035	5000	5009	28126	n/a	0.50	0.535
l-Tridecene	0.035	5000	5008	28121	n/a	0.50	0.535
Triethylbenzene	0.035	5000	5014	28155	n/a	0.50	0.535
Triethylene Glycol	0.035	5000	5007	28111	n/a	0.50	0.535
Trimethylbenzenes (all isomers)	0.036	5000	5069	28461	n/a	0.50	0.536
Trimethyl Benzene (1,2,5-)	0.036	5000	5067	28454	n/a	0.50	0.536
Trimethyl Benzene (1,2,3-)	0.036	5000	5067	28454	n/a	0.50	0.536
Trimethyl Benzene (1,2,4-) (Pseudocumene)	0.036	5000	5067	28454	n/a	0.50	0.536
Trixylenyl Phosphate	0.035	5000	5000	28075	n/a	0.50	0.535
Undecene (1-)	0.035	5000	5033	28262	n/a	0.50	0.535
Undecyl Alcohol	0.035	5000	5008	28118	n/a	0.50	0.535
Xylenes (Ortho-, meta., para-)	0.038	5000	5205	29227	n/a	0.50	0.538
Xylene (M-)	0.038	5000	5205	29227	n/a	0.50	0.538
Xylene (O-)	0.037	5000	5162	28983	n/a	0.50	0.537
Xylene (P-)	0.038	5000	5205	29227	n/a	0.50	0.538
Xylenol	0.035	5000	5041	28305	n/a	0.50	0.535
Zinc Dialkyldithiophosphate	0.000	0	0	0	n/a	0.50	0.500

Cargo with the highest pressure drop is:

Pentane (iso-)	Max ΔP =	0.65 psi	<	3.00 psi	OK
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Notes: 1) Vapor flow rate used in discharge condition is liquid discharge rate, per USCG guidance 7/15/01

2) Air equivalent flow rate derived from maximum liquid discharge rate and a density correction factor for conservatism (see list of allowable cargoes for details)

3) See ERL flow curve "080M077B"

Pressure Drop through VCS - From #1 Cargo Tank to Shore Connection (per 46 CFR 39.30-1(d)(3) and ABS SBR 5-2-3/7.5.2(c))

Pipe sizes, nominal: 8 in
 Pipe ID: 7.981 in
 Pipe Flow Area: 50.03 in²
 Vapor Dynamic Viscosity: 0.019 centipoise (estimated, based on air @ 115F, Crane 410, Table A-5)

PIPE LENGTH

Length (ft): 221.94 ft 8" pipe
 Length (ft): 50.00 ft 6" hose
 f, friction factor (pipe): Varies with Reynold's Number (see table below)

VALVE & FITTING EQUIVALENT LENGTH

Equivalent Length (ft): 285.74 ft
 f_v, friction factor, turbulent flow (fittings): 0.014 constant, for each pipe size

Shore Connection Pressure Drop (at 25% of Maximum Liquid Loading Rate): 1250 BBL/hr

Cargo	Vapor-Air Mix. Density (lb/ft ³)	Vapor Flow Rate		Reynold's Number		Friction Factor		Vapor Velocity		Head Loss			Component ΔP				ΔP
		BBL/hr	ft ³ /s	6" Hose	8" Pipe	6" Hose	8" Pipe	6" Hose	8" Pipe	6" Hose	8" Pipe	8" Fittings	6" Hose	8" Pipe	8" Fittings	TOTAL	
1	0.123	1563	2.44	59153	44952	0.0212	0.0221	12.1	7.0	4.82	5.64	4.60	0.0041	0.0048	0.0039	0.0129	
2	0.085	1563	2.44	40827	31025	0.0228	0.0233	12.1	7.0	5.16	5.94	4.60	0.0030	0.0035	0.0027	0.0093	
19	0.082	1563	2.44	39166	29763	0.0230	0.0235	12.1	7.0	5.21	6.00	4.60	0.0029	0.0034	0.0026	0.0089	
20	0.079	1563	2.44	37955	28843	0.0231	0.0237	12.1	7.0	5.24	6.04	4.60	0.0029	0.0033	0.0025	0.0087	
21	0.079	1563	2.44	37955	28843	0.0231	0.0237	12.1	7.0	5.24	6.04	4.60	0.0029	0.0033	0.0025	0.0087	
23	0.079	1563	2.44	37955	28843	0.0231	0.0237	12.1	7.0	5.24	6.04	4.60	0.0029	0.0033	0.0025	0.0087	
24	0.079	1563	2.44	37955	28843	0.0231	0.0237	12.1	7.0	5.24	6.04	4.60	0.0029	0.0033	0.0025	0.0087	
26	0.079	1563	2.44	37955	28843	0.0231	0.0237	12.1	7.0	5.24	6.04	4.60	0.0029	0.0033	0.0025	0.0087	
34	0.077	1563	2.44	37189	28261	0.0232	0.0238	12.1	7.0	5.26	6.07	4.60	0.0028	0.0033	0.0025	0.0086	
40	0.085	1563	2.44	40637	30881	0.0228	0.0233	12.1	7.0	5.17	5.95	4.60	0.0030	0.0035	0.0027	0.0092	
42	0.097	1563	2.44	46734	35514	0.0222	0.0226	12.1	7.0	5.03	5.76	4.60	0.0034	0.0039	0.0031	0.0104	
44	0.083	1563	2.44	39824	30264	0.0229	0.0234	12.1	7.0	5.19	5.98	4.60	0.0030	0.0034	0.0026	0.0091	
46	0.086	1563	2.44	41269	31362	0.0227	0.0232	12.1	7.0	5.15	5.93	4.60	0.0031	0.0035	0.0027	0.0094	
47	0.097	1563	2.44	46689	35480	0.0222	0.0226	12.1	7.0	5.03	5.76	4.60	0.0034	0.0039	0.0031	0.0104	
48	0.077	1563	2.44	36794	27961	0.0233	0.0239	12.1	7.0	5.27	6.09	4.60	0.0028	0.0032	0.0024	0.0085	
58	0.078	1563	2.44	37501	28498	0.0232	0.0238	12.1	7.0	5.25	6.06	4.60	0.0028	0.0033	0.0025	0.0086	
64	0.077	1563	2.44	36900	28042	0.0232	0.0239	12.1	7.0	5.27	6.08	4.60	0.0028	0.0032	0.0025	0.0085	
70	0.085	1563	2.44	40908	31087	0.0228	0.0233	12.1	7.0	5.16	5.94	4.60	0.0031	0.0035	0.0027	0.0093	
72	0.116	1563	2.44	55879	42464	0.0215	0.0217	12.1	7.0	4.87	5.53	4.60	0.0039	0.0045	0.0037	0.0121	
73	0.078	1563	2.44	37403	28423	0.0232	0.0238	12.1	7.0	5.25	6.07	4.60	0.0028	0.0033	0.0025	0.0086	
74	0.080	1563	2.44	38577	29316	0.0230	0.0236	12.1	7.0	5.22	6.02	4.60	0.0029	0.0034	0.0026	0.0088	
76	0.078	1563	2.44	37472	28476	0.0232	0.0238	12.1	7.0	5.25	6.06	4.60	0.0028	0.0033	0.0025	0.0086	
77	0.078	1563	2.44	37422	28438	0.0232	0.0238	12.1	7.0	5.25	6.06	4.60	0.0028	0.0033	0.0025	0.0086	
78	0.076	1563	2.44	36663	27861	0.0233	0.0239	12.1	7.0	5.28	6.09	4.60	0.0028	0.0032	0.0024	0.0085	
79	0.076	1563	2.44	36573	27793	0.0233	0.0239	12.1	7.0	5.28	6.10	4.60	0.0028	0.0032	0.0024	0.0084	
81	0.078	1563	2.44	37602	28575	0.0232	0.0238	12.1	7.0	5.25	6.06	4.60	0.0029	0.0033	0.0025	0.0086	
82	0.076	1563	2.44	36670	27866	0.0233	0.0239	12.1	7.0	5.28	6.09	4.60	0.0028	0.0032	0.0024	0.0085	
83	0.076	1563	2.44	36670	27866	0.0233	0.0239	12.1	7.0	5.28	6.09	4.60	0.0028	0.0032	0.0024	0.0085	
84	0.076	1563	2.44	36670	27866	0.0233	0.0239	12.1	7.0	5.28	6.09	4.60	0.0028	0.0032	0.0024	0.0085	
85	0.076	1563	2.44	36720	27905	0.0233	0.0239	12.1	7.0	5.27	6.09	4.60	0.0028	0.0032	0.0024	0.0085	
87	0.078	1563	2.44	37250	28307	0.0232	0.0238	12.1	7.0	5.26	6.07	4.60	0.0028	0.0033	0.0025	0.0086	
91	0.076	1563	2.44	36573	27793	0.0233	0.0239	12.1	7.0	5.28	6.10	4.60	0.0028	0.0032	0.0024	0.0084	
92	0.080	1563	2.44	38577	29316	0.0230	0.0236	12.1	7.0	5.22	6.02	4.60	0.0029	0.0034	0.0026	0.0088	
93	0.077	1563	2.44	37227	28290	0.0232	0.0238	12.1	7.0	5.26	6.07	4.60	0.0028	0.0033	0.0025	0.0086	
94	0.076	1563	2.44	36633	27838	0.0233	0.0239	12.1	7.0	5.28	6.10	4.60	0.0028	0.0032	0.0024	0.0085	
95	0.076	1563	2.44	36674	27870	0.0233	0.0239	12.1	7.0	5.28	6.09	4.60	0.0028	0.0032	0.0024	0.0085	
100	0.076	1563	2.44	36736	27917	0.0233	0.0239	12.1	7.0	5.27	6.09	4.60	0.0028	0.0032	0.0024	0.0085	
101	0.077	1563	2.44	36785	27954	0.0233	0.0239	12.1	7.0	5.27	6.09	4.60	0.0028	0.0032	0.0024	0.0085	
111	0.078	1563	2.44	37379	28406	0.0232	0.0238	12.1	7.0	5.26	6.07	4.60	0.0028	0.0033	0.0025	0.0086	
112	0.103	1563	2.44	49488	37608	0.0220	0.0223	12.1	7.0	4.98	5.68	4.60	0.0036	0.0041	0.0033	0.0109	
113	0.079	1563	2.44	37982	28863	0.0231	0.0237	12.1	7.0	5.24	6.04	4.60	0.0029	0.0033	0.0025	0.0087	
119	0.077	1563	2.44	36884	28029	0.0232	0.0239	12.1	7.0	5.27	6.09	4.60	0.0028	0.0032	0.0025	0.0085	
124	0.076	1563	2.44	36573	27793	0.0233	0.0239	12.1	7.0	5.28	6.10	4.60	0.0028	0.0032	0.0024	0.0084	
128	0.077	1563	2.44	36875	28023	0.0232	0.0239	12.1	7.0	5.27	6.09	4.60	0.0028	0.0032	0.0024	0.0085	
130	0.076	1563	2.44	36573	27793	0.0233	0.0239	12.1	7.0	5.28	6.10	4.60	0.0028	0.0032	0.0024	0.0084	
131	0.078	1563	2.44	37453	28462	0.0232	0.0238	12.1	7.0	5.25	6.06	4.60	0.0028	0.0033	0.0025	0.0086	
132	0.076	1563	2.44	36670	27867	0.0233	0.0239	12.1	7.0	5.28	6.09	4.60	0.0028	0.0032	0.0024	0.0085	
133	0.076	1563	2.44	36682	27876	0.0233	0.0239	12.1	7.0	5.28	6.09	4.60	0.0028	0.0032	0.0024	0.0085	

546	0.083	1563	2.44		39636	30121		0.0229	0.0235		12.1	7.0				5.19	5.98	4.60				0.0030	0.0034	0.0026	0.0090
547	0.083	1563	2.44		39636	30121		0.0229	0.0235		12.1	7.0				5.19	5.98	4.60				0.0030	0.0034	0.0026	0.0090
548	0.081	1563	2.44		38975	29618		0.0230	0.0236		12.1	7.0				5.21	6.01	4.60				0.0029	0.0034	0.0026	0.0089
549	0.083	1563	2.44		39636	30121		0.0229	0.0235		12.1	7.0				5.19	5.98	4.60				0.0030	0.0034	0.0026	0.0090
550	0.077	1563	2.44		37173	28249		0.0232	0.0238		12.1	7.0				5.26	6.07	4.60				0.0028	0.0033	0.0025	0.0086

MAX ΔP:	0.0470
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P-V valve pressure setting: 1.5 psi
80% of P-V valve setting: 1.2 psi

Maximum pressure drop to shore connection: 0.047 psi

TOTAL PRESSURE DROP TO SHORE CONNECTION: 0.047 psi OK

Max. allowable back pressure at facility: 1.153 psi

Pressure Drop through VCS - From #1 Cargo Tank to Shore Connection (per 46 CFR 39.30-1(d)(3) and ABS SBR 5-2-3/7.5.2(c))

Pipe sizes, nominal: 8 in
 Pipe ID: 7.981 in
 Pipe Flow Area: 50.03 in²
 Vapor Dynamic Viscosity: 0.019 centipoise (estimated, based on air @ 115F, Crane 410, Table A-5)

PIPE LENGTH

Length (ft): 221.94 ft 8" pipe
 Length (ft): 50.00 ft 6" hose
 f, friction factor (pipe): Varies with Reynold's Number (see table below)

VALVE & FITTING EQUIVALENT LENGTH

Equivalent Length (ft): 285.74 ft
 f_v, friction factor, turbulent flow (fittings): 0.014 constant, for each pipe size

Shore Connection Pressure Drop (at 50% of Maximum Liquid Loading Rate): 2500 BBL/hr

Cargo	Vapor-Air Mix. Density (lb/ft ³)	Vapor Flow Rate		Reynold's Number		Friction Factor		Vapor Velocity		Head Loss			Component ΔP				ΔP
		BBL/hr	ft ³ /s	6" Hose	8" Pipe	6" Hose	8" Pipe	6" Hose	8" Pipe	6" Hose	8" Pipe	8" Fittings	6" Hose	8" Pipe	8" Fittings	TOTAL	
1	0.123	3125	4.87	118305	89904	0.0190	0.0195	24.3	14.0	17.23	19.85	18.38	0.0147	0.0170	0.0157	0.0474	
2	0.085	3125	4.87	81654	62051	0.0201	0.0200	24.3	14.0	18.23	20.35	18.38	0.0108	0.0120	0.0108	0.0336	
19	0.082	3125	4.87	78332	59527	0.0202	0.0201	24.3	14.0	18.36	20.53	18.38	0.0104	0.0116	0.0104	0.0324	
20	0.079	3125	4.87	75909	57686	0.0204	0.0203	24.3	14.0	18.45	20.67	18.38	0.0101	0.0113	0.0101	0.0316	
21	0.079	3125	4.87	75909	57686	0.0204	0.0203	24.3	14.0	18.45	20.67	18.38	0.0101	0.0113	0.0101	0.0316	
23	0.079	3125	4.87	75909	57686	0.0204	0.0203	24.3	14.0	18.45	20.67	18.38	0.0101	0.0113	0.0101	0.0316	
24	0.079	3125	4.87	75909	57686	0.0204	0.0203	24.3	14.0	18.45	20.67	18.38	0.0101	0.0113	0.0101	0.0316	
26	0.079	3125	4.87	75909	57686	0.0204	0.0203	24.3	14.0	18.45	20.67	18.38	0.0101	0.0113	0.0101	0.0316	
34	0.077	3125	4.87	74378	56522	0.0204	0.0204	24.3	14.0	18.52	20.76	18.38	0.0100	0.0112	0.0099	0.0310	
40	0.085	3125	4.87	81274	61763	0.0201	0.0200	24.3	14.0	18.25	20.37	18.38	0.0107	0.0120	0.0108	0.0335	
42	0.097	3125	4.87	93467	71029	0.0197	0.0194	24.3	14.0	17.85	19.78	18.38	0.0121	0.0134	0.0124	0.0378	
44	0.083	3125	4.87	79648	60527	0.0202	0.0201	24.3	14.0	18.31	20.46	18.38	0.0105	0.0118	0.0106	0.0329	
46	0.086	3125	4.87	82539	62724	0.0201	0.0199	24.3	14.0	18.20	20.30	18.38	0.0109	0.0121	0.0110	0.0339	
47	0.097	3125	4.87	93377	70960	0.0197	0.0194	24.3	14.0	17.85	19.78	18.38	0.0120	0.0134	0.0124	0.0378	
48	0.077	3125	4.87	73588	55922	0.0205	0.0204	24.3	14.0	18.55	20.81	18.38	0.0099	0.0111	0.0098	0.0307	
58	0.078	3125	4.87	75001	56996	0.0204	0.0203	24.3	14.0	18.49	20.73	18.38	0.0100	0.0112	0.0100	0.0312	
64	0.077	3125	4.87	73800	56083	0.0204	0.0204	24.3	14.0	18.54	20.80	18.38	0.0099	0.0111	0.0098	0.0308	
70	0.085	3125	4.87	81816	62175	0.0201	0.0199	24.3	14.0	18.23	20.34	18.38	0.0108	0.0120	0.0109	0.0337	
72	0.116	3125	4.87	111757	84928	0.0192	0.0187	24.3	14.0	17.38	19.06	18.38	0.0140	0.0154	0.0148	0.0443	
73	0.078	3125	4.87	74805	56847	0.0204	0.0203	24.3	14.0	18.50	20.74	18.38	0.0100	0.0112	0.0099	0.0312	
74	0.080	3125	4.87	77153	58631	0.0203	0.0202	24.3	14.0	18.40	20.60	18.38	0.0103	0.0115	0.0103	0.0320	
76	0.078	3125	4.87	74944	56952	0.0204	0.0203	24.3	14.0	18.49	20.73	18.38	0.0100	0.0112	0.0100	0.0312	
77	0.078	3125	4.87	74843	56876	0.0204	0.0203	24.3	14.0	18.50	20.74	18.38	0.0100	0.0112	0.0099	0.0312	
78	0.076	3125	4.87	73326	55723	0.0205	0.0204	24.3	14.0	18.56	20.83	18.38	0.0098	0.0110	0.0097	0.0306	
79	0.076	3125	4.87	73145	55585	0.0205	0.0204	24.3	14.0	18.57	20.84	18.38	0.0098	0.0110	0.0097	0.0306	
81	0.078	3125	4.87	75205	57150	0.0204	0.0203	24.3	14.0	18.48	20.71	18.38	0.0100	0.0113	0.0100	0.0313	
82	0.076	3125	4.87	73340	55733	0.0205	0.0204	24.3	14.0	18.56	20.83	18.38	0.0098	0.0110	0.0097	0.0306	
83	0.076	3125	4.87	73340	55733	0.0205	0.0204	24.3	14.0	18.56	20.83	18.38	0.0098	0.0110	0.0097	0.0306	
84	0.076	3125	4.87	73340	55733	0.0205	0.0204	24.3	14.0	18.56	20.83	18.38	0.0098	0.0110	0.0097	0.0306	
85	0.076	3125	4.87	73440	55809	0.0205	0.0204	24.3	14.0	18.56	20.82	18.38	0.0098	0.0111	0.0098	0.0307	
87	0.078	3125	4.87	74500	56615	0.0204	0.0203	24.3	14.0	18.51	20.76	18.38	0.0100	0.0112	0.0099	0.0310	
91	0.076	3125	4.87	73145	55585	0.0205	0.0204	24.3	14.0	18.57	20.84	18.38	0.0098	0.0110	0.0097	0.0306	
92	0.080	3125	4.87	77153	58631	0.0203	0.0202	24.3	14.0	18.40	20.60	18.38	0.0103	0.0115	0.0103	0.0320	
93	0.077	3125	4.87	74453	56579	0.0204	0.0204	24.3	14.0	18.51	20.76	18.38	0.0100	0.0112	0.0099	0.0310	
94	0.076	3125	4.87	73266	55677	0.0205	0.0204	24.3	14.0	18.56	20.83	18.38	0.0098	0.0110	0.0097	0.0306	
95	0.076	3125	4.87	73349	55740	0.0205	0.0204	24.3	14.0	18.56	20.83	18.38	0.0098	0.0110	0.0097	0.0306	
100	0.076	3125	4.87	73472	55834	0.0205	0.0204	24.3	14.0	18.55	20.82	18.38	0.0099	0.0111	0.0098	0.0307	
101	0.077	3125	4.87	73571	55909	0.0205	0.0204	24.3	14.0	18.55	20.81	18.38	0.0099	0.0111	0.0098	0.0307	
111	0.078	3125	4.87	74759	56812	0.0204	0.0203	24.3	14.0	18.50	20.74	18.38	0.0100	0.0112	0.0099	0.0311	
112	0.103	3125	4.87	98977	75215	0.0195	0.0192	24.3	14.0	17.69	19.54	18.38	0.0127	0.0140	0.0132	0.0398	
113	0.079	3125	4.87	75963	57727	0.0204	0.0203	24.3	14.0	18.45	20.67	18.38	0.0101	0.0113	0.0101	0.0316	
119	0.077	3125	4.87	73769	56059	0.0205	0.0204	24.3	14.0	18.54	20.80	18.38	0.0099	0.0111	0.0098	0.0308	
124	0.076	3125	4.87	73145	55585	0.0205	0.0204	24.3	14.0	18.57	20.84	18.38	0.0098	0.0110	0.0097	0.0306	
128	0.077	3125	4.87	73751	56045	0.0205	0.0204	24.3	14.0	18.54	20.80	18.38	0.0099	0.0111	0.0098	0.0308	
130	0.076	3125	4.87	73145	55585	0.0205	0.0204	24.3	14.0	18.57	20.84	18.38	0.0098	0.0110	0.0097	0.0306	
131	0.078	3125	4.87	74907	56924	0.0204	0.0203	24.3	14.0	18.49	20.73	18.38	0.0100	0.0112	0.0100	0.0312	
132	0.076	3125	4.87	73340	55733	0.0205	0.0204	24.3	14.0	18.56	20.83	18.38	0.0098	0.0110	0.0097	0.0306	
133	0.076	3125	4.87	73365	55752	0.0205	0.0204	24.3	14.0	18.56	20.83	18.38	0.0098	0.0110	0.0097	0.0306	

134	0.076	3125	4.87		73365	55753		0.0205	0.0204		24.3	14.0				18.56	20.83	18.38					0.0098	0.0110	0.0097	0.0306
136	0.077	3125	4.87		74293	56457		0.0204	0.0204		24.3	14.0				18.52	20.77	18.38					0.0099	0.0112	0.0099	0.0310
139	0.102	3125	4.87		98074	74529		0.0195	0.0192		24.3	14.0				17.72	19.58	18.38					0.0126	0.0139	0.0130	0.0395
140	0.102	3125	4.87		98074	74529		0.0195	0.0192		24.3	14.0				17.72	19.58	18.38					0.0126	0.0139	0.0130	0.0395
145	0.077	3125	4.87		73580	55916		0.0205	0.0204		24.3	14.0				18.55	20.81	18.38					0.0099	0.0111	0.0098	0.0307
146	0.077	3125	4.87		73580	55916		0.0205	0.0204		24.3	14.0				18.55	20.81	18.38					0.0099	0.0111	0.0098	0.0307
147	0.240	3125	4.87		230211	174945		0.0175	0.0162		24.3	14.0				15.86	16.57	18.38					0.0264	0.0276	0.0306	0.0846
155	0.076	3125	4.87		73145	55585		0.0205	0.0204		24.3	14.0				18.57	20.84	18.38					0.0098	0.0110	0.0097	0.0306
156	0.119	3125	4.87		114602	87090		0.0191	0.0186		24.3	14.0				17.31	18.96	18.38					0.0143	0.0157	0.0152	0.0453
157	0.079	3125	4.87		76289	57974		0.0203	0.0202		24.3	14.0				18.44	20.65	18.38					0.0102	0.0114	0.0101	0.0317
158	0.086	3125	4.87		82629	62792		0.0201	0.0199		24.3	14.0				18.20	20.30	18.38					0.0109	0.0121	0.0110	0.0340
160	0.083	3125	4.87		80082	60857		0.0202	0.0200		24.3	14.0				18.29	20.44	18.38					0.0106	0.0118	0.0106	0.0331
161	0.078	3125	4.87		74511	56623		0.0204	0.0203		24.3	14.0				18.51	20.76	18.38					0.0100	0.0112	0.0099	0.0310
162	0.090	3125	4.87		86693	65881		0.0199	0.0197		24.3	14.0				18.06	20.09	18.38					0.0113	0.0126	0.0115	0.0354
163	0.083	3125	4.87		79626	60510		0.0202	0.0201		24.3	14.0				18.31	20.46	18.38					0.0105	0.0118	0.0106	0.0329
166	0.076	3125	4.87		73200	55627		0.0205	0.0204		24.3	14.0				18.57	20.84	18.38					0.0098	0.0110	0.0097	0.0306
169	0.077	3125	4.87		74166	56361		0.0204	0.0204		24.3	14.0				18.53	20.78	18.38					0.0099	0.0111	0.0099	0.0309
172	0.076	3125	4.87		73327	55724		0.0205	0.0204		24.3	14.0				18.56	20.83	18.38					0.0098	0.0110	0.0097	0.0306
178	0.076	3125	4.87		73317	55716		0.0205	0.0204		24.3	14.0				18.56	20.83	18.38					0.0098	0.0110	0.0097	0.0306
180	0.076	3125	4.87		73317	55716		0.0205	0.0204		24.3	14.0				18.56	20.83	18.38					0.0098	0.0110	0.0097	0.0306
184	0.079	3125	4.87		75763	57575		0.0204	0.0203		24.3	14.0				18.46	20.68	18.38					0.0101	0.0113	0.0101	0.0315
186	0.076	3125	4.87		73462	55826		0.0205	0.0204		24.3	14.0				18.56	20.82	18.38					0.0099	0.0111	0.0098	0.0307
190	0.086	3125	4.87		82629	62792		0.0201	0.0199		24.3	14.0				18.20	20.30	18.38					0.0109	0.0121	0.0110	0.0340
191	0.080	3125	4.87		77129	58612		0.0203	0.0202		24.3	14.0				18.41	20.60	18.38					0.0103	0.0115	0.0102	0.0320
194	0.076	3125	4.87		73394	55774		0.0205	0.0204		24.3	14.0				18.56	20.82	18.38					0.0098	0.0110	0.0098	0.0306
195	0.077	3125	4.87		73687	55997		0.0205	0.0204		24.3	14.0				18.55	20.81	18.38					0.0099	0.0111	0.0098	0.0307
197	0.217	3125	4.87		208625	158540		0.0177	0.0165		24.3	14.0				16.03	16.87	18.38					0.0242	0.0254	0.0277	0.0773
198	0.217	3125	4.87		208625	158540		0.0177	0.0165		24.3	14.0				16.03	16.87	18.38					0.0242	0.0254	0.0277	0.0773
199	0.217	3125	4.87		208625	158540		0.0177	0.0165		24.3	14.0				16.03	16.87	18.38					0.0242	0.0254	0.0277	0.0773
200	0.217	3125	4.87		208625	158540		0.0177	0.0165		24.3	14.0				16.03	16.87	18.38					0.0242	0.0254	0.0277	0.0773
201	0.217	3125	4.87		208625	158540		0.0177	0.0165		24.3	14.0				16.03	16.87	18.38					0.0242	0.0254	0.0277	0.0773
202	0.217	3125	4.87		208625	158540		0.0177	0.0165		24.3	14.0				16.03	16.87	18.38					0.0242	0.0254	0.0277	0.0773
203	0.217	3125	4.87		208625	158540		0.0177	0.0165		24.3	14.0				16.03	16.87	18.38					0.0242	0.0254	0.0277	0.0773
204	0.076	3125	4.87		73145	55585		0.0205	0.0204		24.3	14.0				18.57	20.84	18.38					0.0098	0.0110	0.0097	0.0306
217	0.105	3125	4.87		100806	76605		0.0195	0.0191		24.3	14.0				17.64	19.47	18.38					0.0129	0.0142	0.0134	0.0404
218	0.105	3125	4.87		100806	76605		0.0195	0.0191		24.3	14.0				17.64	19.47	18.38					0.0129	0.0142	0.0134	0.0404
219	0.076	3125	4.87		73303	55705		0.0205	0.0204		24.3	14.0				18.56	20.83	18.38					0.0098	0.0110	0.0097	0.0306
220	0.077	3125	4.87		73687	55997		0.0205	0.0204		24.3	14.0				18.55	20.81	18.38					0.0099	0.0111	0.0098	0.0307
221	0.077	3125	4.87		73687	55997		0.0205	0.0204		24.3	14.0				18.55	20.81	18.38					0.0099	0.0111	0.0098	0.0307
222	0.109	3125	4.87		104577	79471		0.0194	0.0189		24.3	14.0				17.55	19.32	18.38					0.0133	0.0146	0.0139	0.0418
223	0.108	3125	4.87		103493	78647		0.0194	0.0190		24.3	14.0				17.57	19.36	18.38					0.0131	0.0145	0.0138	0.0414
224	0.078	3125	4.87		75178	57130		0.0204	0.0203		24.3	14.0				18.48	20.72	18.38					0.0100	0.0113	0.0100	0.0313
229	0.142	3125	4.87		136369	103631		0.0186	0.0180		24.3	14.0				16.90	18.31	18.38					0.0167	0.0180	0.0181	0.0528
230	0.142	3125	4.87		136369	103631		0.0186	0.0180		24.3	14.0				16.90	18.31	18.38					0.0167	0.0180	0.0181	0.0528
231	0.076	3125	4.87		73281	55688		0.0205	0.0204		24.3	14.0				18.56	20.83	18.38					0.0098	0.0110	0.0097	0.0306
232	0.088	3125	4.87		84526	64234		0.0200	0.0198		24.3	14.0				18.13	20.20	18.38					0.0111	0.0123	0.0112	0.0347
234	0.148	3125	4.87		141788	107749		0.0185	0.0178		24.3	14.0				16.81	18.17	18.38					0.0172	0.0186	0.0188	0.0547
235	0.149	3125	4.87		143504	109053		0.0185	0.0178		24.3	14.0				16.78	18.13	18.38					0.0174	0.0188	0.0191	0.0553
236	0.149	3125	4.87		143504	109053		0.0185	0.0178		24.3	14.0				16.78	18.13	18.38					0.0174	0.0188	0.0191	0.0553
238	0.076	3125	4.87		73150	55589		0.0205	0.0204		24.3	14.0				18.57	20.84	18.38					0.0098	0.0110	0.0097	0.0306
243	0.076	3125	4.87		73315	55714		0.0205	0.0204		24.3	14.0				18.56	20.83	18.38					0.0098	0.0110	0.0097	0.0306
244	0.078	3125	4.87		75358	57267		0.0204	0.0203		24.3	14.0				18.48	20.71	18.38					0.0101	0.0113	0.0100	0.0314
245	0.216	3125	4.87		207654	157803		0.0177	0.0166		24.3	14.0				16.04	16.89	18.38					0.0241	0.0253	0.0276	0.0770
246	0.124	3125	4.87		119208	90590		0.0190	0.0184		24.3	14.0				17.22	18.81	18.38					0.0148	0.0162	0.0158	0.0469
247	0.078	3125	4.87		74500	56615		0.0204	0.0203		24.3	14.0				18.51	20.76	18.38					0.0100	0.0112	0.0099	0.0310
249	0.079	3125	4.87		75516	57387		0.0204	0.0203		24.3	14.0				18.47	20.70	18.38					0.0101	0.0113	0.0100	0.0314
263	0.122	3125	4.87		117221	89080		0.0190	0.0185		24.3	14.0				17.26	18.88	18.38					0.0146	0.0160	0.0156	0.0462
265	0.079	3125	4.87		76140	57																				

546	0.083	3125	4.87		79272	60241		0.0202	0.0201		24.3	14.0				18.32	20.48	18.38				0.0105	0.0117	0.0105	0.0328
547	0.083	3125	4.87		79272	60241		0.0202	0.0201		24.3	14.0				18.32	20.48	18.38				0.0105	0.0117	0.0105	0.0328
548	0.081	3125	4.87		77950	59237		0.0203	0.0202		24.3	14.0				18.37	20.55	18.38				0.0104	0.0116	0.0104	0.0323
549	0.083	3125	4.87		79272	60241		0.0202	0.0201		24.3	14.0				18.32	20.48	18.38				0.0105	0.0117	0.0105	0.0328
550	0.077	1563	2.44		37173	28249		0.0232	0.0238		12.1	7.0				5.26	6.07	4.60				0.0028	0.0033	0.0025	0.0086

MAX ΔP:	0.1770
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P-V valve pressure setting: 1.5 psi
80% of P-V valve setting: 1.2 psi

Maximum pressure drop to shore connection: 0.177 psi

TOTAL PRESSURE DROP TO SHORE CONNECTION: 0.177 psi OK

Max. allowable back pressure at facility: 1.023 psi

Pressure Drop through VCS - From #1 Cargo Tank to Shore Connection (per 46 CFR 39.30-1(d)(3) and ABS SBR 5-2-3/7.5.2(c))

Pipe sizes, nominal: 8 in
 Pipe ID: 7.981 in
 Pipe Flow Area: 50.03 in²
 Vapor Dynamic Viscosity: 0.019 centipoise (estimated, based on air @ 115F, Crane 410, Table A-5)

PIPE LENGTH

Length (ft): 221.94 ft 8" pipe
 Length (ft): 50.00 ft 6" hose
 f, friction factor (pipe): Varies with Reynold's Number (see table below)

VALVE & FITTING EQUIVALENT LENGTH

Equivalent Length (ft): 285.74 ft
 f_v, friction factor, turbulent flow (fittings): 0.014 constant, for each pipe size

Shore Connection Pressure Drop (at 75% of Maximum Liquid Loading Rate): 3750 BBL/hr

Cargo	Vapor-Air Mix. Density (lb/ft ³)	Vapor Flow Rate		Reynold's Number		Friction Factor		Vapor Velocity		Head Loss			Component ΔP			ΔP
		BBL/hr	ft ³ /s	6" Hose	8" Pipe	6" Hose	8" Pipe	6" Hose	8" Pipe	6" Hose	8" Pipe	8" Fittings	6" Hose	8" Pipe	8" Fittings	
1	0.123	4688	7.31	177458	134856	0.0180	0.0183	36.4	21.0	36.76	41.91	41.36	0.0314	0.0358	0.0354	0.1026
2	0.085	4688	7.31	122480	93076	0.0189	0.0183	36.4	21.0	38.59	42.10	41.36	0.0228	0.0248	0.0244	0.0720
19	0.082	4688	7.31	117497	89290	0.0190	0.0185	36.4	21.0	38.81	42.45	41.36	0.0220	0.0240	0.0234	0.0694
20	0.079	4688	7.31	113864	86529	0.0191	0.0186	36.4	21.0	38.99	42.72	41.36	0.0214	0.0234	0.0227	0.0675
21	0.079	4688	7.31	113864	86529	0.0191	0.0186	36.4	21.0	38.99	42.72	41.36	0.0214	0.0234	0.0227	0.0675
23	0.079	4688	7.31	113864	86529	0.0191	0.0186	36.4	21.0	38.99	42.72	41.36	0.0214	0.0234	0.0227	0.0675
24	0.079	4688	7.31	113864	86529	0.0191	0.0186	36.4	21.0	38.99	42.72	41.36	0.0214	0.0234	0.0227	0.0675
26	0.079	4688	7.31	113864	86529	0.0191	0.0186	36.4	21.0	38.99	42.72	41.36	0.0214	0.0234	0.0227	0.0675
34	0.077	4688	7.31	111567	84783	0.0192	0.0187	36.4	21.0	39.10	42.90	41.36	0.0210	0.0231	0.0222	0.0663
40	0.085	4688	7.31	121911	92644	0.0189	0.0184	36.4	21.0	38.61	42.14	41.36	0.0227	0.0248	0.0243	0.0717
42	0.097	4688	7.31	140201	106543	0.0186	0.0179	36.4	21.0	37.88	40.98	41.36	0.0256	0.0277	0.0279	0.0812
44	0.083	4688	7.31	119473	90791	0.0190	0.0184	36.4	21.0	38.72	42.31	41.36	0.0223	0.0244	0.0238	0.0705
46	0.086	4688	7.31	123808	94085	0.0189	0.0183	36.4	21.0	38.53	42.00	41.36	0.0230	0.0251	0.0247	0.0727
47	0.097	4688	7.31	140066	106440	0.0186	0.0179	36.4	21.0	37.88	40.98	41.36	0.0256	0.0277	0.0279	0.0811
48	0.077	4688	7.31	110382	83883	0.0192	0.0187	36.4	21.0	39.17	43.00	41.36	0.0208	0.0229	0.0220	0.0657
58	0.078	4688	7.31	112502	85494	0.0191	0.0187	36.4	21.0	39.06	42.83	41.36	0.0212	0.0232	0.0224	0.0668
64	0.077	4688	7.31	110700	84125	0.0192	0.0187	36.4	21.0	39.15	42.97	41.36	0.0209	0.0229	0.0221	0.0659
70	0.085	4688	7.31	122724	93262	0.0189	0.0183	36.4	21.0	38.58	42.08	41.36	0.0228	0.0249	0.0245	0.0722
72	0.116	4688	7.31	167636	127391	0.0181	0.0172	36.4	21.0	37.02	39.57	41.36	0.0299	0.0320	0.0334	0.0953
73	0.078	4688	7.31	112208	85270	0.0192	0.0187	36.4	21.0	39.07	42.85	41.36	0.0211	0.0232	0.0224	0.0667
74	0.080	4688	7.31	115730	87947	0.0191	0.0186	36.4	21.0	38.90	42.58	41.36	0.0217	0.0237	0.0231	0.0685
76	0.078	4688	7.31	112416	85428	0.0191	0.0187	36.4	21.0	39.06	42.83	41.36	0.0212	0.0232	0.0224	0.0668
77	0.078	4688	7.31	112265	85314	0.0192	0.0187	36.4	21.0	39.07	42.85	41.36	0.0211	0.0232	0.0224	0.0667
78	0.076	4688	7.31	109989	83584	0.0192	0.0187	36.4	21.0	39.19	43.03	41.36	0.0208	0.0228	0.0219	0.0655
79	0.076	4688	7.31	109718	83378	0.0192	0.0188	36.4	21.0	39.20	43.05	41.36	0.0207	0.0228	0.0219	0.0653
81	0.078	4688	7.31	112807	85725	0.0191	0.0187	36.4	21.0	39.04	42.80	41.36	0.0212	0.0233	0.0225	0.0670
82	0.076	4688	7.31	110009	83599	0.0192	0.0187	36.4	21.0	39.18	43.02	41.36	0.0208	0.0228	0.0219	0.0655
83	0.076	4688	7.31	110009	83599	0.0192	0.0187	36.4	21.0	39.18	43.02	41.36	0.0208	0.0228	0.0219	0.0655
84	0.076	4688	7.31	110009	83599	0.0192	0.0187	36.4	21.0	39.18	43.02	41.36	0.0208	0.0228	0.0219	0.0655
85	0.076	4688	7.31	110160	83714	0.0192	0.0187	36.4	21.0	39.18	43.01	41.36	0.0208	0.0228	0.0220	0.0656
87	0.078	4688	7.31	111750	84922	0.0192	0.0187	36.4	21.0	39.10	42.89	41.36	0.0211	0.0231	0.0223	0.0664
91	0.076	4688	7.31	109718	83378	0.0192	0.0188	36.4	21.0	39.20	43.05	41.36	0.0207	0.0228	0.0219	0.0653
92	0.080	4688	7.31	115730	87947	0.0191	0.0186	36.4	21.0	38.90	42.58	41.36	0.0217	0.0237	0.0231	0.0685
93	0.077	4688	7.31	111680	84869	0.0192	0.0187	36.4	21.0	39.10	42.89	41.36	0.0210	0.0231	0.0223	0.0664
94	0.076	4688	7.31	109898	83515	0.0192	0.0188	36.4	21.0	39.19	43.03	41.36	0.0208	0.0228	0.0219	0.0654
95	0.076	4688	7.31	110023	83610	0.0192	0.0187	36.4	21.0	39.18	43.02	41.36	0.0208	0.0228	0.0219	0.0655
100	0.076	4688	7.31	110209	83751	0.0192	0.0187	36.4	21.0	39.17	43.01	41.36	0.0208	0.0228	0.0220	0.0656
101	0.077	4688	7.31	110356	83863	0.0192	0.0187	36.4	21.0	39.17	43.00	41.36	0.0208	0.0229	0.0220	0.0657
111	0.078	4688	7.31	112138	85217	0.0192	0.0187	36.4	21.0	39.08	42.86	41.36	0.0211	0.0232	0.0223	0.0666
112	0.103	4688	7.31	148465	112823	0.0184	0.0177	36.4	21.0	37.59	40.52	41.36	0.0269	0.0290	0.0296	0.0855
113	0.079	4688	7.31	113945	86590	0.0191	0.0186	36.4	21.0	38.99	42.72	41.36	0.0214	0.0235	0.0227	0.0676
119	0.077	4688	7.31	110653	84088	0.0192	0.0187	36.4	21.0	39.15	42.97	41.36	0.0209	0.0229	0.0221	0.0658
124	0.076	4688	7.31	109718	83378	0.0192	0.0188	36.4	21.0	39.20	43.05	41.36	0.0207	0.0228	0.0219	0.0653
128	0.077	4688	7.31	110626	84068	0.0192	0.0187	36.4	21.0	39.15	42.98	41.36	0.0209	0.0229	0.0220	0.0658
130	0.076	4688	7.31	109718	83378	0.0192	0.0188	36.4	21.0	39.20	43.05	41.36	0.0207	0.0228	0.0219	0.0653
131	0.078	4688	7.31	112360	85386	0.0191	0.0187	36.4	21.0	39.06	42.84	41.36	0.0211	0.0232	0.0224	0.0667
132	0.076	4688	7.31	110010	83600	0.0192	0.0187	36.4	21.0	39.18	43.02	41.36	0.0208	0.0228	0.0219	0.0655
133	0.076	4688	7.31	110047	83628	0.0192	0.0187	36.4	21.0	39.18	43.02	41.36	0.0208	0.0228	0.0219	0.0655

134	0.076	4688	7.31		110048	83629		0.0192	0.0187		36.4	21.0								0.0208	0.0228	0.0219	0.0655
136	0.077	4688	7.31		111439	84686		0.0192	0.0187		36.4	21.0								0.0210	0.0230	0.0222	0.0663
139	0.102	4688	7.31		147111	111794		0.0185	0.0177		36.4	21.0								0.0267	0.0288	0.0293	0.0848
140	0.102	4688	7.31		147111	111794		0.0185	0.0177		36.4	21.0								0.0267	0.0288	0.0293	0.0848
145	0.077	4688	7.31		110370	83873		0.0192	0.0187		36.4	21.0								0.0208	0.0229	0.0220	0.0657
146	0.077	4688	7.31		110370	83873		0.0192	0.0187		36.4	21.0								0.0208	0.0229	0.0220	0.0657
147	0.240	4688	7.31		345317	262417		0.0168	0.0151		36.4	21.0								0.0571	0.0577	0.0688	0.1837
155	0.076	4688	7.31		109718	83378		0.0192	0.0188		36.4	21.0								0.0207	0.0228	0.0219	0.0653
156	0.119	4688	7.31		171903	130634		0.0181	0.0172		36.4	21.0								0.0306	0.0326	0.0343	0.0974
157	0.079	4688	7.31		114433	86961		0.0191	0.0186		36.4	21.0								0.0215	0.0235	0.0228	0.0678
158	0.086	4688	7.31		123943	94188		0.0189	0.0183		36.4	21.0								0.0230	0.0251	0.0247	0.0728
160	0.083	4688	7.31		120123	91285		0.0190	0.0184		36.4	21.0								0.0224	0.0245	0.0239	0.0708
161	0.078	4688	7.31		111767	84935		0.0192	0.0187		36.4	21.0								0.0211	0.0231	0.0223	0.0664
162	0.090	4688	7.31		130040	98821		0.0188	0.0181		36.4	21.0								0.0240	0.0261	0.0259	0.0760
163	0.083	4688	7.31		119439	90765		0.0190	0.0184		36.4	21.0								0.0223	0.0243	0.0238	0.0704
166	0.076	4688	7.31		109800	83440		0.0192	0.0188		36.4	21.0								0.0207	0.0228	0.0219	0.0654
169	0.077	4688	7.31		111249	84541		0.0192	0.0187		36.4	21.0								0.0210	0.0230	0.0222	0.0662
172	0.076	4688	7.31		109991	83586		0.0192	0.0187		36.4	21.0								0.0208	0.0228	0.0219	0.0655
178	0.076	4688	7.31		109976	83574		0.0192	0.0187		36.4	21.0								0.0208	0.0228	0.0219	0.0655
180	0.076	4688	7.31		109976	83574		0.0192	0.0187		36.4	21.0								0.0208	0.0228	0.0219	0.0655
184	0.079	4688	7.31		113645	86362		0.0191	0.0186		36.4	21.0								0.0214	0.0234	0.0227	0.0674
186	0.076	4688	7.31		110192	83738		0.0192	0.0187		36.4	21.0								0.0208	0.0228	0.0220	0.0656
190	0.086	4688	7.31		123943	94188		0.0189	0.0183		36.4	21.0								0.0230	0.0251	0.0247	0.0728
191	0.080	4688	7.31		115693	87918		0.0191	0.0186		36.4	21.0								0.0217	0.0237	0.0231	0.0685
194	0.076	4688	7.31		110091	83661		0.0192	0.0187		36.4	21.0								0.0208	0.0228	0.0219	0.0655
195	0.077	4688	7.31		110531	83996		0.0192	0.0187		36.4	21.0								0.0209	0.0229	0.0220	0.0658
197	0.217	4688	7.31		312938	237811		0.0170	0.0154		36.4	21.0								0.0522	0.0532	0.0624	0.1678
198	0.217	4688	7.31		312938	237811		0.0170	0.0154		36.4	21.0								0.0522	0.0532	0.0624	0.1678
199	0.217	4688	7.31		312938	237811		0.0170	0.0154		36.4	21.0								0.0522	0.0532	0.0624	0.1678
200	0.217	4688	7.31		312938	237811		0.0170	0.0154		36.4	21.0								0.0522	0.0532	0.0624	0.1678
201	0.217	4688	7.31		312938	237811		0.0170	0.0154		36.4	21.0								0.0522	0.0532	0.0624	0.1678
202	0.217	4688	7.31		312938	237811		0.0170	0.0154		36.4	21.0								0.0522	0.0532	0.0624	0.1678
203	0.217	4688	7.31		312938	237811		0.0170	0.0154		36.4	21.0								0.0522	0.0532	0.0624	0.1678
204	0.076	4688	7.31		109718	83378		0.0192	0.0188		36.4	21.0								0.0207	0.0228	0.0219	0.0653
217	0.105	4688	7.31		151209	114908		0.0184	0.0176		36.4	21.0								0.0273	0.0294	0.0301	0.0869
218	0.105	4688	7.31		151209	114908		0.0184	0.0176		36.4	21.0								0.0273	0.0294	0.0301	0.0869
219	0.076	4688	7.31		109955	83558		0.0192	0.0187		36.4	21.0								0.0208	0.0228	0.0219	0.0655
220	0.077	4688	7.31		110531	83996		0.0192	0.0187		36.4	21.0								0.0209	0.0229	0.0220	0.0658
221	0.077	4688	7.31		110531	83996		0.0192	0.0187		36.4	21.0								0.0209	0.0229	0.0220	0.0658
222	0.109	4688	7.31		156865	119206		0.0183	0.0175		36.4	21.0								0.0282	0.0303	0.0313	0.0898
223	0.108	4688	7.31		155239	117971		0.0183	0.0175		36.4	21.0								0.0280	0.0300	0.0309	0.0889
224	0.078	4688	7.31		112766	85695		0.0191	0.0187		36.4	21.0								0.0212	0.0233	0.0225	0.0669
229	0.142	4688	7.31		204554	155447		0.0177	0.0166		36.4	21.0								0.0356	0.0376	0.0408	0.1140
230	0.142	4688	7.31		204554	155447		0.0177	0.0166		36.4	21.0								0.0356	0.0376	0.0408	0.1140
231	0.076	4688	7.31		109921	83533		0.0192	0.0188		36.4	21.0								0.0208	0.0228	0.0219	0.0655
232	0.088	4688	7.31		126789	96350		0.0188	0.0182		36.4	21.0								0.0235	0.0255	0.0253	0.0743
234	0.148	4688	7.31		212683	161624		0.0176	0.0165		36.4	21.0								0.0369	0.0388	0.0424	0.1180
235	0.149	4688	7.31		215257	163580		0.0176	0.0164		36.4	21.0								0.0373	0.0391	0.0429	0.1193
236	0.149	4688	7.31		215257	163580		0.0176	0.0164		36.4	21.0								0.0373	0.0391	0.0429	0.1193
238	0.076	4688	7.31		109725	83383		0.0192	0.0188		36.4	21.0								0.0207	0.0228	0.0219	0.0654
243	0.076	4688	7.31		109972	83571		0.0192	0.0187		36.4	21.0								0.0208	0.0228	0.0219	0.0655
244	0.078	4688	7.31		113037	85900		0.0191	0.0186		36.4	21.0								0.0213	0.0233	0.0225	0.0671
245	0.216	4688	7.31		311481	236704		0.0170	0.0154		36.4	21.0								0.0520	0.0530	0.0621	0.1671
246	0.124	4688	7.31		178813	135885		0.0180	0.0170		36.4	21.0								0.0316	0.0337	0.0356	0.1010
247	0.078	4688	7.31		111750	84922		0.0192	0.0187		36.4	21.0								0.0211	0.0231	0.0223	0.0664
249	0.079	4688	7.31		113274	86081		0.0191	0.0186		36.4	21.0								0.0213	0.0233	0.0226	0.0672
263	0.122	4688	7.31		175832	133620		0.0180	0.0171		36.4	21.0								0.0312	0.0332	0.0350	0.0994
265	0.079	4688	7.31		114209	86791		0.0191	0.0186		36.4	21.0								0.0214	0.0235	0.0228	0.0677
266	0.082	4688	7.31		118593	90122		0.0190	0.0185		36.4	21.0								0.0221	0.0242	0.0236	0.0700
267	0.081	4688	7.31		117058	88956		0.0190	0.0185		36.4	21.0								0.0219	0.0240	0.0233	0.0692
271	0.088	4688	7.31		126145	95861		0.0188	0.0182		36.4	21.0								0.0234	0.0254	0.0251	0.0739
273	0.091	4688	7.31		131312	99788		0.0187	0.0181		36.4	21.0								0.0242	0.0263	0.0262	0.0766
274	0.108	4688	7.31		155442	118125		0.0183	0.0175		36.4	21.0								0.0280	0.0301	0.0310	0.0890
275	0.208	4907	7.65		313284	238074		0.0170	0.0154		38.1	22.0								0.0547	0.0558	0.0654	0.1758
276	0.077	4688	7.31		111303	84583		0.0192	0.0187		36.4	21.0								0.0210	0.0230	0.0222	0.0662
278	0.089	4688	7.31		128804	97882		0.0188	0.0182		36.4	21.0								0.0238	0.0259	0.0257	0.0753
281	0.076	4688	7.31		1099																		

286	0.077	4688	7.31		110287	83810		0.0192	0.0187		36.4	21.0				39.17	43.00	41.36				0.0208	0.0229	0.0220	0.0656
288	0.079	4688	7.31		114189	86776		0.0191	0.0186		36.4	21.0				38.97	42.70	41.36				0.0214	0.0235	0.0228	0.0677
289	0.079	4688	7.31		113979	86616		0.0191	0.0186		36.4	21.0				38.98	42.71	41.36				0.0214	0.0235	0.0227	0.0676
295	0.078	4688	7.31		113105	85952		0.0191	0.0186		36.4	21.0				39.03	42.78	41.36				0.0213	0.0233	0.0225	0.0671
296	0.079	4688	7.31		114189	86776		0.0191	0.0186		36.4	21.0				38.97	42.70	41.36				0.0214	0.0235	0.0228	0.0677
297	0.079	4688	7.31		113965	86606		0.0191	0.0186		36.4	21.0				38.98	42.72	41.36				0.0214	0.0235	0.0227	0.0676
300	0.080	4688	7.31		115937	88104		0.0191	0.0185		36.4	21.0				38.89	42.57	41.36				0.0217	0.0238	0.0231	0.0686
301	0.080	4688	7.31		115937	88104		0.0191	0.0185		36.4	21.0				38.89	42.57	41.36				0.0217	0.0238	0.0231	0.0686
304	0.082	4688	7.31		117542	89324		0.0190	0.0185		36.4	21.0				38.81	42.45	41.36				0.0220	0.0240	0.0234	0.0694
305	0.078	4688	7.31		112428	85437		0.0191	0.0187		36.4	21.0				39.06	42.83	41.36				0.0212	0.0232	0.0224	0.0668
306	0.078	4688	7.31		112428	85437		0.0191	0.0187		36.4	21.0				39.06	42.83	41.36				0.0212	0.0232	0.0224	0.0668
307	0.078	4688	7.31		112428	85437		0.0191	0.0187		36.4	21.0				39.06	42.83	41.36				0.0212	0.0232	0.0224	0.0668
309	0.076	4688	7.31		110165	83718		0.0192	0.0187		36.4	21.0				39.18	43.01	41.36				0.0208	0.0228	0.0220	0.0656
316	0.087	4688	7.31		125237	95172		0.0189	0.0183		36.4	21.0				38.47	41.91	41.36				0.0232	0.0253	0.0250	0.0735
317	0.087	4688	7.31		125237	95172		0.0189	0.0183		36.4	21.0				38.47	41.91	41.36				0.0232	0.0253	0.0250	0.0735
318	0.076	4688	7.31		109989	83584		0.0192	0.0187		36.4	21.0				39.19	43.03	41.36				0.0208	0.0228	0.0219	0.0655
319	0.076	4688	7.31		109954	83557		0.0192	0.0187		36.4	21.0				39.19	43.03	41.36				0.0208	0.0228	0.0219	0.0655
320	0.076	4688	7.31		109954	83557		0.0192	0.0187		36.4	21.0				39.19	43.03	41.36				0.0208	0.0228	0.0219	0.0655
321	0.088	4688	7.31		127398	96814		0.0188	0.0182		36.4	21.0				38.37	41.76	41.36				0.0236	0.0256	0.0254	0.0746
322	0.090	4688	7.31		129092	98101		0.0188	0.0182		36.4	21.0				38.30	41.65	41.36				0.0238	0.0259	0.0257	0.0755
324	0.076	4688	7.31		109954	83557		0.0192	0.0187		36.4	21.0				39.19	43.03	41.36				0.0208	0.0228	0.0219	0.0655
325	0.076	4688	7.31		109954	83557		0.0192	0.0187		36.4	21.0				39.19	43.03	41.36				0.0208	0.0228	0.0219	0.0655
364	0.095	4688	7.31		136272	103557		0.0186	0.0180		36.4	21.0				38.02	41.21	41.36				0.0250	0.0271	0.0272	0.0792
366	0.078	4688	7.31		112157	85231		0.0192	0.0187		36.4	21.0				39.07	42.86	41.36				0.0211	0.0232	0.0224	0.0666
367	0.078	4688	7.31		112157	85231		0.0192	0.0187		36.4	21.0				39.07	42.86	41.36				0.0211	0.0232	0.0224	0.0666
366	0.078	4688	7.31		112157	85231		0.0192	0.0187		36.4	21.0				39.07	42.86	41.36				0.0211	0.0232	0.0224	0.0666
382	0.078	4688	7.31		112157	85231		0.0192	0.0187		36.4	21.0				39.07	42.86	41.36				0.0211	0.0232	0.0224	0.0666
383	0.084	4688	7.31		120936	91903		0.0189	0.0184		36.4	21.0				38.66	42.20	41.36				0.0225	0.0246	0.0241	0.0712
389	0.076	4688	7.31		109718	83378		0.0192	0.0188		36.4	21.0				39.20	43.05	41.36				0.0207	0.0228	0.0219	0.0653
403	0.076	4688	7.31		109718	83378		0.0192	0.0188		36.4	21.0				39.20	43.05	41.36				0.0207	0.0228	0.0219	0.0653
418	0.082	4688	7.31		118660	90173		0.0190	0.0185		36.4	21.0				38.76	42.37	41.36				0.0222	0.0242	0.0236	0.0700
429	0.076	4688	7.31		110184	83732		0.0192	0.0187		36.4	21.0				39.18	43.01	41.36				0.0208	0.0228	0.0220	0.0656
432	0.270	5325	8.31		441671	335639		0.0165	0.0145		41.4	23.9				43.42	42.99	53.38				0.0813	0.0805	0.1000	0.2619
433	0.347	5775	9.01		615851	468004		0.0161	0.0138		44.9	25.9				49.94	47.99	62.78				0.1203	0.1156	0.1512	0.3871
434	0.265	5283	8.24		429942	326726		0.0165	0.0146		41.1	23.7				42.83	42.50	52.54				0.0787	0.0781	0.0966	0.2534
436	0.310	5618	8.76		534641	406290		0.0163	0.0141		43.7	25.2				47.68	46.41	59.41				0.1025	0.0998	0.1277	0.3299
437	0.310	5618	8.76		534641	406290		0.0163	0.0141		43.7	25.2				47.68	46.41	59.41				0.1025	0.0998	0.1277	0.3299
442	0.082	4688	7.31		118490	90044		0.0190	0.0185		36.4	21.0				38.77	42.38	41.36				0.0221	0.0242	0.0236	0.0699
448	0.080	4688	7.31		115022	87409		0.0191	0.0186		36.4	21.0				38.93	42.64	41.36				0.0216	0.0236	0.0229	0.0681
457	0.076	4688	7.31		109718	83378		0.0192	0.0188		36.4	21.0				39.20	43.05	41.36				0.0207	0.0228	0.0219	0.0653
458	0.084	4688	7.31		121153	92067		0.0189	0.0184		36.4	21.0				38.65	42.19	41.36				0.0226	0.0246	0.0241	0.0713
464	0.097	4688	7.31		140445	106728		0.0186	0.0178		36.4	21.0				37.87	40.96	41.36				0.0256	0.0277	0.0280	0.0813
465	0.098	4688	7.31		141298	107377		0.0185	0.0178		36.4	21.0				37.84	40.91	41.36				0.0258	0.0279	0.0282	0.0818
466	0.091	4688	7.31		131463	99902		0.0187	0.0181		36.4	21.0				38.21	41.50	41.36				0.0242	0.0263	0.0262	0.0767
467	0.082	4688	7.31		118416	89988		0.0190	0.0185		36.4	21.0				38.77	42.38	41.36				0.0221	0.0242	0.0236	0.0699
468	0.079	4688	7.31		113972	86611		0.0191	0.0186		36.4	21.0				38.98	42.71	41.36				0.0214	0.0235	0.0227	0.0676
469	0.076	4688	7.31		109945	83551		0.0192	0.0187		36.4	21.0				39.19	43.03	41.36				0.0208	0.0228	0.0219	0.0655
473	0.076	4688	7.31		109828	83461		0.0192	0.0188		36.4	21.0				39.19	43.04	41.36				0.0207	0.0228	0.0219	0.0654
476	0.083	4688	7.31		119723	90981		0.0190	0.0184		36.4	21.0				38.71	42.29	41.36				0.0223	0.0244	0.0239	0.0706
478	0.076	4688	7.31		109718	83378		0.0192	0.0188		36.4	21.0				39.20	43.05	41.36				0.0207	0.0228	0.0219	0.0653
468	0.076	4688	7.31		109931	83540		0.0192	0.0188		36.4	21.0				39.19	43.03	41.36				0.0208	0.0228	0.0219	0.0655
493	0.076	4688	7.31		109718	83378		0.0192	0.0188		36.4	21.0				39.20	43.05	41.36				0.0207	0.0228	0.0219	0.0653
494	0.076	4688	7.31		110109	83675		0.0192	0.0187		36.4	21.0				39.18	43.02	41.36				0.0208	0.0228	0.0219	0.0656
496	0.076	4688	7.31		110104	83672		0.0192	0.0187		36.4	21.0				39.18	43.02	41.36				0.0208	0.0228	0.0219	0.0656
497	0.077	4688	7.31		110683	84111		0.0192	0.0187		36.4	21.0				39.15	42.97	41.36				0.0209	0.0229	0.0221	0.0659
499	0.091	4688	7.31		131463	99902		0.0187	0.0181		36.4	21.0				38.21	41.50	41.36				0.0242	0.0263	0.0262	0.0767
502	0.077	4688	7.31		110510	83980		0.0192	0.0187		36.4	21.0				39.16	42.98	41.36				0.0209	0.0229	0.0220	0.0658
503	0.077	4688	7.31		110450	83934		0.0192	0.0187		36.4	21.0				39.16	42.99	41.36				0.0208	0.0229	0.0220	0.0657
505	0.076	4688	7.31		1																				

546	0.083	4688	7.31		118908	90362		0.0190	0.0185		36.4	21.0				38.75	42.35	41.36				0.0222	0.0243	0.0237	0.0702
547	0.083	4688	7.31		118908	90362		0.0190	0.0185		36.4	21.0				38.75	42.35	41.36				0.0222	0.0243	0.0237	0.0702
548	0.081	4688	7.31		116926	88855		0.0190	0.0185		36.4	21.0				38.84	42.49	41.36				0.0219	0.0239	0.0233	0.0691
549	0.083	4688	7.31		118908	90362		0.0190	0.0185		36.4	21.0				38.75	42.35	41.36				0.0222	0.0243	0.0237	0.0702
550	0.077	4688	7.31		111520	84747		0.0192	0.0187		36.4	21.0				39.11	42.90	41.36				0.0210	0.0231	0.0222	0.0663

MAX ΔP:	0.3871
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P-V valve pressure setting: 1.5 psi
80% of P-V valve setting: 1.2 psi

Maximum pressure drop to shore connection: 0.387 psi

TOTAL PRESSURE DROP TO SHORE CONNECTION: **0.387 psi** OK

Max. allowable back pressure at facility: **0.813 psi**

Pressure Drop through VCS - From #1 Cargo Tank to Shore Connection (per 46 CFR 39.30-1(d)(3) and ABS SBR 5-2-3/7.5.2(c))

Pipe sizes, nominal: 8 in
 Pipe ID: 7.981 in
 Pipe Flow Area: 50.03 in²
 Vapor Dynamic Viscosity: 0.019 centipoise (estimated, based on air @ 115F, Crane 410, Table A-5)

PIPE LENGTH

Length (ft): 221.94 ft 8" pipe
 Length (ft): 50.00 ft 6" hose
 f, friction factor (pipe): Varies with Reynold's Number (see table below)

VALVE & FITTING EQUIVALENT LENGTH

Equivalent Length (ft): 285.74 ft
 f_v, friction factor, turbulent flow (fittings): 0.014 constant, for each pipe size

Shore Connection Pressure Drop (at 100% of Maximum Liquid Loading Rate): 5000 BBL/hr

Cargo	Vapor-Air Mix. Density (lb/ft ³)	Vapor Flow Rate		Reynold's Number		Friction Factor		Vapor Velocity		Head Loss			Component ΔP			ΔP	
		BBL/hr	ft ³ /s	6" Hose	8" Pipe	6" Hose	8" Pipe	6" Hose	8" Pipe	6" Hose	8" Pipe	8" Fittings	6" Hose	8" Pipe	8" Fittings	TOTAL	
1	0.123	6250	9.75	236611	179807	0.0174	0.0175	48.6	28.1	63.27	71.59	73.54	0.0541	0.0612	0.0629	0.1782	
2	0.085	6250	9.75	163307	124102	0.0182	0.0173	48.6	28.1	66.03	70.71	73.54	0.0390	0.0417	0.0434	0.1241	
19	0.082	6250	9.75	156663	119053	0.0183	0.0175	48.6	28.1	66.37	71.28	73.54	0.0376	0.0404	0.0416	0.1196	
20	0.079	6250	9.75	151818	115371	0.0184	0.0176	48.6	28.1	66.64	71.71	73.54	0.0366	0.0393	0.0403	0.1163	
21	0.079	6250	9.75	151818	115371	0.0184	0.0176	48.6	28.1	66.64	71.71	73.54	0.0366	0.0393	0.0403	0.1163	
23	0.079	6250	9.75	151818	115371	0.0184	0.0176	48.6	28.1	66.64	71.71	73.54	0.0366	0.0393	0.0403	0.1163	
24	0.079	6250	9.75	151818	115371	0.0184	0.0176	48.6	28.1	66.64	71.71	73.54	0.0366	0.0393	0.0403	0.1163	
26	0.079	6250	9.75	151818	115371	0.0184	0.0176	48.6	28.1	66.64	71.71	73.54	0.0366	0.0393	0.0403	0.1163	
34	0.077	6250	9.75	148757	113045	0.0184	0.0176	48.6	28.1	66.82	72.00	73.54	0.0359	0.0387	0.0395	0.1142	
40	0.085	6250	9.75	162548	123525	0.0182	0.0173	48.6	28.1	66.07	70.77	73.54	0.0388	0.0416	0.0432	0.1236	
42	0.097	6250	9.75	186935	142057	0.0179	0.0169	48.6	28.1	64.95	68.90	73.54	0.0439	0.0465	0.0497	0.1401	
44	0.083	6250	9.75	159297	121054	0.0183	0.0174	48.6	28.1	66.23	71.05	73.54	0.0381	0.0409	0.0423	0.1214	
46	0.086	6250	9.75	165077	125447	0.0182	0.0173	48.6	28.1	65.94	70.56	73.54	0.0393	0.0421	0.0439	0.1253	
47	0.097	6250	9.75	186754	141920	0.0179	0.0169	48.6	28.1	64.96	68.91	73.54	0.0438	0.0465	0.0496	0.1400	
48	0.077	6250	9.75	147176	111843	0.0184	0.0177	48.6	28.1	66.91	72.15	73.54	0.0356	0.0384	0.0391	0.1131	
58	0.078	6250	9.75	150003	113992	0.0184	0.0176	48.6	28.1	66.74	71.88	73.54	0.0362	0.0390	0.0399	0.1150	
64	0.077	6250	9.75	147600	112166	0.0184	0.0177	48.6	28.1	66.89	72.11	73.54	0.0357	0.0385	0.0392	0.1134	
70	0.085	6250	9.75	163632	124349	0.0182	0.0173	48.6	28.1	66.01	70.68	73.54	0.0390	0.0418	0.0435	0.1243	
72	0.116	6250	9.75	223514	169855	0.0176	0.0163	48.6	28.1	63.65	66.64	73.54	0.0514	0.0538	0.0594	0.1646	
73	0.078	6250	9.75	149610	113693	0.0184	0.0176	48.6	28.1	66.77	71.92	73.54	0.0361	0.0389	0.0398	0.1147	
74	0.080	6250	9.75	154307	117262	0.0183	0.0175	48.6	28.1	66.50	71.49	73.54	0.0371	0.0399	0.0410	0.1180	
76	0.078	6250	9.75	149887	113904	0.0184	0.0176	48.6	28.1	66.75	71.89	73.54	0.0362	0.0389	0.0398	0.1149	
77	0.078	6250	9.75	149687	113752	0.0184	0.0176	48.6	28.1	66.76	71.91	73.54	0.0361	0.0389	0.0398	0.1148	
78	0.076	6250	9.75	146652	111445	0.0185	0.0177	48.6	28.1	66.94	72.20	73.54	0.0355	0.0383	0.0390	0.1127	
79	0.076	6250	9.75	146291	111171	0.0185	0.0177	48.6	28.1	66.96	72.24	73.54	0.0354	0.0382	0.0389	0.1125	
81	0.078	6250	9.75	150409	114301	0.0184	0.0176	48.6	28.1	66.72	71.85	73.54	0.0363	0.0391	0.0400	0.1153	
82	0.076	6250	9.75	146679	111466	0.0185	0.0177	48.6	28.1	66.94	72.20	73.54	0.0355	0.0383	0.0390	0.1127	
83	0.076	6250	9.75	146679	111466	0.0185	0.0177	48.6	28.1	66.94	72.20	73.54	0.0355	0.0383	0.0390	0.1127	
84	0.076	6250	9.75	146679	111466	0.0185	0.0177	48.6	28.1	66.94	72.20	73.54	0.0355	0.0383	0.0390	0.1127	
85	0.076	6250	9.75	146880	111618	0.0185	0.0177	48.6	28.1	66.93	72.18	73.54	0.0355	0.0383	0.0390	0.1129	
87	0.078	6250	9.75	149000	113230	0.0184	0.0176	48.6	28.1	66.80	71.98	73.54	0.0360	0.0388	0.0396	0.1143	
91	0.076	6250	9.75	146291	111171	0.0185	0.0177	48.6	28.1	66.96	72.24	73.54	0.0354	0.0382	0.0389	0.1125	
92	0.080	6250	9.75	154307	117262	0.0183	0.0175	48.6	28.1	66.50	71.49	73.54	0.0371	0.0399	0.0410	0.1180	
93	0.077	6250	9.75	148907	113158	0.0184	0.0176	48.6	28.1	66.81	71.99	73.54	0.0359	0.0387	0.0396	0.1143	
94	0.076	6250	9.75	146531	111353	0.0185	0.0177	48.6	28.1	66.95	72.21	73.54	0.0355	0.0382	0.0389	0.1126	
95	0.076	6250	9.75	146697	111480	0.0185	0.0177	48.6	28.1	66.94	72.20	73.54	0.0355	0.0383	0.0390	0.1127	
100	0.076	6250	9.75	146945	111668	0.0185	0.0177	48.6	28.1	66.92	72.17	73.54	0.0355	0.0383	0.0390	0.1129	
101	0.077	6250	9.75	147142	111817	0.0185	0.0177	48.6	28.1	66.91	72.16	73.54	0.0356	0.0384	0.0391	0.1130	
111	0.078	6250	9.75	149518	113623	0.0184	0.0176	48.6	28.1	66.77	71.93	73.54	0.0361	0.0389	0.0397	0.1147	
112	0.103	6250	9.75	197954	150431	0.0178	0.0166	48.6	28.1	64.52	68.16	73.54	0.0462	0.0488	0.0526	0.1475	
113	0.079	6250	9.75	151927	115454	0.0184	0.0176	48.6	28.1	66.63	71.70	73.54	0.0366	0.0394	0.0404	0.1163	
119	0.077	6250	9.75	147537	112118	0.0184	0.0177	48.6	28.1	66.89	72.12	73.54	0.0357	0.0384	0.0392	0.1133	
124	0.076	6250	9.75	146291	111171	0.0185	0.0177	48.6	28.1	66.96	72.24	73.54	0.0354	0.0382	0.0389	0.1125	
128	0.077	6250	9.75	147501	112091	0.0184	0.0177	48.6	28.1	66.89	72.12	73.54	0.0357	0.0384	0.0392	0.1133	
130	0.076	6250	9.75	146291	111171	0.0185	0.0177	48.6	28.1	66.96	72.24	73.54	0.0354	0.0382	0.0389	0.1125	
131	0.078	6250	9.75	149813	113848	0.0184	0.0176	48.6	28.1	66.76	71.90	73.54	0.0361	0.0389	0.0398	0.1149	
132	0.076	6250	9.75	146680	111467	0.0185	0.0177	48.6	28.1	66.94	72.20	73.54	0.0355	0.0383	0.0390	0.1127	
133	0.076	6250	9.75	146730	111504	0.0185	0.0177	48.6	28.1	66.94	72.20	73.54	0.0355	0.0383	0.0390	0.1128	

134	0.076	6250	9.75		146731	111505		0.0185	0.0177		48.6	28.1					66.94	72.20	73.54					0.0355	0.0383	0.0390	0.1128
136	0.077	6250	9.75		148586	112915		0.0184	0.0177		48.6	28.1					66.83	72.02	73.54					0.0359	0.0387	0.0395	0.1140
139	0.102	6250	9.75		196147	149058		0.0178	0.0167		48.6	28.1				64.59	68.28	73.54					0.0458	0.0484	0.0521	0.1463	
140	0.102	6250	9.75		196147	149058		0.0178	0.0167		48.6	28.1				64.59	68.28	73.54					0.0458	0.0484	0.0521	0.1463	
145	0.077	6250	9.75		147160	111831		0.0184	0.0177		48.6	28.1				66.91	72.15	73.54					0.0356	0.0384	0.0391	0.1131	
146	0.077	6250	9.75		147160	111831		0.0184	0.0177		48.6	28.1				66.91	72.15	73.54					0.0356	0.0384	0.0391	0.1131	
147	0.240	6250	9.75		460423	349889		0.0164	0.0144		48.6	28.1				59.64	58.82	73.54					0.0992	0.0979	0.1224	0.3194	
155	0.076	6250	9.75		146291	111171		0.0185	0.0177		48.6	28.1				66.96	72.24	73.54					0.0354	0.0382	0.0389	0.1125	
156	0.119	6250	9.75		229204	174179		0.0175	0.0163		48.6	28.1				63.48	66.33	73.54					0.0526	0.0549	0.0609	0.1684	
157	0.079	6250	9.75		152577	115948		0.0184	0.0176		48.6	28.1				66.60	71.64	73.54					0.0367	0.0395	0.0405	0.1168	
158	0.086	6250	9.75		165258	125584		0.0182	0.0173		48.6	28.1				65.93	70.54	73.54					0.0394	0.0421	0.0439	0.1254	
160	0.083	6250	9.75		160164	121713		0.0183	0.0174		48.6	28.1				66.19	70.97	73.54					0.0383	0.0411	0.0426	0.1219	
161	0.078	6250	9.75		149022	113246		0.0184	0.0176		48.6	28.1				66.80	71.98	73.54					0.0360	0.0388	0.0396	0.1143	
162	0.090	6250	9.75		173387	131762		0.0181	0.0171		48.6	28.1				65.54	69.90	73.54					0.0411	0.0438	0.0461	0.1309	
163	0.083	6250	9.75		159252	121020		0.0183	0.0174		48.6	28.1				66.24	71.05	73.54					0.0381	0.0409	0.0423	0.1213	
166	0.076	6250	9.75		146400	111254		0.0185	0.0177		48.6	28.1				66.96	72.23	73.54					0.0354	0.0382	0.0389	0.1125	
169	0.077	6250	9.75		148332	112722		0.0184	0.0177		48.6	28.1				66.84	72.04	73.54					0.0358	0.0386	0.0394	0.1139	
172	0.076	6250	9.75		146655	111447		0.0185	0.0177		48.6	28.1				66.94	72.20	73.54					0.0355	0.0383	0.0390	0.1127	
178	0.076	6250	9.75		146634	111432		0.0185	0.0177		48.6	28.1				66.94	72.20	73.54					0.0355	0.0383	0.0390	0.1127	
180	0.076	6250	9.75		146634	111432		0.0185	0.0177		48.6	28.1				66.94	72.20	73.54					0.0355	0.0383	0.0390	0.1127	
184	0.079	6250	9.75		151527	115150		0.0184	0.0176		48.6	28.1				66.66	71.74	73.54					0.0365	0.0393	0.0403	0.1161	
186	0.076	6250	9.75		146923	111651		0.0185	0.0177		48.6	28.1				66.93	72.18	73.54					0.0355	0.0383	0.0390	0.1129	
190	0.086	6250	9.75		165258	125584		0.0182	0.0173		48.6	28.1				65.93	70.54	73.54					0.0394	0.0421	0.0439	0.1254	
191	0.080	6250	9.75		154257	117225		0.0183	0.0175		48.6	28.1				66.50	71.49	73.54					0.0371	0.0399	0.0410	0.1179	
194	0.076	6250	9.75		146788	111548		0.0185	0.0177		48.6	28.1				66.93	72.19	73.54					0.0355	0.0383	0.0390	0.1128	
195	0.077	6250	9.75		147375	111994		0.0184	0.0177		48.6	28.1				66.90	72.13	73.54					0.0356	0.0384	0.0392	0.1132	
197	0.217	6250	9.75		417250	317081		0.0166	0.0147		48.6	28.1				60.08	59.77	73.54					0.0906	0.0901	0.1109	0.2916	
198	0.217	6250	9.75		417250	317081		0.0166	0.0147		48.6	28.1				60.08	59.77	73.54					0.0906	0.0901	0.1109	0.2916	
199	0.217	6250	9.75		417250	317081		0.0166	0.0147		48.6	28.1				60.08	59.77	73.54					0.0906	0.0901	0.1109	0.2916	
200	0.217	6250	9.75		417250	317081		0.0166	0.0147		48.6	28.1				60.08	59.77	73.54					0.0906	0.0901	0.1109	0.2916	
201	0.217	6250	9.75		417250	317081		0.0166	0.0147		48.6	28.1				60.08	59.77	73.54					0.0906	0.0901	0.1109	0.2916	
202	0.217	6250	9.75		417250	317081		0.0166	0.0147		48.6	28.1				60.08	59.77	73.54					0.0906	0.0901	0.1109	0.2916	
203	0.217	6250	9.75		417250	317081		0.0166	0.0147		48.6	28.1				60.08	59.77	73.54					0.0906	0.0901	0.1109	0.2916	
204	0.076	6250	9.75		146291	111171		0.0185	0.0177		48.6	28.1				66.96	72.24	73.54					0.0354	0.0382	0.0389	0.1125	
217	0.105	6250	9.75		201612	153211		0.0178	0.0166		48.6	28.1				64.39	67.93	73.54					0.0469	0.0495	0.0536	0.1500	
218	0.105	6250	9.75		201612	153211		0.0178	0.0166		48.6	28.1				64.39	67.93	73.54					0.0469	0.0495	0.0536	0.1500	
219	0.076	6250	9.75		146606	111410		0.0185	0.0177		48.6	28.1				66.94	72.21	73.54					0.0355	0.0383	0.0390	0.1127	
220	0.077	6250	9.75		147375	111994		0.0184	0.0177		48.6	28.1				66.90	72.13	73.54					0.0356	0.0384	0.0392	0.1132	
221	0.077	6250	9.75		147375	111994		0.0184	0.0177		48.6	28.1				66.90	72.13	73.54					0.0356	0.0384	0.0392	0.1132	
222	0.109	6250	9.75		209153	158942		0.0177	0.0165		48.6	28.1				64.12	67.46	73.54					0.0485	0.0510	0.0556	0.1550	
223	0.108	6250	9.75		206986	157295		0.0177	0.0166		48.6	28.1				64.19	67.60	73.54					0.0480	0.0506	0.0550	0.1536	
224	0.078	6250	9.75		150355	114259		0.0184	0.0176		48.6	28.1				66.72	71.85	73.54					0.0363	0.0390	0.0400	0.1152	
229	0.142	6250	9.75		272738	207262		0.0172	0.0158		48.6	28.1				62.36	64.28	73.54					0.0615	0.0634	0.0725	0.1973	
230	0.142	6250	9.75		272738	207262		0.0172	0.0158		48.6	28.1				62.36	64.28	73.54					0.0615	0.0634	0.0725	0.1973	
231	0.076	6250	9.75		146562	111377		0.0185	0.0177		48.6	28.1				66.95	72.21	73.54					0.0355	0.0382	0.0389	0.1127	
232	0.088	6250	9.75		169051	128467		0.0181	0.0172		48.6	28.1				65.74	70.24	73.54					0.0402	0.0429	0.0449	0.1280	
234	0.148	6250	9.75		283577	215498		0.0171	0.0156		48.6	28.1				62.12	63.84	73.54					0.0637	0.0654	0.0754	0.2044	
235	0.149	6250	9.75		287009	218107		0.0171	0.0156		48.6	28.1				62.05	63.71	73.54					0.0644	0.0661	0.0763	0.2067	
236	0.149	6250	9.75		287009	218107		0.0171	0.0156		48.6	28.1				62.05	63.71	73.54					0.0644	0.0661	0.0763	0.2067	
238	0.076	6250	9.75		146300	111178		0.0185	0.0177		48.6	28.1				66.96	72.24	73.54					0.0354	0.0382	0.0389	0.1125	
243	0.076	6250	9.75		146630	111428		0.0185	0.0177		48.6	28.1				66.94	72.20	73.54					0.0355	0.0383	0.0390	0.1127	
244	0.078	6250	9.75		150717	114534		0.0184	0.0176		48.6	28.1				66.70	71.82	73.54					0.0363	0.0391	0.0401	0.1155	
245	0.216	6250	9.75		415308	315605		0.0166	0.0147		48.6	28.1				60.10	59.82	73.54					0.0902	0.0898	0.1104	0.2903	
246	0.124	6250	9.75		238417	181180		0.0174	0.0161		48.6	28.1				63.22	65.86	73.54					0.0545	0.0567	0.0634	0.1746	
247	0.078	6250	9.75		149000	113230		0.0184	0.0176		48.6	28.1				66.80	71.98	73.54					0.0360	0.0388	0.0396	0.1143	
249	0.079	6250	9.75		151033	114774		0.0184	0.0176		48.6	28.1				66.69	71.79	73.54					0.0364	0.0392	0.0401	0.1157	
263	0.122	6250	9.75		234443	178160		0.0175	0.0162		48.6	28.1				63.33	66.06	73.54					0.0537	0.0			

286	0.077	6250	9.75		147050	111747		0.0185	0.0177		48.6	28.1					66.92	72.16	73.54				0.0356	0.0383	0.0391	0.1130
288	0.079	6250	9.75		152252	115701		0.0184	0.0176		48.6	28.1					66.62	71.67	73.54				0.0367	0.0394	0.0405	0.1165
289	0.079	6250	9.75		151972	115488		0.0184	0.0176		48.6	28.1					66.63	71.70	73.54				0.0366	0.0394	0.0404	0.1164
295	0.078	6250	9.75		150807	114603		0.0184	0.0176		48.6	28.1					66.70	71.81	73.54				0.0363	0.0391	0.0401	0.1156
296	0.079	6250	9.75		152252	115701		0.0184	0.0176		48.6	28.1					66.62	71.67	73.54				0.0367	0.0394	0.0405	0.1165
297	0.079	6250	9.75		151954	115474		0.0184	0.0176		48.6	28.1					66.63	71.70	73.54				0.0366	0.0394	0.0404	0.1163
300	0.080	6250	9.75		154582	117472		0.0183	0.0175		48.6	28.1					66.49	71.46	73.54				0.0371	0.0399	0.0411	0.1181
301	0.080	6250	9.75		154582	117472		0.0183	0.0175		48.6	28.1					66.49	71.46	73.54				0.0371	0.0399	0.0411	0.1181
304	0.082	6250	9.75		156723	119098		0.0183	0.0175		48.6	28.1					66.37	71.27	73.54				0.0376	0.0404	0.0416	0.1196
305	0.078	6250	9.75		149904	113916		0.0184	0.0176		48.6	28.1					66.75	71.89	73.54				0.0362	0.0389	0.0398	0.1149
306	0.078	6250	9.75		149904	113916		0.0184	0.0176		48.6	28.1					66.75	71.89	73.54				0.0362	0.0389	0.0398	0.1149
307	0.078	6250	9.75		149904	113916		0.0184	0.0176		48.6	28.1					66.75	71.89	73.54				0.0362	0.0389	0.0398	0.1149
309	0.076	6250	9.75		146887	111624		0.0185	0.0177		48.6	28.1					66.93	72.18	73.54				0.0355	0.0383	0.0390	0.1129
316	0.087	6250	9.75		166983	126895		0.0182	0.0173		48.6	28.1					65.84	70.40	73.54				0.0397	0.0425	0.0444	0.1266
317	0.087	6250	9.75		166983	126895		0.0182	0.0173		48.6	28.1					65.84	70.40	73.54				0.0397	0.0425	0.0444	0.1266
318	0.076	6250	9.75		146652	111445		0.0185	0.0177		48.6	28.1					66.94	72.20	73.54				0.0355	0.0383	0.0390	0.1127
319	0.076	6250	9.75		146605	111410		0.0185	0.0177		48.6	28.1					66.94	72.21	73.54				0.0355	0.0383	0.0390	0.1127
320	0.076	6250	9.75		146605	111410		0.0185	0.0177		48.6	28.1					66.94	72.21	73.54				0.0355	0.0383	0.0390	0.1127
321	0.088	6250	9.75		169864	129085		0.0181	0.0172		48.6	28.1					65.71	70.17	73.54				0.0403	0.0431	0.0451	0.1285
322	0.090	6250	9.75		172122	130801		0.0181	0.0172		48.6	28.1					65.60	69.99	73.54				0.0408	0.0435	0.0457	0.1301
324	0.076	6250	9.75		146605	111410		0.0185	0.0177		48.6	28.1					66.94	72.21	73.54				0.0355	0.0383	0.0390	0.1127
325	0.076	6250	9.75		146605	111410		0.0185	0.0177		48.6	28.1					66.94	72.21	73.54				0.0355	0.0383	0.0390	0.1127
364	0.095	6250	9.75		181696	138076		0.0180	0.0170		48.6	28.1					65.17	69.27	73.54				0.0428	0.0455	0.0483	0.1366
366	0.078	6250	9.75		149542	113642		0.0184	0.0176		48.6	28.1					66.77	71.93	73.54				0.0361	0.0389	0.0397	0.1147
367	0.078	6250	9.75		149542	113642		0.0184	0.0176		48.6	28.1					66.77	71.93	73.54				0.0361	0.0389	0.0397	0.1147
366	0.078	6250	9.75		149542	113642		0.0184	0.0176		48.6	28.1					66.77	71.93	73.54				0.0361	0.0389	0.0397	0.1147
382	0.078	6250	9.75		149542	113642		0.0184	0.0176		48.6	28.1					66.77	71.93	73.54				0.0361	0.0389	0.0397	0.1147
383	0.084	6250	9.75		161248	122537		0.0182	0.0174		48.6	28.1					66.13	70.88	73.54				0.0385	0.0413	0.0429	0.1227
389	0.076	6250	9.75		146291	111171		0.0185	0.0177		48.6	28.1					66.96	72.24	73.54				0.0354	0.0382	0.0389	0.1125
403	0.076	6250	9.75		146291	111171		0.0185	0.0177		48.6	28.1					66.96	72.24	73.54				0.0354	0.0382	0.0389	0.1125
418	0.082	6250	9.75		158213	120231		0.0183	0.0174		48.6	28.1					66.29	71.14	73.54				0.0379	0.0407	0.0420	0.1206
429	0.076	6250	9.75		146912	111643		0.0185	0.0177		48.6	28.1					66.93	72.18	73.54				0.0355	0.0383	0.0390	0.1129
432	0.270	7100	11.07		588895	447519		0.0162	0.0139		55.2	31.9					75.69	73.03	94.90				0.1418	0.1368	0.1778	0.4564
433	0.347	7700	12.01		821135	624005		0.0159	0.0132		59.9	34.6					87.38	81.81	111.62				0.2105	0.1970	0.2688	0.6763
434	0.265	7044	10.99		573256	435634		0.0162	0.0139		54.8	31.6					74.63	72.18	93.41				0.1372	0.1327	0.1717	0.4415
436	0.310	7490	11.68		712854	541719		0.0160	0.0135		58.2	33.6					83.29	78.99	105.61				0.1790	0.1698	0.2270	0.5759
437	0.310	7490	11.68		712854	541719		0.0160	0.0135		58.2	33.6					83.29	78.99	105.61				0.1790	0.1698	0.2270	0.5759
442	0.082	6250	9.75		157987	120059		0.0183	0.0174		48.6	28.1					66.30	71.16	73.54				0.0379	0.0406	0.0420	0.1205
448	0.080	6250	9.75		153363	116545		0.0184	0.0175		48.6	28.1					66.55	71.57	73.54				0.0369	0.0397	0.0408	0.1173
457	0.076	6250	9.75		146291	111171		0.0185	0.0177		48.6	28.1					66.96	72.24	73.54				0.0354	0.0382	0.0389	0.1125
458	0.084	6250	9.75		161537	122757		0.0182	0.0174		48.6	28.1					66.12	70.85	73.54				0.0386	0.0414	0.0429	0.1229
464	0.097	6250	9.75		187260	142304		0.0179	0.0169		48.6	28.1					64.94	68.88	73.54				0.0439	0.0466	0.0498	0.1403
465	0.098	6250	9.75		188398	143169		0.0179	0.0169		48.6	28.1					64.89	68.80	73.54				0.0442	0.0468	0.0501	0.1411
466	0.091	6250	9.75		175283	133203		0.0180	0.0171		48.6	28.1					65.45	69.75	73.54				0.0415	0.0442	0.0466	0.1322
467	0.082	6250	9.75		157888	119984		0.0183	0.0174		48.6	28.1					66.31	71.17	73.54				0.0378	0.0406	0.0420	0.1204
468	0.079	6250	9.75		151963	115481		0.0184	0.0176		48.6	28.1					66.63	71.70	73.54				0.0366	0.0394	0.0404	0.1163
469	0.076	6250	9.75		146593	111401		0.0185	0.0177		48.6	28.1					66.94	72.21	73.54				0.0355	0.0383	0.0390	0.1127
473	0.076	6250	9.75		146437	111282		0.0185	0.0177		48.6	28.1					66.95	72.22	73.54				0.0354	0.0382	0.0389	0.1126
476	0.083	6250	9.75		159631	121308		0.0183	0.0174		48.6	28.1					66.22	71.02	73.54				0.0382	0.0410	0.0424	0.1216
478	0.076	6250	9.75		146291	111171		0.0185	0.0177		48.6	28.1					66.96	72.24	73.54				0.0354	0.0382	0.0389	0.1125
468	0.076	6250	9.75		146574	111386		0.0185	0.0177		48.6	28.1					66.95	72.21	73.54				0.0355	0.0382	0.0390	0.1127
493	0.076	6250	9.75		146291	111171		0.0185	0.0177		48.6	28.1					66.96	72.24	73.54				0.0354	0.0382	0.0389	0.1125
494	0.076	6250	9.75		146812	111567		0.0185	0.0177		48.6	28.1					66.93	72.19	73.54				0.0355	0.0383	0.0390	0.1128
496	0.076	6250	9.75		146806	111562		0.0185	0.0177		48.6	28.1					66.93	72.19	73.54				0.0355	0.0383	0.0390	0.1128
497	0.077	6250	9.75		147577	112148		0.0184	0.0177		48.6	28.1					66.89	72.11	73.54				0.0357	0.0385	0.0392	0.1133
499	0.091	6250	9.75		175283	133203		0.0180	0.0171		48.6	28.1					65.45	69.75	73.54				0.0415	0.0442	0.0466	0.1322
502	0.077	6250	9.75		147347	111973		0.0184	0.0177		48.6	28.1					66.90	72.14	73.54				0.0356	0.0		

546	0.083	6250	9.75		158544	120482		0.0183	0.0174		48.6	28.1				66.27	71.11	73.54				0.0380	0.0407	0.0421	0.1208
547	0.083	6250	9.75		158544	120482		0.0183	0.0174		48.6	28.1				66.27	71.11	73.54				0.0380	0.0407	0.0421	0.1208
548	0.081	6250	9.75		155901	118474		0.0183	0.0175		48.6	28.1				66.41	71.34	73.54				0.0374	0.0402	0.0414	0.1190
549	0.083	6250	9.75		158544	120482		0.0183	0.0174		48.6	28.1				66.27	71.11	73.54				0.0380	0.0407	0.0421	0.1208
550	0.077	6250	9.75		148693	112997		0.0184	0.0176		48.6	28.1				66.82	72.01	73.54				0.0359	0.0387	0.0395	0.1141

MAX ΔP:	0.6763
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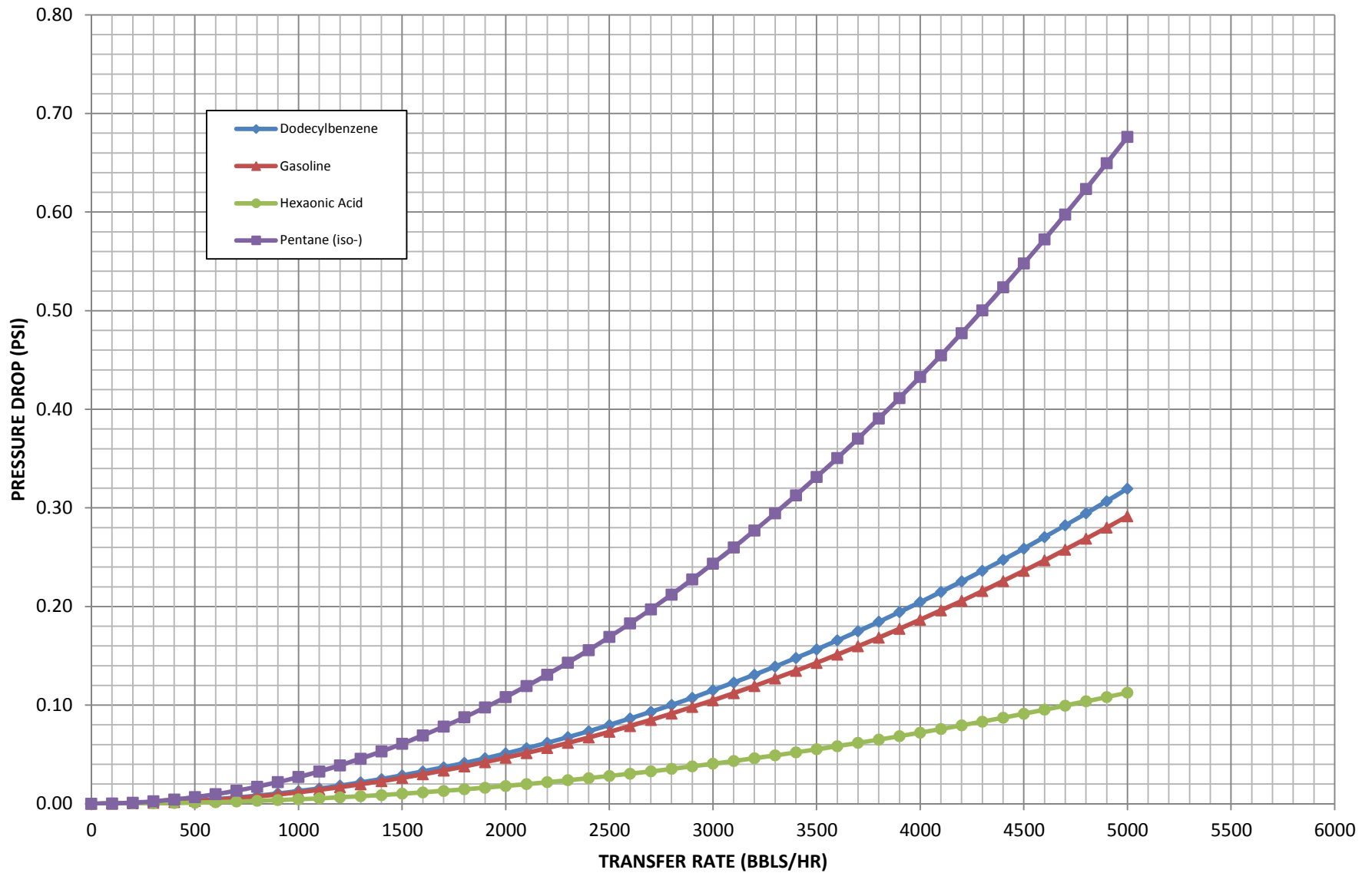
P-V valve pressure setting: 1.5 psi
80% of P-V valve setting: 1.2 psi

Maximum pressure drop to shore connection: 0.676 psi

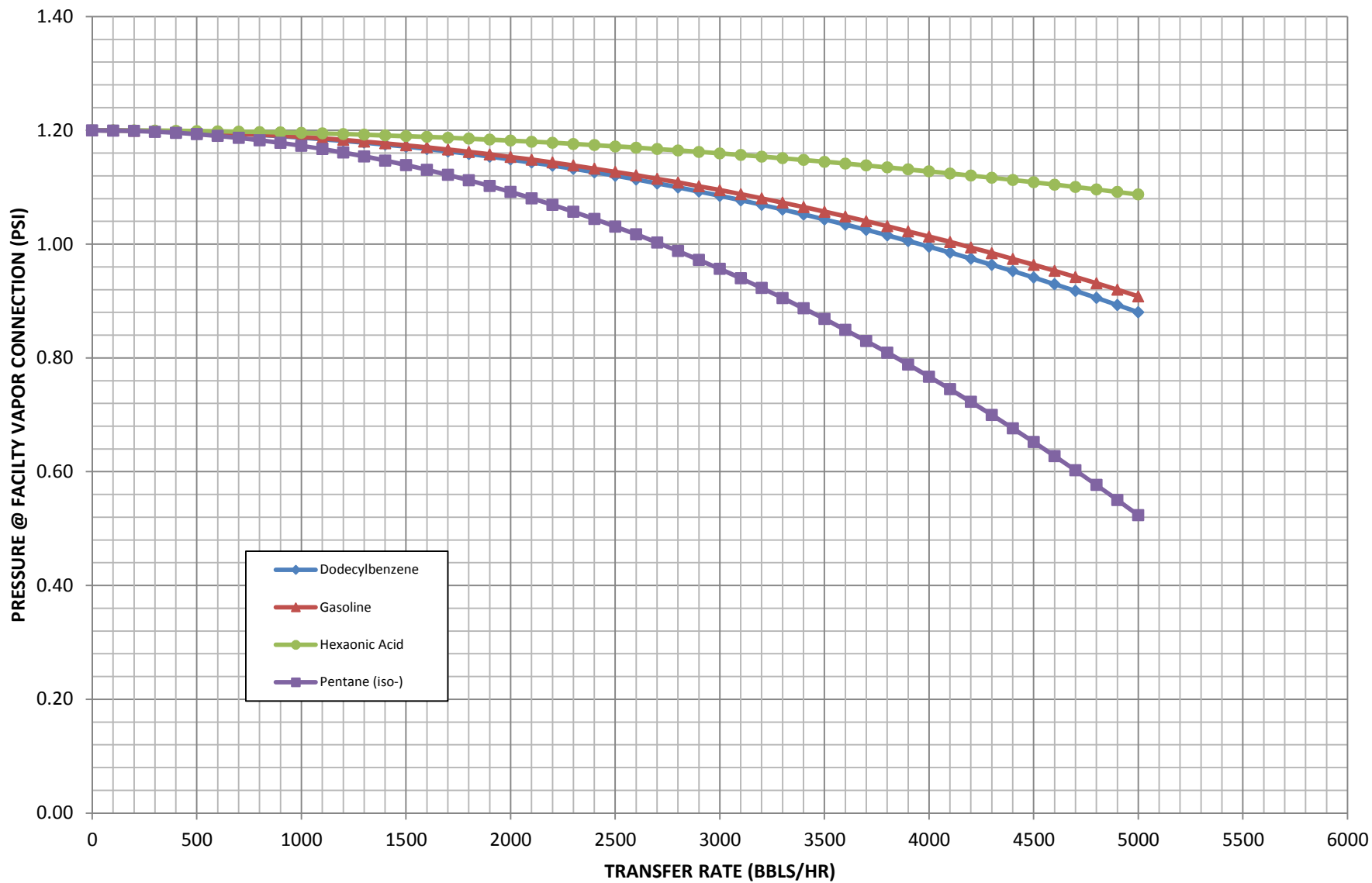
TOTAL PRESSURE DROP TO SHORE CONNECTION: 0.676 psi OK

Max. allowable back pressure at facility: 0.524 psi

LIQUID TRANSFER RATE vs PRESSURE DROP (FOR SUBCHAPTER "D" CARGOES)



LIQUID TRANSFER RATE vs PRESSURE DROP (FOR SUBCHAPTER "D" CARGOES)



Pressure Drop through VCS - From #1 Cargo Tank to Shore Connection (per 46 CFR 39.30-1(d)(3) and ABS SBR 5-2-3/7.5.2(c))

Pipe sizes, nominal: 8 in
 Pipe ID: 7.981 in
 Pipe Flow Area: 50.03 in²
 Vapor Dynamic Viscosity: 0.019 centipoise (estimated, based on air @ 115F, Crane 410, Table A-5)

PIPE LENGTH

Length (ft): 221.94 ft 8" pipe
 Length (ft): 50.00 ft 6" hose
 f, friction factor (pipe): Varies with Reynold's Number (see table below)

VALVE & FITTING EQUIVALENT LENGTH

Equivalent Length (ft): 285.74 ft
 f_v, friction factor, turbulent flow (fittings): 0.014 constant, for each pipe size

Shore Connection Pressure Drop (at 25% of Maximum Liquid Discharge Rate): 1250 BBL/hr

Cargo	Vapor-Air Mix. Density (lb/ft ³)	Vapor Flow Rate		Reynold's Number		Friction Factor		Vapor Velocity		Head Loss			Component ΔP				ΔP
		BBL/hr	ft ³ /s	6" Hose	8" Pipe	6" Hose	8" Pipe	6" Hose	8" Pipe	6" Hose	8" Pipe	8" Fittings	6" Hose	8" Pipe	8" Fittings	TOTAL	
1	0.123	1250	1.95	47322	35961	0.0221	0.0231	9.7	5.6	3.21	3.78	2.94	0.0027	0.0032	0.0025	0.0085	
2	0.085	1250	1.95	32661	24820	0.0238	0.0246	9.7	5.6	3.46	4.01	2.94	0.0020	0.0024	0.0017	0.0061	
19	0.082	1250	1.95	31333	23811	0.0240	0.0248	9.7	5.6	3.49	4.05	2.94	0.0020	0.0023	0.0017	0.0059	
20	0.079	1250	1.95	30364	23074	0.0242	0.0250	9.7	5.6	3.51	4.08	2.94	0.0019	0.0022	0.0016	0.0058	
21	0.079	1250	1.95	30364	23074	0.0242	0.0250	9.7	5.6	3.51	4.08	2.94	0.0019	0.0022	0.0016	0.0058	
23	0.079	1250	1.95	30364	23074	0.0242	0.0250	9.7	5.6	3.51	4.08	2.94	0.0019	0.0022	0.0016	0.0058	
24	0.079	1250	1.95	30364	23074	0.0242	0.0250	9.7	5.6	3.51	4.08	2.94	0.0019	0.0022	0.0016	0.0058	
26	0.079	1250	1.95	30364	23074	0.0242	0.0250	9.7	5.6	3.51	4.08	2.94	0.0019	0.0022	0.0016	0.0058	
34	0.077	1250	1.95	29751	22609	0.0243	0.0251	9.7	5.6	3.53	4.10	2.94	0.0019	0.0022	0.0016	0.0057	
40	0.085	1250	1.95	32510	24705	0.0239	0.0246	9.7	5.6	3.46	4.01	2.94	0.0020	0.0024	0.0017	0.0061	
42	0.097	1250	1.95	37387	28411	0.0232	0.0238	9.7	5.6	3.36	3.88	2.94	0.0023	0.0026	0.0020	0.0069	
44	0.083	1250	1.95	31859	24211	0.0240	0.0247	9.7	5.6	3.48	4.03	2.94	0.0020	0.0023	0.0017	0.0060	
46	0.086	1250	1.95	33015	25089	0.0238	0.0245	9.7	5.6	3.45	4.00	2.94	0.0021	0.0024	0.0018	0.0062	
47	0.097	1250	1.95	37351	28384	0.0232	0.0238	9.7	5.6	3.36	3.88	2.94	0.0023	0.0026	0.0020	0.0069	
48	0.077	1250	1.95	29435	22369	0.0244	0.0252	9.7	5.6	3.53	4.11	2.94	0.0019	0.0022	0.0016	0.0056	
58	0.078	1250	1.95	30001	22798	0.0243	0.0251	9.7	5.6	3.52	4.09	2.94	0.0019	0.0022	0.0016	0.0057	
64	0.077	1250	1.95	29520	22433	0.0243	0.0252	9.7	5.6	3.53	4.11	2.94	0.0019	0.0022	0.0016	0.0056	
70	0.085	1250	1.95	32726	24870	0.0238	0.0246	9.7	5.6	3.46	4.01	2.94	0.0020	0.0024	0.0017	0.0062	
72	0.116	1250	1.95	44703	33971	0.0224	0.0228	9.7	5.6	3.25	3.72	2.94	0.0026	0.0030	0.0024	0.0080	
73	0.078	1250	1.95	29922	22739	0.0243	0.0251	9.7	5.6	3.52	4.10	2.94	0.0019	0.0022	0.0016	0.0057	
74	0.080	1250	1.95	30861	23452	0.0241	0.0249	9.7	5.6	3.50	4.07	2.94	0.0020	0.0023	0.0016	0.0059	
76	0.078	1250	1.95	29977	22781	0.0243	0.0251	9.7	5.6	3.52	4.09	2.94	0.0019	0.0022	0.0016	0.0057	
77	0.078	1250	1.95	29937	22750	0.0243	0.0251	9.7	5.6	3.52	4.10	2.94	0.0019	0.0022	0.0016	0.0057	
78	0.076	1250	1.95	29330	22289	0.0244	0.0252	9.7	5.6	3.54	4.12	2.94	0.0019	0.0022	0.0016	0.0056	
79	0.076	1250	1.95	29258	22234	0.0244	0.0252	9.7	5.6	3.54	4.12	2.94	0.0019	0.0022	0.0016	0.0056	
81	0.078	1250	1.95	30082	22860	0.0242	0.0251	9.7	5.6	3.52	4.09	2.94	0.0019	0.0022	0.0016	0.0057	
82	0.076	1250	1.95	29336	22293	0.0244	0.0252	9.7	5.6	3.54	4.12	2.94	0.0019	0.0022	0.0016	0.0056	
83	0.076	1250	1.95	29336	22293	0.0244	0.0252	9.7	5.6	3.54	4.12	2.94	0.0019	0.0022	0.0016	0.0056	
84	0.076	1250	1.95	29336	22293	0.0244	0.0252	9.7	5.6	3.54	4.12	2.94	0.0019	0.0022	0.0016	0.0056	
85	0.076	1250	1.95	29376	22324	0.0244	0.0252	9.7	5.6	3.54	4.11	2.94	0.0019	0.0022	0.0016	0.0056	
87	0.078	1250	1.95	29800	22646	0.0243	0.0251	9.7	5.6	3.52	4.10	2.94	0.0019	0.0022	0.0016	0.0057	
91	0.076	1250	1.95	29258	22234	0.0244	0.0252	9.7	5.6	3.54	4.12	2.94	0.0019	0.0022	0.0016	0.0056	
92	0.080	1250	1.95	30861	23452	0.0241	0.0249	9.7	5.6	3.50	4.07	2.94	0.0020	0.0023	0.0016	0.0059	
93	0.077	1250	1.95	29781	22632	0.0243	0.0251	9.7	5.6	3.53	4.10	2.94	0.0019	0.0022	0.0016	0.0057	
94	0.076	1250	1.95	29306	22271	0.0244	0.0252	9.7	5.6	3.54	4.12	2.94	0.0019	0.0022	0.0016	0.0056	
95	0.076	1250	1.95	29339	22296	0.0244	0.0252	9.7	5.6	3.54	4.12	2.94	0.0019	0.0022	0.0016	0.0056	
100	0.076	1250	1.95	29389	22334	0.0244	0.0252	9.7	5.6	3.54	4.11	2.94	0.0019	0.0022	0.0016	0.0056	
101	0.077	1250	1.95	29428	22363	0.0244	0.0252	9.7	5.6	3.53	4.11	2.94	0.0019	0.0022	0.0016	0.0056	
111	0.078	1250	1.95	29904	22725	0.0243	0.0251	9.7	5.6	3.52	4.10	2.94	0.0019	0.0022	0.0016	0.0057	
112	0.103	1250	1.95	39591	30086	0.0229	0.0235	9.7	5.6	3.32	3.83	2.94	0.0024	0.0027	0.0021	0.0072	
113	0.079	1250	1.95	30385	23091	0.0242	0.0250	9.7	5.6	3.51	4.08	2.94	0.0019	0.0022	0.0016	0.0058	
119	0.077	1250	1.95	29507	22424	0.0243	0.0252	9.7	5.6	3.53	4.11	2.94	0.0019	0.0022	0.0016	0.0056	
124	0.076	1250	1.95	29258	22234	0.0244	0.0252	9.7	5.6	3.54	4.12	2.94	0.0019	0.0022	0.0016	0.0056	
128	0.077	1250	1.95	29500	22418	0.0243	0.0252	9.7	5.6	3.53	4.11	2.94	0.0019	0.0022	0.0016	0.0056	
130	0.076	1250	1.95	29258	22234	0.0244	0.0252	9.7	5.6	3.54	4.12	2.94	0.0019	0.0022	0.0016	0.0056	
131	0.078	1250	1.95	29963	22770	0.0243	0.0251	9.7	5.6	3.52	4.09	2.94	0.0019	0.0022	0.0016	0.0057	
132	0.076	1250	1.95	29336	22293	0.0244	0.0252	9.7	5.6	3.54	4.12	2.94	0.0019	0.0022	0.0016	0.0056	
133	0.076	1250	1.95	29346	22301	0.0244	0.0252	9.7	5.6	3.54	4.12	2.94	0.0019	0.0022	0.0016	0.0056	

134	0.076	1250	1.95		29346	22301		0.0244	0.0252		9.7	5.6				3.54	4.12	2.94								0.0019	0.0022	0.0016	0.0056	
136	0.077	1250	1.95		29717	22583		0.0243	0.0251		9.7	5.6				3.53	4.10	2.94									0.0019	0.0022	0.0016	0.0057
139	0.102	1250	1.95		39229	29812		0.0230	0.0235		9.7	5.6				3.33	3.84	2.94								0.0024	0.0027	0.0021	0.0072	
140	0.102	1250	1.95		39229	29812		0.0230	0.0235		9.7	5.6				3.33	3.84	2.94								0.0024	0.0027	0.0021	0.0072	
145	0.077	1250	1.95		29432	22366		0.0244	0.0252		9.7	5.6				3.53	4.11	2.94								0.0019	0.0022	0.0016	0.0056	
146	0.077	1250	1.95		29432	22366		0.0244	0.0252		9.7	5.6				3.53	4.11	2.94								0.0019	0.0022	0.0016	0.0056	
147	0.240	1250	1.95		92085	69978		0.0197	0.0195		9.7	5.6				2.86	3.17	2.94								0.0048	0.0053	0.0049	0.0149	
155	0.076	1250	1.95		29258	22234		0.0244	0.0252		9.7	5.6				3.54	4.12	2.94								0.0019	0.0022	0.0016	0.0056	
156	0.119	1250	1.95		45841	34836		0.0223	0.0227		9.7	5.6				3.23	3.70	2.94								0.0027	0.0031	0.0024	0.0082	
157	0.079	1250	1.95		30515	23190		0.0242	0.0250		9.7	5.6				3.51	4.08	2.94								0.0019	0.0022	0.0016	0.0058	
158	0.086	1250	1.95		33052	25117		0.0238	0.0245		9.7	5.6				3.45	4.00	2.94								0.0021	0.0024	0.0018	0.0062	
160	0.083	1250	1.95		32033	24343		0.0239	0.0247		9.7	5.6				3.47	4.03	2.94								0.0020	0.0023	0.0017	0.0060	
161	0.078	1250	1.95		29804	22649		0.0243	0.0251		9.7	5.6				3.52	4.10	2.94								0.0019	0.0022	0.0016	0.0057	
162	0.090	1250	1.95		34677	26352		0.0235	0.0242		9.7	5.6				3.41	3.95	2.94								0.0021	0.0025	0.0018	0.0065	
163	0.083	1250	1.95		31850	24204		0.0240	0.0247		9.7	5.6				3.48	4.03	2.94								0.0020	0.0023	0.0017	0.0060	
166	0.076	1250	1.95		29280	22251		0.0244	0.0252		9.7	5.6				3.54	4.12	2.94								0.0019	0.0022	0.0016	0.0056	
169	0.077	1250	1.95		29666	22544		0.0243	0.0252		9.7	5.6				3.53	4.10	2.94								0.0019	0.0022	0.0016	0.0057	
172	0.076	1250	1.95		29331	22289		0.0244	0.0252		9.7	5.6				3.54	4.12	2.94								0.0019	0.0022	0.0016	0.0056	
178	0.076	1250	1.95		29327	22286		0.0244	0.0252		9.7	5.6				3.54	4.12	2.94								0.0019	0.0022	0.0016	0.0056	
180	0.076	1250	1.95		29327	22286		0.0244	0.0252		9.7	5.6				3.54	4.12	2.94								0.0019	0.0022	0.0016	0.0056	
184	0.079	1250	1.95		30305	23030		0.0242	0.0250		9.7	5.6				3.51	4.08	2.94								0.0019	0.0022	0.0016	0.0058	
186	0.076	1250	1.95		29385	22330		0.0244	0.0252		9.7	5.6				3.54	4.11	2.94								0.0019	0.0022	0.0016	0.0056	
190	0.086	1250	1.95		33052	25117		0.0238	0.0245		9.7	5.6				3.45	4.00	2.94								0.0021	0.0024	0.0018	0.0062	
191	0.080	1250	1.95		30851	23445		0.0241	0.0249		9.7	5.6				3.50	4.07	2.94								0.0020	0.0023	0.0016	0.0059	
194	0.076	1250	1.95		29358	22310		0.0244	0.0252		9.7	5.6				3.54	4.12	2.94								0.0019	0.0022	0.0016	0.0056	
195	0.077	1250	1.95		29475	22399		0.0244	0.0252		9.7	5.6				3.53	4.11	2.94								0.0019	0.0022	0.0016	0.0056	
197	0.217	1250	1.95		83450	63416		0.0200	0.0199		9.7	5.6				2.91	3.24	2.94								0.0044	0.0049	0.0044	0.0137	
198	0.217	1250	1.95		83450	63416		0.0200	0.0199		9.7	5.6				2.91	3.24	2.94								0.0044	0.0049	0.0044	0.0137	
199	0.217	1250	1.95		83450	63416		0.0200	0.0199		9.7	5.6				2.91	3.24	2.94								0.0044	0.0049	0.0044	0.0137	
200	0.217	1250	1.95		83450	63416		0.0200	0.0199		9.7	5.6				2.91	3.24	2.94								0.0044	0.0049	0.0044	0.0137	
201	0.217	1250	1.95		83450	63416		0.0200	0.0199		9.7	5.6				2.91	3.24	2.94								0.0044	0.0049	0.0044	0.0137	
202	0.217	1250	1.95		83450	63416		0.0200	0.0199		9.7	5.6				2.91	3.24	2.94								0.0044	0.0049	0.0044	0.0137	
203	0.217	1250	1.95		83450	63416		0.0200	0.0199		9.7	5.6				2.91	3.24	2.94								0.0044	0.0049	0.0044	0.0137	
204	0.076	1250	1.95		29258	22234		0.0244	0.0252		9.7	5.6				3.54	4.12	2.94								0.0019	0.0022	0.0016	0.0056	
217	0.105	1250	1.95		40322	30642		0.0228	0.0234		9.7	5.6				3.31	3.81	2.94								0.0024	0.0028	0.0021	0.0073	
218	0.105	1250	1.95		40322	30642		0.0228	0.0234		9.7	5.6				3.31	3.81	2.94								0.0024	0.0028	0.0021	0.0073	
219	0.076	1250	1.95		29321	22282		0.0244	0.0252		9.7	5.6				3.54	4.12	2.94								0.0019	0.0022	0.0016	0.0056	
220	0.077	1250	1.95		29475	22399		0.0244	0.0252		9.7	5.6				3.53	4.11	2.94								0.0019	0.0022	0.0016	0.0056	
221	0.077	1250	1.95		29475	22399		0.0244	0.0252		9.7	5.6				3.53	4.11	2.94								0.0019	0.0022	0.0016	0.0056	
222	0.109	1250	1.95		41831	31788		0.0227	0.0232		9.7	5.6				3.29	3.78	2.94								0.0025	0.0029	0.0022	0.0076	
223	0.108	1250	1.95		41397	31459		0.0227	0.0232		9.7	5.6				3.30	3.79	2.94								0.0025	0.0028	0.0022	0.0075	
224	0.078	1250	1.95		30071	22852		0.0243	0.0251		9.7	5.6				3.52	4.09	2.94								0.0019	0.0022	0.0016	0.0057	
229	0.142	1250	1.95		54548	41452		0.0216	0.0218		9.7	5.6				3.13	3.56	2.94								0.0031	0.0035	0.0029	0.0095	
230	0.142	1250	1.95		54548	41452		0.0216	0.0218		9.7	5.6				3.13	3.56	2.94								0.0031	0.0035	0.0029	0.0095	
231	0.076	1250	1.95		29312	22275		0.0244	0.0252		9.7	5.6				3.54	4.12	2.94								0.0019	0.0022	0.0016	0.0056	
232	0.088	1250	1.95		33810	25693		0.0237	0.0244		9.7	5.6				3.43	3.98	2.94								0.0021	0.0024	0.0018	0.0063	
234	0.148	1250	1.95		56715	43100		0.0214	0.0216		9.7	5.6				3.11	3.53	2.94								0.0032	0.0036	0.0030	0.0098	
235	0.149	1250	1.95		57402	43621		0.0214	0.0216		9.7	5.6				3.10	3.52	2.94								0.0032	0.0036	0.0031	0.0099	
236	0.149	1250	1.95		57402	43621		0.0214	0.0216		9.7	5.6				3.10	3.52	2.94								0.0032	0.0036	0.0031	0.0099	
238	0.076	1250	1.95		29260	22236		0.0244	0.0252		9.7	5.6				3.54	4.12	2.94								0.0019	0.0022	0.0016	0.0056	
243	0.076	1250	1.95		29326	22286		0.0244	0.0252		9.7	5.6				3.54	4.12	2.94								0.0019	0.0022	0.0016	0.0056	
244	0.078	1250	1.95		30143	22907		0.0242	0.0251		9.7	5.6				3.52	4.09	2.94								0.0019	0.0022	0.0016	0.0057	
245	0.216	1250	1.95		83062	63121		0.0201	0.0199		9.7	5.6				2.91	3.24	2.94								0.0044	0.0049	0.0044	0.0137	
246	0.124	1250	1.95		47683	36236		0.0221	0.0225		9.7	5.6				3.21	3.67	2.94								0.0028	0.0032	0.0025	0.0085	
247	0.078	1250	1.95		29800	22646		0.0243	0.0251		9.7	5.6				3.52	4.10	2.94								0.0019	0.0022	0.0016	0.0057	
249	0.079	1250	1.95		30207	22955		0.0242	0.0250		9.7	5.6				3.51	4.09	2.94								0.0019	0.00			

286	0.077	1250	1.95		29410	22349		0.0244	0.0252		9.7	5.6				3.53	4.11	2.94					0.0019	0.0022	0.0016	0.0056
288	0.079	1250	1.95		30450	23140		0.0242	0.0250		9.7	5.6				3.51	4.08	2.94					0.0019	0.0022	0.0016	0.0058
289	0.079	1250	1.95		30394	23098		0.0242	0.0250		9.7	5.6				3.51	4.08	2.94					0.0019	0.0022	0.0016	0.0058
295	0.078	1250	1.95		30161	22921		0.0242	0.0250		9.7	5.6				3.52	4.09	2.94					0.0019	0.0022	0.0016	0.0057
296	0.079	1250	1.95		30450	23140		0.0242	0.0250		9.7	5.6				3.51	4.08	2.94					0.0019	0.0022	0.0016	0.0058
297	0.079	1250	1.95		30391	23095		0.0242	0.0250		9.7	5.6				3.51	4.08	2.94					0.0019	0.0022	0.0016	0.0058
300	0.080	1250	1.95		30916	23494		0.0241	0.0249		9.7	5.6				3.50	4.06	2.94					0.0020	0.0023	0.0016	0.0059
301	0.080	1250	1.95		30916	23494		0.0241	0.0249		9.7	5.6				3.50	4.06	2.94					0.0020	0.0023	0.0016	0.0059
304	0.082	1250	1.95		31345	23820		0.0240	0.0248		9.7	5.6				3.49	4.05	2.94					0.0020	0.0023	0.0017	0.0059
305	0.078	1250	1.95		29981	22783		0.0243	0.0251		9.7	5.6				3.52	4.09	2.94					0.0019	0.0022	0.0016	0.0057
306	0.078	1250	1.95		29981	22783		0.0243	0.0251		9.7	5.6				3.52	4.09	2.94					0.0019	0.0022	0.0016	0.0057
307	0.078	1250	1.95		29981	22783		0.0243	0.0251		9.7	5.6				3.52	4.09	2.94					0.0019	0.0022	0.0016	0.0057
309	0.076	1250	1.95		29377	22325		0.0244	0.0252		9.7	5.6				3.54	4.11	2.94					0.0019	0.0022	0.0016	0.0056
316	0.087	1250	1.95		33397	25379		0.0237	0.0244		9.7	5.6				3.44	3.99	2.94					0.0021	0.0024	0.0018	0.0063
317	0.087	1250	1.95		33397	25379		0.0237	0.0244		9.7	5.6				3.44	3.99	2.94					0.0021	0.0024	0.0018	0.0063
318	0.076	1250	1.95		29330	22289		0.0244	0.0252		9.7	5.6				3.54	4.12	2.94					0.0019	0.0022	0.0016	0.0056
319	0.076	1250	1.95		29321	22282		0.0244	0.0252		9.7	5.6				3.54	4.12	2.94					0.0019	0.0022	0.0016	0.0056
320	0.076	1250	1.95		29321	22282		0.0244	0.0252		9.7	5.6				3.54	4.12	2.94					0.0019	0.0022	0.0016	0.0056
321	0.088	1250	1.95		33973	25817		0.0236	0.0243		9.7	5.6				3.43	3.97	2.94					0.0021	0.0024	0.0018	0.0063
322	0.090	1250	1.95		34424	26160		0.0236	0.0243		9.7	5.6				3.42	3.96	2.94					0.0021	0.0025	0.0018	0.0064
324	0.076	1250	1.95		29321	22282		0.0244	0.0252		9.7	5.6				3.54	4.12	2.94					0.0019	0.0022	0.0016	0.0056
325	0.076	1250	1.95		29321	22282		0.0244	0.0252		9.7	5.6				3.54	4.12	2.94					0.0019	0.0022	0.0016	0.0056
364	0.095	1250	1.95		36339	27615		0.0233	0.0239		9.7	5.6				3.38	3.91	2.94					0.0022	0.0026	0.0019	0.0067
366	0.078	1250	1.95		29908	22728		0.0243	0.0251		9.7	5.6				3.52	4.10	2.94					0.0019	0.0022	0.0016	0.0057
367	0.078	1250	1.95		29908	22728		0.0243	0.0251		9.7	5.6				3.52	4.10	2.94					0.0019	0.0022	0.0016	0.0057
366	0.078	1250	1.95		29908	22728		0.0243	0.0251		9.7	5.6				3.52	4.10	2.94					0.0019	0.0022	0.0016	0.0057
382	0.078	1250	1.95		29908	22728		0.0243	0.0251		9.7	5.6				3.52	4.10	2.94					0.0019	0.0022	0.0016	0.0057
383	0.084	1250	1.95		32250	24507		0.0239	0.0246		9.7	5.6				3.47	4.02	2.94					0.0020	0.0023	0.0017	0.0061
389	0.076	1250	1.95		29258	22234		0.0244	0.0252		9.7	5.6				3.54	4.12	2.94					0.0019	0.0022	0.0016	0.0056
403	0.076	1250	1.95		29258	22234		0.0244	0.0252		9.7	5.6				3.54	4.12	2.94					0.0019	0.0022	0.0016	0.0056
418	0.082	1250	1.95		31643	24046		0.0240	0.0248		9.7	5.6				3.48	4.04	2.94					0.0020	0.0023	0.0017	0.0060
429	0.076	1250	1.95		29382	22329		0.0244	0.0252		9.7	5.6				3.54	4.11	2.94					0.0019	0.0022	0.0016	0.0056
432	0.270	1250	1.95		103679	78789		0.0194	0.0190		9.7	5.6				2.81	3.10	2.94					0.0053	0.0058	0.0055	0.0166
433	0.347	1250	1.95		133301	101300		0.0187	0.0180		9.7	5.6				2.71	2.94	2.94					0.0065	0.0071	0.0071	0.0207
434	0.265	1250	1.95		101728	77306		0.0194	0.0191		9.7	5.6				2.82	3.11	2.94					0.0052	0.0057	0.0054	0.0163
436	0.310	1250	1.95		118968	90407		0.0190	0.0185		9.7	5.6				2.76	3.01	2.94					0.0059	0.0065	0.0063	0.0187
437	0.310	1250	1.95		118968	90407		0.0190	0.0185		9.7	5.6				2.76	3.01	2.94					0.0059	0.0065	0.0063	0.0187
442	0.082	1250	1.95		31597	24012		0.0240	0.0248		9.7	5.6				3.48	4.04	2.94					0.0020	0.0023	0.0017	0.0060
448	0.080	1250	1.95		30673	23309		0.0241	0.0249		9.7	5.6				3.50	4.07	2.94					0.0019	0.0023	0.0016	0.0058
457	0.076	1250	1.95		29258	22234		0.0244	0.0252		9.7	5.6				3.54	4.12	2.94					0.0019	0.0022	0.0016	0.0056
458	0.084	1250	1.95		32307	24551		0.0239	0.0246		9.7	5.6				3.47	4.02	2.94					0.0020	0.0023	0.0017	0.0061
464	0.097	1250	1.95		37452	28461		0.0232	0.0238		9.7	5.6				3.36	3.88	2.94					0.0023	0.0026	0.0020	0.0069
465	0.098	1250	1.95		37680	28634		0.0231	0.0237		9.7	5.6				3.36	3.88	2.94					0.0023	0.0026	0.0020	0.0069
466	0.091	1250	1.95		35057	26641		0.0235	0.0242		9.7	5.6				3.41	3.94	2.94					0.0022	0.0025	0.0019	0.0065
467	0.082	1250	1.95		31578	23997		0.0240	0.0248		9.7	5.6				3.48	4.04	2.94					0.0020	0.0023	0.0017	0.0060
468	0.079	1250	1.95		30393	23096		0.0242	0.0250		9.7	5.6				3.51	4.08	2.94					0.0019	0.0022	0.0016	0.0058
469	0.076	1250	1.95		29319	22280		0.0244	0.0252		9.7	5.6				3.54	4.12	2.94					0.0019	0.0022	0.0016	0.0056
473	0.076	1250	1.95		29287	22256		0.0244	0.0252		9.7	5.6				3.54	4.12	2.94					0.0019	0.0022	0.0016	0.0056
476	0.083	1250	1.95		31926	24262		0.0239	0.0247		9.7	5.6				3.47	4.03	2.94					0.0020	0.0023	0.0017	0.0060
478	0.076	1250	1.95		29258	22234		0.0244	0.0252		9.7	5.6				3.54	4.12	2.94					0.0019	0.0022	0.0016	0.0056
468	0.076	1250	1.95		29315	22277		0.0244	0.0252		9.7	5.6				3.54	4.12	2.94					0.0019	0.0022	0.0016	0.0056
493	0.076	1250	1.95		29258	22234		0.0244	0.0252		9.7	5.6				3.54	4.12	2.94					0.0019	0.0022	0.0016	0.0056
494	0.076	1250	1.95		29362	22313		0.0244	0.0252		9.7	5.6				3.54	4.11	2.94					0.0019	0.0022	0.0016	0.0056
496	0.076	1250	1.95		29361	22312		0.0244	0.0252		9.7	5.6				3.54	4.11	2.94					0.0019	0.0022	0.0016	0.0056
497	0.077	1250	1.95		29515	22430		0.0243	0.0252		9.7	5.6				3.53	4.11	2.94					0.0019	0.0022	0.0016	0.0056
499	0.091	1250	1.95		35057	26641		0.0235	0.0242		9.7	5.6				3.41	3.94	2.94					0.0022	0.0025	0.0019	0.0065
502	0.077	1250	1.95		29469	22395		0.0244	0.0252		9.7	5.6				3.53	4.11	2.94					0.0019	0.0022	0.0016	0.0056
503	0.077	1250	1.95		29453	22382		0.0244	0.0252		9.7	5.6				3.53	4.11	2.94					0.0019	0.0022	0.0016	0.0056
505	0.076	1250	1.95		29365	22315		0.0244	0.0252		9.7	5.6				3.54	4.11	2.94								

546	0.083	1250	1.95		31709	24096		0.0240	0.0247		9.7	5.6				3.48	4.04	2.94				0.0020	0.0023	0.0017	0.0060
547	0.083	1250	1.95		31709	24096		0.0240	0.0247		9.7	5.6				3.48	4.04	2.94				0.0020	0.0023	0.0017	0.0060
548	0.081	1250	1.95		31180	23695		0.0241	0.0248		9.7	5.6				3.49	4.06	2.94				0.0020	0.0023	0.0017	0.0059
549	0.083	1250	1.95		31709	24096		0.0240	0.0247		9.7	5.6				3.48	4.04	2.94				0.0020	0.0023	0.0017	0.0060
550	0.077	1250	1.95		29739	22599		0.0243	0.0251		9.7	5.6				3.53	4.10	2.94				0.0019	0.0022	0.0016	0.0057

MAX ΔP:	0.0207
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P-V valve vacuum setting: 0.5 psi
80% of P-V valve setting: 0.4 psi

Maximum pressure drop to shore connection: 0.021 psi

TOTAL PRESSURE DROP TO SHORE CONNECTION: 0.021 psi OK

Max. allowable back pressure at facility: 0.379 psi

Pressure Drop through VCS - From #1 Cargo Tank to Shore Connection (per 46 CFR 39.30-1(d)(3) and ABS SBR 5-2-3/7.5.2(c))

Pipe sizes, nominal: 8 in
 Pipe ID: 7.981 in
 Pipe Flow Area: 50.03 in²
 Vapor Dynamic Viscosity: 0.019 centipoise (estimated, based on air @ 115F, Crane 410, Table A-5)

PIPE LENGTH

Length (ft): 221.94 ft 8" pipe
 Length (ft): 50.00 ft 6" hose
 f, friction factor (pipe): Varies with Reynold's Number (see table below)

VALVE & FITTING EQUIVALENT LENGTH

Equivalent Length (ft): 285.74 ft
 f_v, friction factor, turbulent flow (fittings): 0.014 constant, for each pipe size

Shore Connection Pressure Drop (at 50% of Maximum Liquid Discharge Rate): 2500 BBL/hr

Cargo	Vapor-Air Mix. Density (lb/ft ³)	Vapor Flow Rate		Reynold's Number		Friction Factor		Vapor Velocity		Head Loss			Component ΔP				ΔP
		BBL/hr	ft ³ /s	6" Hose	8" Pipe	6" Hose	8" Pipe	6" Hose	8" Pipe	6" Hose	8" Pipe	8" Fittings	6" Hose	8" Pipe	8" Fittings	TOTAL	
1	0.123	2500	3.90	94644	71923	0.0196	0.0202	19.4	11.2	11.40	13.20	11.77	0.0097	0.0113	0.0101	0.0311	
2	0.085	2500	3.90	65323	49641	0.0209	0.0209	19.4	11.2	12.12	13.67	11.77	0.0071	0.0081	0.0069	0.0222	
19	0.082	2500	3.90	62665	47621	0.0210	0.0211	19.4	11.2	12.20	13.80	11.77	0.0069	0.0078	0.0067	0.0214	
20	0.079	2500	3.90	60727	46149	0.0211	0.0213	19.4	11.2	12.27	13.89	11.77	0.0067	0.0076	0.0065	0.0208	
21	0.079	2500	3.90	60727	46149	0.0211	0.0213	19.4	11.2	12.27	13.89	11.77	0.0067	0.0076	0.0065	0.0208	
23	0.079	2500	3.90	60727	46149	0.0211	0.0213	19.4	11.2	12.27	13.89	11.77	0.0067	0.0076	0.0065	0.0208	
24	0.079	2500	3.90	60727	46149	0.0211	0.0213	19.4	11.2	12.27	13.89	11.77	0.0067	0.0076	0.0065	0.0208	
26	0.079	2500	3.90	60727	46149	0.0211	0.0213	19.4	11.2	12.27	13.89	11.77	0.0067	0.0076	0.0065	0.0208	
34	0.077	2500	3.90	59503	45218	0.0212	0.0214	19.4	11.2	12.32	13.96	11.77	0.0066	0.0075	0.0063	0.0204	
40	0.085	2500	3.90	65019	49410	0.0209	0.0210	19.4	11.2	12.13	13.68	11.77	0.0071	0.0080	0.0069	0.0221	
42	0.097	2500	3.90	74774	56823	0.0204	0.0203	19.4	11.2	11.84	13.27	11.77	0.0080	0.0090	0.0079	0.0249	
44	0.083	2500	3.90	63719	48422	0.0210	0.0211	19.4	11.2	12.17	13.75	11.77	0.0070	0.0079	0.0068	0.0217	
46	0.086	2500	3.90	66031	50179	0.0208	0.0209	19.4	11.2	12.09	13.64	11.77	0.0072	0.0081	0.0070	0.0224	
47	0.097	2500	3.90	74702	56768	0.0204	0.0203	19.4	11.2	11.84	13.28	11.77	0.0080	0.0090	0.0079	0.0249	
48	0.077	2500	3.90	58870	44737	0.0213	0.0214	19.4	11.2	12.34	13.99	11.77	0.0066	0.0074	0.0063	0.0203	
58	0.078	2500	3.90	60001	45597	0.0212	0.0213	19.4	11.2	12.30	13.93	11.77	0.0067	0.0076	0.0064	0.0206	
64	0.077	2500	3.90	59040	44866	0.0213	0.0214	19.4	11.2	12.33	13.98	11.77	0.0066	0.0075	0.0063	0.0203	
70	0.085	2500	3.90	65453	49740	0.0209	0.0209	19.4	11.2	12.11	13.66	11.77	0.0072	0.0081	0.0070	0.0222	
72	0.116	2500	3.90	89406	67942	0.0198	0.0196	19.4	11.2	11.50	12.78	11.77	0.0093	0.0103	0.0095	0.0291	
73	0.078	2500	3.90	59844	45477	0.0212	0.0214	19.4	11.2	12.30	13.94	11.77	0.0067	0.0075	0.0064	0.0205	
74	0.080	2500	3.90	61723	46905	0.0211	0.0212	19.4	11.2	12.24	13.84	11.77	0.0068	0.0077	0.0066	0.0211	
76	0.078	2500	3.90	59955	45562	0.0212	0.0213	19.4	11.2	12.30	13.93	11.77	0.0067	0.0075	0.0064	0.0206	
77	0.078	2500	3.90	59875	45501	0.0212	0.0213	19.4	11.2	12.30	13.94	11.77	0.0067	0.0075	0.0064	0.0206	
78	0.076	2500	3.90	58661	44578	0.0213	0.0214	19.4	11.2	12.35	14.00	11.77	0.0065	0.0074	0.0062	0.0202	
79	0.076	2500	3.90	58516	44468	0.0213	0.0215	19.4	11.2	12.35	14.01	11.77	0.0065	0.0074	0.0062	0.0202	
81	0.078	2500	3.90	60164	45720	0.0212	0.0213	19.4	11.2	12.29	13.92	11.77	0.0067	0.0076	0.0064	0.0206	
82	0.076	2500	3.90	58672	44586	0.0213	0.0214	19.4	11.2	12.35	14.00	11.77	0.0065	0.0074	0.0062	0.0202	
83	0.076	2500	3.90	58672	44586	0.0213	0.0214	19.4	11.2	12.35	14.00	11.77	0.0065	0.0074	0.0062	0.0202	
84	0.076	2500	3.90	58672	44586	0.0213	0.0214	19.4	11.2	12.35	14.00	11.77	0.0065	0.0074	0.0062	0.0202	
85	0.076	2500	3.90	58752	44647	0.0213	0.0214	19.4	11.2	12.34	14.00	11.77	0.0066	0.0074	0.0062	0.0202	
87	0.078	2500	3.90	59600	45292	0.0212	0.0214	19.4	11.2	12.31	13.95	11.77	0.0066	0.0075	0.0063	0.0205	
91	0.076	2500	3.90	58516	44468	0.0213	0.0215	19.4	11.2	12.35	14.01	11.77	0.0065	0.0074	0.0062	0.0202	
92	0.080	2500	3.90	61723	46905	0.0211	0.0212	19.4	11.2	12.24	13.84	11.77	0.0068	0.0077	0.0066	0.0211	
93	0.077	2500	3.90	59563	45263	0.0212	0.0214	19.4	11.2	12.31	13.95	11.77	0.0066	0.0075	0.0063	0.0205	
94	0.076	2500	3.90	58612	44541	0.0213	0.0215	19.4	11.2	12.35	14.00	11.77	0.0065	0.0074	0.0062	0.0202	
95	0.076	2500	3.90	58679	44592	0.0213	0.0214	19.4	11.2	12.35	14.00	11.77	0.0065	0.0074	0.0062	0.0202	
100	0.076	2500	3.90	58778	44667	0.0213	0.0214	19.4	11.2	12.34	13.99	11.77	0.0066	0.0074	0.0062	0.0202	
101	0.077	2500	3.90	58857	44727	0.0213	0.0214	19.4	11.2	12.34	13.99	11.77	0.0066	0.0074	0.0063	0.0203	
111	0.078	2500	3.90	59807	45449	0.0212	0.0214	19.4	11.2	12.30	13.94	11.77	0.0066	0.0075	0.0064	0.0205	
112	0.103	2500	3.90	79181	60172	0.0202	0.0201	19.4	11.2	11.73	13.11	11.77	0.0084	0.0094	0.0084	0.0262	
113	0.079	2500	3.90	60771	46181	0.0211	0.0213	19.4	11.2	12.27	13.89	11.77	0.0067	0.0076	0.0065	0.0208	
119	0.077	2500	3.90	59015	44847	0.0213	0.0214	19.4	11.2	12.33	13.98	11.77	0.0066	0.0075	0.0063	0.0203	
124	0.076	2500	3.90	58516	44468	0.0213	0.0215	19.4	11.2	12.35	14.01	11.77	0.0065	0.0074	0.0062	0.0202	
128	0.077	2500	3.90	59000	44836	0.0213	0.0214	19.4	11.2	12.33	13.98	11.77	0.0066	0.0075	0.0063	0.0203	
130	0.076	2500	3.90	58516	44468	0.0213	0.0215	19.4	11.2	12.35	14.01	11.77	0.0065	0.0074	0.0062	0.0202	
131	0.078	2500	3.90	59925	45539	0.0212	0.0213	19.4	11.2	12.30	13.93	11.77	0.0067	0.0075	0.0064	0.0206	
132	0.076	2500	3.90	58672	44587	0.0213	0.0214	19.4	11.2	12.35	14.00	11.77	0.0065	0.0074	0.0062	0.0202	
133	0.076	2500	3.90	58692	44602	0.0213	0.0214	19.4	11.2	12.35	14.00	11.77	0.0065	0.0074	0.0062	0.0202	

286	0.077	2500	3.90		58820	44699		0.0213	0.0214		19.4	11.2								0.0066	0.0074	0.0063	0.0202	
288	0.079	2500	3.90		60901	46280		0.0211	0.0213		19.4	11.2									0.0067	0.0076	0.0065	0.0209
289	0.079	2500	3.90		60789	46195		0.0211	0.0213		19.4	11.2									0.0067	0.0076	0.0065	0.0208
295	0.078	2500	3.90		60323	45841		0.0212	0.0213		19.4	11.2									0.0067	0.0076	0.0064	0.0207
296	0.079	2500	3.90		60901	46280		0.0211	0.0213		19.4	11.2									0.0067	0.0076	0.0065	0.0209
297	0.079	2500	3.90		60782	46190		0.0211	0.0213		19.4	11.2									0.0067	0.0076	0.0065	0.0208
300	0.080	2500	3.90		61833	46989		0.0211	0.0212		19.4	11.2									0.0068	0.0077	0.0066	0.0211
301	0.080	2500	3.90		61833	46989		0.0211	0.0212		19.4	11.2									0.0068	0.0077	0.0066	0.0211
304	0.082	2500	3.90		62689	47639		0.0210	0.0211		19.4	11.2									0.0069	0.0078	0.0067	0.0214
305	0.078	2500	3.90		59961	45566		0.0212	0.0213		19.4	11.2									0.0067	0.0075	0.0064	0.0206
306	0.078	2500	3.90		59961	45566		0.0212	0.0213		19.4	11.2									0.0067	0.0075	0.0064	0.0206
307	0.078	2500	3.90		59961	45566		0.0212	0.0213		19.4	11.2									0.0067	0.0075	0.0064	0.0206
309	0.076	2500	3.90		58755	44650		0.0213	0.0214		19.4	11.2									0.0066	0.0074	0.0062	0.0202
316	0.087	2500	3.90		66793	50758		0.0208	0.0208		19.4	11.2									0.0073	0.0082	0.0071	0.0226
317	0.087	2500	3.90		66793	50758		0.0208	0.0208		19.4	11.2									0.0073	0.0082	0.0071	0.0226
318	0.076	2500	3.90		58661	44578		0.0213	0.0214		19.4	11.2									0.0065	0.0074	0.0062	0.0202
319	0.076	2500	3.90		58642	44564		0.0213	0.0214		19.4	11.2									0.0065	0.0074	0.0062	0.0202
320	0.076	2500	3.90		58642	44564		0.0213	0.0214		19.4	11.2									0.0065	0.0074	0.0062	0.0202
321	0.088	2500	3.90		67946	51634		0.0207	0.0208		19.4	11.2									0.0074	0.0083	0.0072	0.0229
322	0.090	2500	3.90		68849	52320		0.0207	0.0207		19.4	11.2									0.0075	0.0084	0.0073	0.0232
324	0.076	2500	3.90		58642	44564		0.0213	0.0214		19.4	11.2									0.0065	0.0074	0.0062	0.0202
325	0.076	2500	3.90		58642	44564		0.0213	0.0214		19.4	11.2									0.0065	0.0074	0.0062	0.0202
364	0.095	2500	3.90		72678	55231		0.0205	0.0205		19.4	11.2									0.0078	0.0088	0.0077	0.0243
366	0.078	2500	3.90		59817	45457		0.0212	0.0214		19.4	11.2									0.0066	0.0075	0.0064	0.0205
367	0.078	2500	3.90		59817	45457		0.0212	0.0214		19.4	11.2									0.0066	0.0075	0.0064	0.0205
366	0.078	2500	3.90		59817	45457		0.0212	0.0214		19.4	11.2									0.0066	0.0075	0.0064	0.0205
382	0.078	2500	3.90		59817	45457		0.0212	0.0214		19.4	11.2									0.0066	0.0075	0.0064	0.0205
383	0.084	2500	3.90		64499	49015		0.0209	0.0210		19.4	11.2									0.0071	0.0080	0.0069	0.0219
389	0.076	2500	3.90		58516	44468		0.0213	0.0215		19.4	11.2									0.0065	0.0074	0.0062	0.0202
403	0.076	2500	3.90		58516	44468		0.0213	0.0215		19.4	11.2									0.0065	0.0074	0.0062	0.0202
418	0.082	2500	3.90		63285	48092		0.0210	0.0211		19.4	11.2									0.0070	0.0079	0.0067	0.0216
429	0.076	2500	3.90		58765	44657		0.0213	0.0214		19.4	11.2									0.0066	0.0074	0.0062	0.0202
432	0.270	2500	3.90		207357	157577		0.0177	0.0166		19.4	11.2									0.0192	0.0203	0.0220	0.0615
433	0.347	2500	3.90		266602	202599		0.0172	0.0158		19.4	11.2									0.0241	0.0249	0.0283	0.0773
434	0.265	2500	3.90		203455	154612		0.0177	0.0166		19.4	11.2									0.0189	0.0199	0.0216	0.0605
436	0.310	2500	3.90		237935	180814		0.0174	0.0161		19.4	11.2									0.0217	0.0227	0.0253	0.0697
437	0.310	2500	3.90		237935	180814		0.0174	0.0161		19.4	11.2									0.0217	0.0227	0.0253	0.0697
442	0.082	2500	3.90		63195	48024		0.0210	0.0211		19.4	11.2									0.0070	0.0079	0.0067	0.0215
448	0.080	2500	3.90		61345	46618		0.0211	0.0212		19.4	11.2									0.0068	0.0077	0.0065	0.0210
457	0.076	2500	3.90		58516	44468		0.0213	0.0215		19.4	11.2									0.0065	0.0074	0.0062	0.0202
458	0.084	2500	3.90		64615	49103		0.0209	0.0210		19.4	11.2									0.0071	0.0080	0.0069	0.0220
464	0.097	2500	3.90		74904	56922		0.0204	0.0203		19.4	11.2									0.0080	0.0090	0.0080	0.0250
465	0.098	2500	3.90		75359	57268		0.0204	0.0203		19.4	11.2									0.0081	0.0090	0.0080	0.0251
466	0.091	2500	3.90		70113	53281		0.0206	0.0206		19.4	11.2									0.0076	0.0085	0.0075	0.0236
467	0.082	2500	3.90		63155	47993		0.0210	0.0211		19.4	11.2									0.0070	0.0079	0.0067	0.0215
468	0.079	2500	3.90		60785	46192		0.0211	0.0213		19.4	11.2									0.0067	0.0076	0.0065	0.0208
469	0.076	2500	3.90		58637	44560		0.0213	0.0214		19.4	11.2									0.0065	0.0074	0.0062	0.0202
473	0.076	2500	3.90		58575	44513		0.0213	0.0215		19.4	11.2									0.0065	0.0074	0.0062	0.0202
476	0.083	2500	3.90		63852	48523		0.0210	0.0210		19.4	11.2									0.0070	0.0079	0.0068	0.0217
478	0.076	2500	3.90		58516	44468		0.0213	0.0215		19.4	11.2									0.0065	0.0074	0.0062	0.0202
468	0.076	2500	3.90		58630	44555		0.0213	0.0214		19.4	11.2									0.0065	0.0074	0.0062	0.0202
493	0.076	2500	3.90		58516	44468		0.0213	0.0215		19.4	11.2									0.0065	0.0074	0.0062	0.0202
494	0.076	2500	3.90		58725	44627		0.0213	0.0214		19.4	11.2									0.0065	0.0074	0.0062	0.0202
496	0.076	2500	3.90		58722	44625		0.0213	0.0214		19.4	11.2									0.0065	0.0074	0.0062	0.0202
497	0.077	2500	3.90		59031	44859		0.0213	0.0214		19.4	11.2									0.0066	0.0075	0.0063	0.0203
499	0.091	2500	3.90		70113	53281		0.0206	0.0206		19.4	11.2									0.0076	0.0085	0.0075	0.0236
502	0.077	2500	3.90		58939	44789		0.0213	0.0214		19.4	11.2									0.0066	0.0074	0.0063	0.0203
503	0.077	2500	3.90		58907	44765		0.0213	0.0214		19.4	11.2									0.0066	0.0074	0.0063	0.0203
505	0.076	2500	3.90		58730	44631		0.0213	0.0214		19.4	11.2									0.0065	0.0074	0.0062	0.0202
506	0.076	2500	3.90		58707	44614		0.0213	0.0214		19.4	11.2									0.0065	0.0074	0.0062	0.0202
508	0.077	2500	3.90		58849	44721		0.0213	0.0214		19.4	11.2									0.0066	0.0074	0.0063	0.0203
509	0.076	2500	3.90		58667	44583		0.0213	0.0214		19.4	11.2									0.0065	0.0074	0.0062	0.0202
519	0.078	2500	3.90		60135	45698		0.0212	0.0213		19.4	11.2									0.0067	0.0076	0.0064	0.0206
520	0.078	2500	3.90		60105	45675		0.0212	0.0213		19.4	11.2									0.0067	0.0076	0.0064	0.0206
521	0.078	2500	3.90		60105	45675		0.0212	0.0213		19.4	11.2									0.0067	0.0076	0.0064	0.0206
522	0.078	2500	3.90		60105	4567																		

546	0.083	2500	3.90		63417	48193		0.0210	0.0211		19.4	11.2				12.18	13.76	11.77				0.0070	0.0079	0.0067	0.0216
547	0.083	2500	3.90		63417	48193		0.0210	0.0211		19.4	11.2				12.18	13.76	11.77				0.0070	0.0079	0.0067	0.0216
548	0.081	2500	3.90		62360	47389		0.0210	0.0212		19.4	11.2				12.21	13.81	11.77				0.0069	0.0078	0.0066	0.0213
549	0.083	2500	3.90		63417	48193		0.0210	0.0211		19.4	11.2				12.18	13.76	11.77				0.0070	0.0079	0.0067	0.0216
550	0.077	2500	3.90		59477	45199		0.0212	0.0214		19.4	11.2				12.32	13.96	11.77				0.0066	0.0075	0.0063	0.0204

MAX ΔP:	0.0773
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P-V valve vacuum setting: 0.5 psi
80% of P-V valve setting: 0.4 psi

Maximum pressure drop to shore connection: 0.077 psi

TOTAL PRESSURE DROP TO SHORE CONNECTION: 0.077 psi OK

Max. allowable back pressure at facility: 0.323 psi

Pressure Drop through VCS - From #1 Cargo Tank to Shore Connection (per 46 CFR 39.30-1(d)(3) and ABS SBR 5-2-3/7.5.2(c))

Pipe sizes, nominal: 8 in
 Pipe ID: 7.981 in
 Pipe Flow Area: 50.03 in²
 Vapor Dynamic Viscosity: 0.019 centipoise (estimated, based on air @ 115F, Crane 410, Table A-5)

PIPE LENGTH

Length (ft): 221.94 ft 8" pipe
 Length (ft): 50.00 ft 6" hose
 f, friction factor (pipe): Varies with Reynold's Number (see table below)

VALVE & FITTING EQUIVALENT LENGTH

Equivalent Length (ft): 285.74 ft
 f_v, friction factor, turbulent flow (fittings): 0.014 constant, for each pipe size

Shore Connection Pressure Drop (at 75% of Maximum Liquid Discharge Rate): 3750 BBL/hr

Cargo	Vapor-Air Mix. Density (lb/ft ³)	Vapor Flow Rate		Reynold's Number		Friction Factor		Vapor Velocity		Head Loss			Component ΔP				ΔP
		BBL/hr	ft ³ /s	6" Hose	8" Pipe	6" Hose	8" Pipe	6" Hose	8" Pipe	6" Hose	8" Pipe	8" Fittings	6" Hose	8" Pipe	8" Fittings	TOTAL	
1	0.123	3750	5.85	141966	107884	0.0185	0.0189	29.2	16.8	24.20	27.75	26.47	0.0207	0.0237	0.0226	0.0671	
2	0.085	3750	5.85	97984	74461	0.0195	0.0192	29.2	16.8	25.52	28.20	26.47	0.0151	0.0166	0.0156	0.0473	
19	0.082	3750	5.85	93998	71432	0.0197	0.0194	29.2	16.8	25.68	28.45	26.47	0.0145	0.0161	0.0150	0.0456	
20	0.079	3750	5.85	91091	69223	0.0198	0.0195	29.2	16.8	25.80	28.64	26.47	0.0142	0.0157	0.0145	0.0444	
21	0.079	3750	5.85	91091	69223	0.0198	0.0195	29.2	16.8	25.80	28.64	26.47	0.0142	0.0157	0.0145	0.0444	
23	0.079	3750	5.85	91091	69223	0.0198	0.0195	29.2	16.8	25.80	28.64	26.47	0.0142	0.0157	0.0145	0.0444	
24	0.079	3750	5.85	91091	69223	0.0198	0.0195	29.2	16.8	25.80	28.64	26.47	0.0142	0.0157	0.0145	0.0444	
26	0.079	3750	5.85	91091	69223	0.0198	0.0195	29.2	16.8	25.80	28.64	26.47	0.0142	0.0157	0.0145	0.0444	
34	0.077	3750	5.85	89254	67827	0.0198	0.0196	29.2	16.8	25.89	28.76	26.47	0.0139	0.0155	0.0142	0.0436	
40	0.085	3750	5.85	97529	74115	0.0196	0.0192	29.2	16.8	25.53	28.23	26.47	0.0150	0.0166	0.0156	0.0471	
42	0.097	3750	5.85	112161	85234	0.0192	0.0187	29.2	16.8	25.01	27.43	26.47	0.0169	0.0185	0.0179	0.0533	
44	0.083	3750	5.85	95578	72633	0.0196	0.0193	29.2	16.8	25.61	28.35	26.47	0.0147	0.0163	0.0152	0.0463	
46	0.086	3750	5.85	99046	75268	0.0195	0.0192	29.2	16.8	25.47	28.14	26.47	0.0152	0.0168	0.0158	0.0478	
47	0.097	3750	5.85	112052	85152	0.0192	0.0187	29.2	16.8	25.01	27.43	26.47	0.0169	0.0185	0.0179	0.0533	
48	0.077	3750	5.85	88306	67106	0.0199	0.0196	29.2	16.8	25.93	28.82	26.47	0.0138	0.0153	0.0141	0.0432	
58	0.078	3750	5.85	90002	68395	0.0198	0.0195	29.2	16.8	25.85	28.71	26.47	0.0140	0.0156	0.0144	0.0439	
64	0.077	3750	5.85	88560	67300	0.0199	0.0196	29.2	16.8	25.92	28.81	26.47	0.0138	0.0154	0.0141	0.0433	
70	0.085	3750	5.85	98179	74609	0.0195	0.0192	29.2	16.8	25.51	28.19	26.47	0.0151	0.0167	0.0157	0.0474	
72	0.116	3750	5.85	134109	101913	0.0187	0.0180	29.2	16.8	24.39	26.46	26.47	0.0197	0.0214	0.0214	0.0625	
73	0.078	3750	5.85	89766	68216	0.0198	0.0196	29.2	16.8	25.86	28.72	26.47	0.0140	0.0155	0.0143	0.0438	
74	0.080	3750	5.85	92584	70357	0.0197	0.0194	29.2	16.8	25.74	28.54	26.47	0.0144	0.0159	0.0148	0.0450	
76	0.078	3750	5.85	89932	68342	0.0198	0.0195	29.2	16.8	25.86	28.71	26.47	0.0140	0.0156	0.0143	0.0439	
77	0.078	3750	5.85	89812	68251	0.0198	0.0196	29.2	16.8	25.86	28.72	26.47	0.0140	0.0155	0.0143	0.0438	
78	0.076	3750	5.85	87991	66867	0.0199	0.0196	29.2	16.8	25.95	28.84	26.47	0.0137	0.0153	0.0140	0.0431	
79	0.076	3750	5.85	87775	66702	0.0199	0.0196	29.2	16.8	25.96	28.86	26.47	0.0137	0.0153	0.0140	0.0430	
81	0.078	3750	5.85	90246	68580	0.0198	0.0195	29.2	16.8	25.84	28.69	26.47	0.0140	0.0156	0.0144	0.0440	
82	0.076	3750	5.85	88008	66880	0.0199	0.0196	29.2	16.8	25.94	28.84	26.47	0.0138	0.0153	0.0140	0.0431	
83	0.076	3750	5.85	88008	66880	0.0199	0.0196	29.2	16.8	25.94	28.84	26.47	0.0138	0.0153	0.0140	0.0431	
84	0.076	3750	5.85	88008	66880	0.0199	0.0196	29.2	16.8	25.94	28.84	26.47	0.0138	0.0153	0.0140	0.0431	
85	0.076	3750	5.85	88128	66971	0.0199	0.0196	29.2	16.8	25.94	28.84	26.47	0.0138	0.0153	0.0141	0.0431	
87	0.078	3750	5.85	89400	67938	0.0198	0.0196	29.2	16.8	25.88	28.75	26.47	0.0139	0.0155	0.0143	0.0437	
91	0.076	3750	5.85	87775	66702	0.0199	0.0196	29.2	16.8	25.96	28.86	26.47	0.0137	0.0153	0.0140	0.0430	
92	0.080	3750	5.85	92584	70357	0.0197	0.0194	29.2	16.8	25.74	28.54	26.47	0.0144	0.0159	0.0148	0.0450	
93	0.077	3750	5.85	89344	67895	0.0198	0.0196	29.2	16.8	25.88	28.75	26.47	0.0139	0.0155	0.0142	0.0436	
94	0.076	3750	5.85	87919	66812	0.0199	0.0196	29.2	16.8	25.95	28.85	26.47	0.0137	0.0153	0.0140	0.0430	
95	0.076	3750	5.85	88018	66888	0.0199	0.0196	29.2	16.8	25.94	28.84	26.47	0.0138	0.0153	0.0140	0.0431	
100	0.076	3750	5.85	88167	67001	0.0199	0.0196	29.2	16.8	25.94	28.83	26.47	0.0138	0.0153	0.0141	0.0431	
101	0.077	3750	5.85	88285	67090	0.0199	0.0196	29.2	16.8	25.93	28.82	26.47	0.0138	0.0153	0.0141	0.0432	
111	0.078	3750	5.85	89711	68174	0.0198	0.0196	29.2	16.8	25.87	28.73	26.47	0.0140	0.0155	0.0143	0.0438	
112	0.103	3750	5.85	118772	90259	0.0190	0.0185	29.2	16.8	24.80	27.11	26.47	0.0177	0.0194	0.0189	0.0561	
113	0.079	3750	5.85	91156	69272	0.0198	0.0195	29.2	16.8	25.80	28.63	26.47	0.0142	0.0157	0.0145	0.0444	
119	0.077	3750	5.85	88522	67271	0.0199	0.0196	29.2	16.8	25.92	28.81	26.47	0.0138	0.0154	0.0141	0.0433	
124	0.076	3750	5.85	87775	66702	0.0199	0.0196	29.2	16.8	25.96	28.86	26.47	0.0137	0.0153	0.0140	0.0430	
128	0.077	3750	5.85	88501	67254	0.0199	0.0196	29.2	16.8	25.92	28.81	26.47	0.0138	0.0154	0.0141	0.0433	
130	0.076	3750	5.85	87775	66702	0.0199	0.0196	29.2	16.8	25.96	28.86	26.47	0.0137	0.0153	0.0140	0.0430	
131	0.078	3750	5.85	89888	68309	0.0198	0.0196	29.2	16.8	25.86	28.72	26.47	0.0140	0.0155	0.0143	0.0439	
132	0.076	3750	5.85	88008	66880	0.0199	0.0196	29.2	16.8	25.94	28.84	26.47	0.0138	0.0153	0.0140	0.0431	
133	0.076	3750	5.85	88038	66903	0.0199	0.0196	29.2	16.8	25.94	28.84	26.47	0.0138	0.0153	0.0140	0.0431	

134	0.076	3750	5.85	88038	66903	0.0199	0.0196	29.2	16.8	25.94	28.84	26.47	0.0138	0.0153	0.0140	0.0431
136	0.077	3750	5.85	89152	67749	0.0198	0.0196	29.2	16.8	25.89	28.77	26.47	0.0139	0.0154	0.0142	0.0436
139	0.102	3750	5.85	117688	89435	0.0190	0.0185	29.2	16.8	24.83	27.16	26.47	0.0176	0.0193	0.0188	0.0556
140	0.102	3750	5.85	117688	89435	0.0190	0.0185	29.2	16.8	24.83	27.16	26.47	0.0176	0.0193	0.0188	0.0556
145	0.077	3750	5.85	88296	67099	0.0199	0.0196	29.2	16.8	25.93	28.82	26.47	0.0138	0.0153	0.0141	0.0432
146	0.077	3750	5.85	88296	67099	0.0199	0.0196	29.2	16.8	25.93	28.82	26.47	0.0138	0.0153	0.0141	0.0432
147	0.240	3750	5.85	276254	209933	0.0172	0.0157	29.2	16.8	22.42	23.09	26.47	0.0373	0.0384	0.0440	0.1198
155	0.076	3750	5.85	87775	66702	0.0199	0.0196	29.2	16.8	25.96	28.86	26.47	0.0137	0.0153	0.0140	0.0430
156	0.119	3750	5.85	137523	104508	0.0186	0.0179	29.2	16.8	24.31	26.32	26.47	0.0201	0.0218	0.0219	0.0639
157	0.079	3750	5.85	91546	69569	0.0197	0.0195	29.2	16.8	25.78	28.61	26.47	0.0142	0.0158	0.0146	0.0446
158	0.086	3750	5.85	99155	75351	0.0195	0.0192	29.2	16.8	25.47	28.13	26.47	0.0152	0.0168	0.0158	0.0478
160	0.083	3750	5.85	96098	73028	0.0196	0.0193	29.2	16.8	25.59	28.32	26.47	0.0148	0.0164	0.0153	0.0465
161	0.078	3750	5.85	89413	67948	0.0198	0.0196	29.2	16.8	25.88	28.75	26.47	0.0139	0.0155	0.0143	0.0437
162	0.090	3750	5.85	104032	79057	0.0194	0.0190	29.2	16.8	25.29	27.85	26.47	0.0158	0.0175	0.0166	0.0499
163	0.083	3750	5.85	95551	72612	0.0196	0.0193	29.2	16.8	25.61	28.35	26.47	0.0147	0.0163	0.0152	0.0463
166	0.076	3750	5.85	87840	66752	0.0199	0.0196	29.2	16.8	25.95	28.86	26.47	0.0137	0.0153	0.0140	0.0430
169	0.077	3750	5.85	88999	67633	0.0198	0.0196	29.2	16.8	25.90	28.78	26.47	0.0139	0.0154	0.0142	0.0435
172	0.076	3750	5.85	87993	66868	0.0199	0.0196	29.2	16.8	25.95	28.84	26.47	0.0138	0.0153	0.0140	0.0431
178	0.076	3750	5.85	87980	66859	0.0199	0.0196	29.2	16.8	25.95	28.85	26.47	0.0137	0.0153	0.0140	0.0431
180	0.076	3750	5.85	87980	66859	0.0199	0.0196	29.2	16.8	25.95	28.85	26.47	0.0137	0.0153	0.0140	0.0431
184	0.079	3750	5.85	90916	69090	0.0198	0.0195	29.2	16.8	25.81	28.65	26.47	0.0141	0.0157	0.0145	0.0443
186	0.076	3750	5.85	88154	66991	0.0199	0.0196	29.2	16.8	25.94	28.83	26.47	0.0138	0.0153	0.0141	0.0431
190	0.086	3750	5.85	99155	75351	0.0195	0.0192	29.2	16.8	25.47	28.13	26.47	0.0152	0.0168	0.0158	0.0478
191	0.080	3750	5.85	92554	70335	0.0197	0.0194	29.2	16.8	25.74	28.54	26.47	0.0143	0.0159	0.0148	0.0450
194	0.076	3750	5.85	88073	66929	0.0199	0.0196	29.2	16.8	25.94	28.84	26.47	0.0138	0.0153	0.0140	0.0431
195	0.077	3750	5.85	88425	67197	0.0199	0.0196	29.2	16.8	25.93	28.82	26.47	0.0138	0.0153	0.0141	0.0433
197	0.217	3750	5.85	250350	190248	0.0173	0.0160	29.2	16.8	22.64	23.50	26.47	0.0341	0.0354	0.0399	0.1095
198	0.217	3750	5.85	250350	190248	0.0173	0.0160	29.2	16.8	22.64	23.50	26.47	0.0341	0.0354	0.0399	0.1095
199	0.217	3750	5.85	250350	190248	0.0173	0.0160	29.2	16.8	22.64	23.50	26.47	0.0341	0.0354	0.0399	0.1095
200	0.217	3750	5.85	250350	190248	0.0173	0.0160	29.2	16.8	22.64	23.50	26.47	0.0341	0.0354	0.0399	0.1095
201	0.217	3750	5.85	250350	190248	0.0173	0.0160	29.2	16.8	22.64	23.50	26.47	0.0341	0.0354	0.0399	0.1095
202	0.217	3750	5.85	250350	190248	0.0173	0.0160	29.2	16.8	22.64	23.50	26.47	0.0341	0.0354	0.0399	0.1095
203	0.217	3750	5.85	250350	190248	0.0173	0.0160	29.2	16.8	22.64	23.50	26.47	0.0341	0.0354	0.0399	0.1095
204	0.076	3750	5.85	87775	66702	0.0199	0.0196	29.2	16.8	25.96	28.86	26.47	0.0137	0.0153	0.0140	0.0430
217	0.105	3750	5.85	120967	91926	0.0189	0.0184	29.2	16.8	24.74	27.01	26.47	0.0180	0.0197	0.0193	0.0570
218	0.105	3750	5.85	120967	91926	0.0189	0.0184	29.2	16.8	24.74	27.01	26.47	0.0180	0.0197	0.0193	0.0570
219	0.076	3750	5.85	87964	66846	0.0199	0.0196	29.2	16.8	25.95	28.85	26.47	0.0137	0.0153	0.0140	0.0431
220	0.077	3750	5.85	88425	67197	0.0199	0.0196	29.2	16.8	25.93	28.82	26.47	0.0138	0.0153	0.0141	0.0433
221	0.077	3750	5.85	88425	67197	0.0199	0.0196	29.2	16.8	25.93	28.82	26.47	0.0138	0.0153	0.0141	0.0433
222	0.109	3750	5.85	125492	95365	0.0189	0.0183	29.2	16.8	24.61	26.81	26.47	0.0186	0.0203	0.0200	0.0589
223	0.108	3750	5.85	124191	94377	0.0189	0.0183	29.2	16.8	24.65	26.87	26.47	0.0184	0.0201	0.0198	0.0583
224	0.078	3750	5.85	90213	68556	0.0198	0.0195	29.2	16.8	25.84	28.69	26.47	0.0140	0.0156	0.0144	0.0440
229	0.142	3750	5.85	163643	124357	0.0182	0.0173	29.2	16.8	23.76	25.44	26.47	0.0234	0.0251	0.0261	0.0746
230	0.142	3750	5.85	163643	124357	0.0182	0.0173	29.2	16.8	23.76	25.44	26.47	0.0234	0.0251	0.0261	0.0746
231	0.076	3750	5.85	87937	66826	0.0199	0.0196	29.2	16.8	25.95	28.85	26.47	0.0137	0.0153	0.0140	0.0430
232	0.088	3750	5.85	101431	77080	0.0194	0.0191	29.2	16.8	25.38	28.00	26.47	0.0155	0.0171	0.0162	0.0488
234	0.148	3750	5.85	170146	129299	0.0181	0.0172	29.2	16.8	23.65	25.25	26.47	0.0242	0.0259	0.0271	0.0772
235	0.149	3750	5.85	172205	130864	0.0181	0.0172	29.2	16.8	23.61	25.20	26.47	0.0245	0.0261	0.0275	0.0781
236	0.149	3750	5.85	172205	130864	0.0181	0.0172	29.2	16.8	23.61	25.20	26.47	0.0245	0.0261	0.0275	0.0781
238	0.076	3750	5.85	87780	66707	0.0199	0.0196	29.2	16.8	25.96	28.86	26.47	0.0137	0.0153	0.0140	0.0430
243	0.076	3750	5.85	87978	66857	0.0199	0.0196	29.2	16.8	25.95	28.85	26.47	0.0137	0.0153	0.0140	0.0431
244	0.078	3750	5.85	90430	68720	0.0198	0.0195	29.2	16.8	25.83	28.68	26.47	0.0141	0.0156	0.0144	0.0441
245	0.216	3750	5.85	249185	189363	0.0174	0.0160	29.2	16.8	22.65	23.52	26.47	0.0340	0.0353	0.0397	0.1090
246	0.124	3750	5.85	143050	108708	0.0185	0.0178	29.2	16.8	24.18	26.12	26.47	0.0208	0.0225	0.0228	0.0661
247	0.078	3750	5.85	89400	67938	0.0198	0.0196	29.2	16.8	25.88	28.75	26.47	0.0139	0.0155	0.0143	0.0437
249	0.079	3750	5.85	90620	68865	0.0198	0.0195	29.2	16.8	25.83	28.67	26.47	0.0141	0.0156	0.0144	0.0442
263	0.122	3750	5.85	140666	106896	0.0186	0.0178	29.2	16.8	24.23	26.21	26.47	0.0205	0.0222	0.0224	0.0652
265	0.079	3750	5.85	91367	69433	0.0198	0.0195	29.2	16.8	25.79	28.62	26.47	0.0142	0.0157	0.0146	0.0445
266	0.082	3750	5.85	94874	72098	0.0196	0.0193	29.2	16.8	25.64	28.39	26.47	0.0147	0.0162	0.0151	0.0460
267	0.081	3750	5.85	93647	71165	0.0197	0.0194	29.2	16.8	25.69	28.47	26.47	0.0145	0.0161	0.0149	0.0455
271	0.088	3750	5.85	100916	76689	0.0195	0.0191	29.2	16.8	25.40	28.03	26.47	0.0154	0.0170	0.0161	0.0486
273	0.091	3750	5.85	105050	79830	0.0193	0.0189	29.2	16.8	25.25	27.80	26.47	0.0160	0.0176	0.0167	0.0503
274	0.108	3750	5.85	124354	94500	0.0189	0.0183	29.2	16.8	24.64	26.86	26.47	0.0185	0.0201	0.0198	0.0584
275	0.208	3750	5.85	239440	181958	0.0174	0.0161	29.2	16.8	22.75	23.69	26.47	0.0328	0.0342	0.0382	0.1051
276	0.077	3750	5.85	89043	67666	0.0198	0.0196	29.2	16.8	25.90	28.77	26.47	0.0139	0.0154	0.0142	0.0435
278	0.089	3750	5.85	103043	78305	0.0194	0.0190	29.2	16.8	25.32	27.91	26.47	0.0157	0.0173	0.0164	0.0495
281	0.076	3750	5.85	87986	66863	0.0199	0.0196	29.2	16.8	25.95	28.85	26.47	0.0137	0.0153	0.0140	0.0431
283	0.132	3750	5.85	152642	115997	0.0184	0.0176	29.2	16.8	23.97	25.79	26.47	0.0220	0.0237	0.0243	0.0701
284	0.152	3750	5.85	175191	133133	0.0180	0.0171	29.2	16.8	23.56	25.11	26.47	0.0249	0.0265	0.0279	0.0793

286	0.077	3750	5.85	88230	67048	0.0199	0.0196	29.2	16.8	25.93	28.83	26.47	0.0138	0.0153	0.0141	0.0432
288	0.079	3750	5.85	91351	69420	0.0198	0.0195	29.2	16.8	25.79	28.62	26.47	0.0142	0.0157	0.0146	0.0445
289	0.079	3750	5.85	91183	69293	0.0198	0.0195	29.2	16.8	25.80	28.63	26.47	0.0142	0.0157	0.0145	0.0444
295	0.078	3750	5.85	90484	68762	0.0198	0.0195	29.2	16.8	25.83	28.68	26.47	0.0141	0.0156	0.0144	0.0441
296	0.079	3750	5.85	91351	69420	0.0198	0.0195	29.2	16.8	25.79	28.62	26.47	0.0142	0.0157	0.0146	0.0445
297	0.079	3750	5.85	91172	69285	0.0198	0.0195	29.2	16.8	25.80	28.63	26.47	0.0142	0.0157	0.0145	0.0444
300	0.080	3750	5.85	92749	70483	0.0197	0.0194	29.2	16.8	25.73	28.53	26.47	0.0144	0.0159	0.0148	0.0451
301	0.080	3750	5.85	92749	70483	0.0197	0.0194	29.2	16.8	25.73	28.53	26.47	0.0144	0.0159	0.0148	0.0451
304	0.082	3750	5.85	94034	71459	0.0197	0.0194	29.2	16.8	25.68	28.44	26.47	0.0145	0.0161	0.0150	0.0456
305	0.078	3750	5.85	89942	68350	0.0198	0.0195	29.2	16.8	25.86	28.71	26.47	0.0140	0.0156	0.0143	0.0439
306	0.078	3750	5.85	89942	68350	0.0198	0.0195	29.2	16.8	25.86	28.71	26.47	0.0140	0.0156	0.0143	0.0439
307	0.078	3750	5.85	89942	68350	0.0198	0.0195	29.2	16.8	25.86	28.71	26.47	0.0140	0.0156	0.0143	0.0439
309	0.076	3750	5.85	88132	66974	0.0199	0.0196	29.2	16.8	25.94	28.84	26.47	0.0138	0.0153	0.0141	0.0431
316	0.087	3750	5.85	100190	76137	0.0195	0.0191	29.2	16.8	25.43	28.07	26.47	0.0153	0.0169	0.0160	0.0483
317	0.087	3750	5.85	100190	76137	0.0195	0.0191	29.2	16.8	25.43	28.07	26.47	0.0153	0.0169	0.0160	0.0483
318	0.076	3750	5.85	87991	66867	0.0199	0.0196	29.2	16.8	25.95	28.84	26.47	0.0137	0.0153	0.0140	0.0431
319	0.076	3750	5.85	87963	66846	0.0199	0.0196	29.2	16.8	25.95	28.85	26.47	0.0137	0.0153	0.0140	0.0431
320	0.076	3750	5.85	87963	66846	0.0199	0.0196	29.2	16.8	25.95	28.85	26.47	0.0137	0.0153	0.0140	0.0431
321	0.088	3750	5.85	101919	77451	0.0194	0.0190	29.2	16.8	25.36	27.97	26.47	0.0156	0.0172	0.0163	0.0490
322	0.090	3750	5.85	103273	78481	0.0194	0.0190	29.2	16.8	25.31	27.90	26.47	0.0157	0.0174	0.0165	0.0496
324	0.076	3750	5.85	87963	66846	0.0199	0.0196	29.2	16.8	25.95	28.85	26.47	0.0137	0.0153	0.0140	0.0431
325	0.076	3750	5.85	87963	66846	0.0199	0.0196	29.2	16.8	25.95	28.85	26.47	0.0137	0.0153	0.0140	0.0431
364	0.095	3750	5.85	109018	82846	0.0192	0.0188	29.2	16.8	25.11	27.59	26.47	0.0165	0.0181	0.0174	0.0520
366	0.078	3750	5.85	89725	68185	0.0198	0.0196	29.2	16.8	25.87	28.73	26.47	0.0140	0.0155	0.0143	0.0438
367	0.078	3750	5.85	89725	68185	0.0198	0.0196	29.2	16.8	25.87	28.73	26.47	0.0140	0.0155	0.0143	0.0438
366	0.078	3750	5.85	89725	68185	0.0198	0.0196	29.2	16.8	25.87	28.73	26.47	0.0140	0.0155	0.0143	0.0438
382	0.078	3750	5.85	89725	68185	0.0198	0.0196	29.2	16.8	25.87	28.73	26.47	0.0140	0.0155	0.0143	0.0438
383	0.084	3750	5.85	96749	73522	0.0196	0.0193	29.2	16.8	25.57	28.28	26.47	0.0149	0.0165	0.0154	0.0468
389	0.076	3750	5.85	87775	66702	0.0199	0.0196	29.2	16.8	25.96	28.86	26.47	0.0137	0.0153	0.0140	0.0430
403	0.076	3750	5.85	87775	66702	0.0199	0.0196	29.2	16.8	25.96	28.86	26.47	0.0137	0.0153	0.0140	0.0430
418	0.082	3750	5.85	94928	72138	0.0196	0.0193	29.2	16.8	25.64	28.39	26.47	0.0147	0.0162	0.0151	0.0460
429	0.076	3750	5.85	88147	66986	0.0199	0.0196	29.2	16.8	25.94	28.83	26.47	0.0138	0.0153	0.0141	0.0431
432	0.270	3750	5.85	311036	236366	0.0170	0.0154	29.2	16.8	22.17	22.61	26.47	0.0415	0.0424	0.0496	0.1335
433	0.347	3750	5.85	399903	303899	0.0166	0.0148	29.2	16.8	21.70	21.67	26.47	0.0523	0.0522	0.0638	0.1682
434	0.265	3750	5.85	305183	231918	0.0170	0.0154	29.2	16.8	22.21	22.69	26.47	0.0408	0.0417	0.0487	0.1312
436	0.310	3750	5.85	356903	271221	0.0168	0.0150	29.2	16.8	21.90	22.09	26.47	0.0471	0.0475	0.0569	0.1515
437	0.310	3750	5.85	356903	271221	0.0168	0.0150	29.2	16.8	21.90	22.09	26.47	0.0471	0.0475	0.0569	0.1515
442	0.082	3750	5.85	94792	72036	0.0196	0.0193	29.2	16.8	25.65	28.40	26.47	0.0146	0.0162	0.0151	0.0459
448	0.080	3750	5.85	92018	69927	0.0197	0.0195	29.2	16.8	25.76	28.57	26.47	0.0143	0.0158	0.0147	0.0448
457	0.076	3750	5.85	87775	66702	0.0199	0.0196	29.2	16.8	25.96	28.86	26.47	0.0137	0.0153	0.0140	0.0430
458	0.084	3750	5.85	96922	73654	0.0196	0.0192	29.2	16.8	25.56	28.27	26.47	0.0149	0.0165	0.0155	0.0469
464	0.097	3750	5.85	112356	85383	0.0191	0.0187	29.2	16.8	25.00	27.42	26.47	0.0169	0.0186	0.0179	0.0534
465	0.098	3750	5.85	113039	85902	0.0191	0.0186	29.2	16.8	24.98	27.38	26.47	0.0170	0.0186	0.0180	0.0537
466	0.091	3750	5.85	105170	79922	0.0193	0.0189	29.2	16.8	25.25	27.79	26.47	0.0160	0.0176	0.0168	0.0504
467	0.082	3750	5.85	94733	71990	0.0196	0.0193	29.2	16.8	25.65	28.40	26.47	0.0146	0.0162	0.0151	0.0459
468	0.079	3750	5.85	91178	69289	0.0198	0.0195	29.2	16.8	25.80	28.63	26.47	0.0142	0.0157	0.0145	0.0444
469	0.076	3750	5.85	87956	66840	0.0199	0.0196	29.2	16.8	25.95	28.85	26.47	0.0137	0.0153	0.0140	0.0431
473	0.076	3750	5.85	87862	66769	0.0199	0.0196	29.2	16.8	25.95	28.85	26.47	0.0137	0.0153	0.0140	0.0430
476	0.083	3750	5.85	95779	72785	0.0196	0.0193	29.2	16.8	25.60	28.34	26.47	0.0148	0.0163	0.0153	0.0464
478	0.076	3750	5.85	87775	66702	0.0199	0.0196	29.2	16.8	25.96	28.86	26.47	0.0137	0.0153	0.0140	0.0430
468	0.076	3750	5.85	87945	66832	0.0199	0.0196	29.2	16.8	25.95	28.85	26.47	0.0137	0.0153	0.0140	0.0430
493	0.076	3750	5.85	87775	66702	0.0199	0.0196	29.2	16.8	25.96	28.86	26.47	0.0137	0.0153	0.0140	0.0430
494	0.076	3750	5.85	88087	66940	0.0199	0.0196	29.2	16.8	25.94	28.84	26.47	0.0138	0.0153	0.0140	0.0431
496	0.076	3750	5.85	88083	66937	0.0199	0.0196	29.2	16.8	25.94	28.84	26.47	0.0138	0.0153	0.0140	0.0431
497	0.077	3750	5.85	88546	67289	0.0199	0.0196	29.2	16.8	25.92	28.81	26.47	0.0138	0.0154	0.0141	0.0433
499	0.091	3750	5.85	105170	79922	0.0193	0.0189	29.2	16.8	25.25	27.79	26.47	0.0160	0.0176	0.0168	0.0504
502	0.077	3750	5.85	88408	67184	0.0199	0.0196	29.2	16.8	25.93	28.82	26.47	0.0138	0.0153	0.0141	0.0432
503	0.077	3750	5.85	88360	67147	0.0199	0.0196	29.2	16.8	25.93	28.82	26.47	0.0138	0.0153	0.0141	0.0432
505	0.076	3750	5.85	88095	66946	0.0199	0.0196	29.2	16.8	25.94	28.84	26.47	0.0138	0.0153	0.0140	0.0431
506	0.076	3750	5.85	88061	66920	0.0199	0.0196	29.2	16.8	25.94	28.84	26.47	0.0138	0.0153	0.0140	0.0431
508	0.077	3750	5.85	88273	67081	0.0199	0.0196	29.2	16.8	25.93	28.83	26.47	0.0138	0.0153	0.0141	0.0432
509	0.076	3750	5.85	88000	66874	0.0199	0.0196	29.2	16.8	25.94	28.84	26.47	0.0138	0.0153	0.0140	0.0431
519	0.078	3750	5.85	90202	68547	0.0198	0.0195	29.2	16.8	25.84	28.69	26.47	0.0140	0.0156	0.0144	0.0440
520	0.078	3750	5.85	90157	68513	0.0198	0.0195	29.2	16.8	25.85	28.70	26.47	0.0140	0.0156	0.0144	0.0440
521	0.078	3750	5.85	90157	68513	0.0198	0.0195	29.2	16.8	25.85	28.70	26.47	0.0140	0.0156	0.0144	0.0440
522	0.078	3750	5.85	90157	68513	0.0198	0.0195	29.2	16.8	25.85	28.70	26.47	0.0140	0.0156	0.0144	0.0440
529	0.076	3750	5.85	87775	66702	0.0199	0.0196	29.2	16.8	25.96	28.86	26.47	0.0137	0.0153	0.0140	0.0430
533	0.077	3750	5.85	88945	67592	0.0198	0.0196	29.2	16.8	25.90	28.78	26.47	0.0139	0.0154	0.0142	0.0435
534	0.076	3750	5.85	88042	66906	0.0199	0.0196	29.2	16.8	25.94	28.84	26.47	0.0138	0.0153	0.0140	0.0431

546	0.083	3750	5.85		95126	72289		0.0196	0.0193		29.2	16.8			25.63	28.38	26.47				0.0147	0.0163	0.0152	0.0461
547	0.083	3750	5.85		95126	72289		0.0196	0.0193		29.2	16.8			25.63	28.38	26.47				0.0147	0.0163	0.0152	0.0461
548	0.081	3750	5.85		93541	71084		0.0197	0.0194		29.2	16.8			25.70	28.48	26.47				0.0145	0.0160	0.0149	0.0454
549	0.083	3750	5.85		95126	72289		0.0196	0.0193		29.2	16.8			25.63	28.38	26.47				0.0147	0.0163	0.0152	0.0461
550	0.077	3750	5.85		89216	67798		0.0198	0.0196		29.2	16.8			25.89	28.76	26.47				0.0139	0.0155	0.0142	0.0436

MAX ΔP:	0.1682
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P-V valve vacuum setting: 0.5 psi
80% of P-V valve setting: 0.4 psi

Maximum pressure drop to shore connection: 0.168 psi

TOTAL PRESSURE DROP TO SHORE CONNECTION: 0.168 psi OK

Max. allowable back pressure at facility: 0.232 psi

Pressure Drop through VCS - From #1 Cargo Tank to Shore Connection (per 46 CFR 39.30-1(d)(3) and ABS SBR 5-2-3/7.5.2(c))

Pipe sizes, nominal: 8 in
 Pipe ID: 7.981 in
 Pipe Flow Area: 50.03 in²
 Vapor Dynamic Viscosity: 0.019 centipoise (estimated, based on air @ 115F, Crane 410, Table A-5)

PIPE LENGTH

Length (ft): 221.94 ft 8" pipe
 Length (ft): 50.00 ft 6" hose
 f, friction factor (pipe): Varies with Reynold's Number (see table below)

VALVE & FITTING EQUIVALENT LENGTH

Equivalent Length (ft): 285.74 ft
 f_v, friction factor, turbulent flow (fittings): 0.014 constant, for each pipe size

Shore Connection Pressure Drop (at 100% of Maximum Liquid Discharge Rate) 5000 BBL/hr

Cargo	Vapor-Air Mix. Density (lb/ft ³)	Vapor Flow Rate		Reynold's Number		Friction Factor		Vapor Velocity		Head Loss			Component ΔP				ΔP
		BBL/hr	ft ³ /s	6" Hose	8" Pipe	6" Hose	8" Pipe	6" Hose	8" Pipe	6" Hose	8" Pipe	8" Fittings	6" Hose	8" Pipe	8" Fittings	TOTAL	
1	0.123	5000	7.80	189288	143846	0.0179	0.0181	38.9	22.4	41.51	47.24	47.06	0.0355	0.0404	0.0402	0.1161	
2	0.085	5000	7.80	130646	99282	0.0187	0.0181	38.9	22.4	43.51	47.28	47.06	0.0257	0.0279	0.0278	0.0814	
19	0.082	5000	7.80	125331	95242	0.0189	0.0183	38.9	22.4	43.76	47.67	47.06	0.0248	0.0270	0.0266	0.0784	
20	0.079	5000	7.80	121455	92297	0.0189	0.0184	38.9	22.4	43.95	47.98	47.06	0.0241	0.0263	0.0258	0.0763	
21	0.079	5000	7.80	121455	92297	0.0189	0.0184	38.9	22.4	43.95	47.98	47.06	0.0241	0.0263	0.0258	0.0763	
23	0.079	5000	7.80	121455	92297	0.0189	0.0184	38.9	22.4	43.95	47.98	47.06	0.0241	0.0263	0.0258	0.0763	
24	0.079	5000	7.80	121455	92297	0.0189	0.0184	38.9	22.4	43.95	47.98	47.06	0.0241	0.0263	0.0258	0.0763	
26	0.079	5000	7.80	121455	92297	0.0189	0.0184	38.9	22.4	43.95	47.98	47.06	0.0241	0.0263	0.0258	0.0763	
34	0.077	5000	7.80	119005	90436	0.0190	0.0185	38.9	22.4	44.08	48.18	47.06	0.0237	0.0259	0.0253	0.0749	
40	0.085	5000	7.80	130039	98820	0.0188	0.0181	38.9	22.4	43.54	47.32	47.06	0.0256	0.0278	0.0276	0.0810	
42	0.097	5000	7.80	149548	113646	0.0184	0.0176	38.9	22.4	42.73	46.03	47.06	0.0289	0.0311	0.0318	0.0918	
44	0.083	5000	7.80	127438	96844	0.0188	0.0182	38.9	22.4	43.66	47.52	47.06	0.0251	0.0274	0.0271	0.0796	
46	0.086	5000	7.80	132062	100358	0.0187	0.0181	38.9	22.4	43.45	47.18	47.06	0.0259	0.0281	0.0281	0.0821	
47	0.097	5000	7.80	149403	113536	0.0184	0.0176	38.9	22.4	42.74	46.04	47.06	0.0288	0.0311	0.0318	0.0917	
48	0.077	5000	7.80	117741	89475	0.0190	0.0185	38.9	22.4	44.15	48.28	47.06	0.0235	0.0257	0.0250	0.0742	
58	0.078	5000	7.80	120002	91193	0.0190	0.0184	38.9	22.4	44.03	48.09	47.06	0.0239	0.0261	0.0255	0.0754	
64	0.077	5000	7.80	118080	89733	0.0190	0.0185	38.9	22.4	44.13	48.25	47.06	0.0235	0.0257	0.0251	0.0744	
70	0.085	5000	7.80	130906	99479	0.0187	0.0181	38.9	22.4	43.50	47.26	47.06	0.0257	0.0279	0.0278	0.0815	
72	0.116	5000	7.80	178811	135884	0.0180	0.0170	38.9	22.4	41.79	44.47	47.06	0.0338	0.0359	0.0380	0.1077	
73	0.078	5000	7.80	119688	90955	0.0190	0.0184	38.9	22.4	44.05	48.12	47.06	0.0238	0.0260	0.0254	0.0753	
74	0.080	5000	7.80	123445	93810	0.0189	0.0183	38.9	22.4	43.85	47.82	47.06	0.0245	0.0267	0.0262	0.0774	
76	0.078	5000	7.80	119910	91123	0.0190	0.0184	38.9	22.4	44.03	48.10	47.06	0.0239	0.0261	0.0255	0.0754	
77	0.078	5000	7.80	119749	91001	0.0190	0.0184	38.9	22.4	44.04	48.11	47.06	0.0238	0.0260	0.0255	0.0753	
78	0.076	5000	7.80	117322	89156	0.0190	0.0185	38.9	22.4	44.17	48.31	47.06	0.0234	0.0256	0.0249	0.0740	
79	0.076	5000	7.80	117033	88937	0.0190	0.0185	38.9	22.4	44.19	48.34	47.06	0.0234	0.0256	0.0249	0.0738	
81	0.078	5000	7.80	120328	91440	0.0190	0.0184	38.9	22.4	44.01	48.07	47.06	0.0239	0.0261	0.0256	0.0756	
82	0.076	5000	7.80	117343	89173	0.0190	0.0185	38.9	22.4	44.17	48.31	47.06	0.0234	0.0256	0.0249	0.0740	
83	0.076	5000	7.80	117343	89173	0.0190	0.0185	38.9	22.4	44.17	48.31	47.06	0.0234	0.0256	0.0249	0.0740	
84	0.076	5000	7.80	117343	89173	0.0190	0.0185	38.9	22.4	44.17	48.31	47.06	0.0234	0.0256	0.0249	0.0740	
85	0.076	5000	7.80	117504	89295	0.0190	0.0185	38.9	22.4	44.16	48.30	47.06	0.0234	0.0256	0.0250	0.0741	
87	0.078	5000	7.80	119200	90584	0.0190	0.0184	38.9	22.4	44.07	48.16	47.06	0.0237	0.0259	0.0253	0.0750	
91	0.076	5000	7.80	117033	88937	0.0190	0.0185	38.9	22.4	44.19	48.34	47.06	0.0234	0.0256	0.0249	0.0738	
92	0.080	5000	7.80	123445	93810	0.0189	0.0183	38.9	22.4	43.85	47.82	47.06	0.0245	0.0267	0.0262	0.0774	
93	0.077	5000	7.80	119125	90527	0.0190	0.0184	38.9	22.4	44.07	48.17	47.06	0.0237	0.0259	0.0253	0.0750	
94	0.076	5000	7.80	117225	89083	0.0190	0.0185	38.9	22.4	44.18	48.32	47.06	0.0234	0.0256	0.0249	0.0739	
95	0.076	5000	7.80	117358	89184	0.0190	0.0185	38.9	22.4	44.17	48.31	47.06	0.0234	0.0256	0.0249	0.0740	
100	0.076	5000	7.80	117556	89334	0.0190	0.0185	38.9	22.4	44.16	48.30	47.06	0.0234	0.0256	0.0250	0.0741	
101	0.077	5000	7.80	117713	89454	0.0190	0.0185	38.9	22.4	44.15	48.28	47.06	0.0235	0.0257	0.0250	0.0742	
111	0.078	5000	7.80	119614	90899	0.0190	0.0184	38.9	22.4	44.05	48.13	47.06	0.0238	0.0260	0.0254	0.0752	
112	0.103	5000	7.80	158363	120345	0.0183	0.0174	38.9	22.4	42.42	45.52	47.06	0.0303	0.0326	0.0337	0.0966	
113	0.079	5000	7.80	121541	92363	0.0189	0.0184	38.9	22.4	43.95	47.97	47.06	0.0241	0.0263	0.0258	0.0763	
119	0.077	5000	7.80	118030	89694	0.0190	0.0185	38.9	22.4	44.13	48.26	47.06	0.0235	0.0257	0.0251	0.0743	
124	0.076	5000	7.80	117033	88937	0.0190	0.0185	38.9	22.4	44.19	48.34	47.06	0.0234	0.0256	0.0249	0.0738	
128	0.077	5000	7.80	118001	89672	0.0190	0.0185	38.9	22.4	44.13	48.26	47.06	0.0235	0.0257	0.0251	0.0743	
130	0.076	5000	7.80	117033	88937	0.0190	0.0185	38.9	22.4	44.19	48.34	47.06	0.0234	0.0256	0.0249	0.0738	
131	0.078	5000	7.80	119851	91078	0.0190	0.0184	38.9	22.4	44.04	48.11	47.06	0.0238	0.0260	0.0255	0.0754	
132	0.076	5000	7.80	117344	89173	0.0190	0.0185	38.9	22.4	44.17	48.31	47.06	0.0234	0.0256	0.0249	0.0740	
133	0.076	5000	7.80	117384	89203	0.0190	0.0185	38.9	22.4	44.17	48.31	47.06	0.0234	0.0256	0.0250	0.0740	

134	0.076	5000	7.80		117385	89204		0.0190	0.0185		38.9	22.4					44.17	48.31	47.06																0.0234	0.0256	0.0250	0.0740									
136	0.077	5000	7.80		118869	90332		0.0190	0.0185		38.9	22.4					44.09	48.19	47.06																	0.0237	0.0259	0.0253	0.0748								
139	0.102	5000	7.80		156918	119247		0.0183	0.0175		38.9	22.4					42.47	45.60	47.06																	0.0301	0.0323	0.0334	0.0958								
140	0.102	5000	7.80		156918	119247		0.0183	0.0175		38.9	22.4					42.47	45.60	47.06																		0.0301	0.0323	0.0334	0.0958							
145	0.077	5000	7.80		117728	89465		0.0190	0.0185		38.9	22.4					44.15	48.28	47.06																		0.0235	0.0257	0.0250	0.0742							
146	0.077	5000	7.80		117728	89465		0.0190	0.0185		38.9	22.4					44.15	48.28	47.06																			0.0235	0.0257	0.0250	0.0742						
147	0.240	5000	7.80		368338	279911		0.0167	0.0150		38.9	22.4					38.84	39.06	47.06																			0.0646	0.0650	0.0783	0.2079						
155	0.076	5000	7.80		117033	88937		0.0190	0.0185		38.9	22.4					44.19	48.34	47.06																				0.0234	0.0256	0.0249	0.0738					
156	0.119	5000	7.80		183363	139343		0.0180	0.0169		38.9	22.4					41.66	44.26	47.06																				0.0345	0.0367	0.0390	0.1101					
157	0.079	5000	7.80		122062	92758		0.0189	0.0184		38.9	22.4					43.92	47.93	47.06																					0.0242	0.0264	0.0259	0.0766				
158	0.086	5000	7.80		132206	100468		0.0187	0.0181		38.9	22.4					43.44	47.17	47.06																					0.0259	0.0282	0.0281	0.0822				
160	0.083	5000	7.80		128131	97371		0.0188	0.0182		38.9	22.4					43.63	47.46	47.06																						0.0253	0.0275	0.0272	0.0800			
161	0.078	5000	7.80		119218	90597		0.0190	0.0184		38.9	22.4					44.07	48.16	47.06																						0.0237	0.0259	0.0253	0.0750			
162	0.090	5000	7.80		138709	105409		0.0186	0.0179		38.9	22.4					43.16	46.72	47.06																						0.0270	0.0293	0.0295	0.0858			
163	0.083	5000	7.80		127401	96816		0.0188	0.0182		38.9	22.4					43.66	47.52	47.06																							0.0251	0.0273	0.0271	0.0796		
166	0.076	5000	7.80		117120	89003		0.0190	0.0185		38.9	22.4					44.18	48.33	47.06																							0.0234	0.0256	0.0249	0.0738		
169	0.077	5000	7.80		118666	90178		0.0190	0.0185		38.9	22.4					44.10	48.20	47.06																							0.0236	0.0258	0.0252	0.0747		
172	0.076	5000	7.80		117324	89158		0.0190	0.0185		38.9	22.4					44.17	48.31	47.06																							0.0234	0.0256	0.0249	0.0740		
178	0.076	5000	7.80		117307	89145		0.0190	0.0185		38.9	22.4					44.17	48.32	47.06																								0.0234	0.0256	0.0249	0.0739	
180	0.076	5000	7.80		117307	89145		0.0190	0.0185		38.9	22.4					44.17	48.32	47.06																								0.0234	0.0256	0.0249	0.0739	
184	0.079	5000	7.80		121221	92120		0.0189	0.0184		38.9	22.4					43.97	48.00	47.06																								0.0241	0.0263	0.0258	0.0761	
186	0.076	5000	7.80		117538	89321		0.0190	0.0185		38.9	22.4					44.16	48.30	47.06																								0.0234	0.0256	0.0250	0.0741	
190	0.086	5000	7.80		132206	100468		0.0187	0.0181		38.9	22.4					43.44	47.17	47.06																								0.0259	0.0282	0.0281	0.0822	
191	0.080	5000	7.80		123406	93780		0.0189	0.0183		38.9	22.4					43.86	47.82	47.06																									0.0244	0.0267	0.0262	0.0773
194	0.076	5000	7.80		117430	89239		0.0190	0.0185		38.9	22.4					44.16	48.31	47.06																									0.0234	0.0256	0.0250	0.0740
195	0.077	5000	7.80		117900	89596		0.0190	0.0185		38.9	22.4					44.14	48.27	47.06																									0.0235	0.0257	0.0251	0.0743
197	0.217	5000	7.80		333800	253665		0.0169	0.0152		38.9	22.4					39.17	39.71	47.06																									0.0591	0.0599	0.0710	0.1899
198	0.217	5000	7.80		333800	253665		0.0169	0.0152		38.9	22.4					39.17	39.71	47.06																									0.0591	0.0599	0.0710	0.1899
199	0.217	5000	7.80		333800	253665		0.0169	0.0152		38.9	22.4					39.17	39.71	47.06																									0.0591	0.0599	0.0710	0.1899
200	0.217	5000	7.80		333800	253665		0.0169	0.0152		38.9	22.4					39.17	39.71	47.06																									0.0591	0.0599	0.0710	0.1899
201	0.217	5000	7.80		333800	253665		0.0169	0.0152		38.9	22.4					39.17	39.71	47.06																									0.0591	0.0599	0.0710	0.1899
202	0.217	5000	7.80		333800	253665		0.0169	0.0152		38.9	22.4					39.17	39.71	47.06																									0.0591	0.0599	0.0710	0.1899
203	0.217	5000	7.80		333800	253665		0.0169	0.0152		38.9	22.4					39.17	39.71	47.06																									0.0591	0.0599	0.0710	0.1899
204	0.076	5000	7.80		117033	88937		0.0190	0.0185		38.9	22.4					44.19	48.34	47.06																									0.0234	0.0256	0.0249	0.0738
217	0.105	5000	7.80		161289	122569		0.0182	0.0174		38.9	22.4					42.32	45.36	47.06																									0.0308	0.0330	0.0343	0.0982
218	0.105	5000	7.80		161289	122569		0.0182	0.0174		38.9	22.4					42.32	45.36	47.06																									0.0308	0.0330	0.0343	0.0982
219	0.076	5000	7.80		117285	89128		0.0190	0.0185		38.9	22.4					44.17	48.32	47.06																									0.0234	0.0256	0.0249	0.0739
220	0.077	5000	7.80		117900	89596		0.0190	0.0185		38.9	22.4					44.14	48.27	47.06																									0.0235	0.0257	0.0251	0.0743
221	0.077	5000	7.80		117900	89596		0.0190	0.0185		38.9	22.4					44.14	48.27	47.06																									0.0235	0.0257	0.0251	0.0743
222	0.109	5000	7.80		167323	127154		0.0182	0.0172		38.9	22.4					42.13	45.04	47.06																									0.0318	0.0340	0.0356	0.1015
223	0.108	5000	7.80		165589	125836		0.0182	0.0173		38.9	22.4					42.18	45.13	47.06																									0.0316	0.0338	0.0352	0.1005
224	0.078	5000	7.80		120284	91408		0.0190	0.0184		38.9	22.4					44.01	48.07	47.06																									0.0239	0.0261	0.0256	0.0756
229	0.142	5000	7.80		218191	165810		0.0176	0.0164	</																																					

546	0.083	5000	7.80		126835	96386		0.0188	0.0182		38.9	22.4				43.69	47.56	47.06				0.0250	0.0272	0.0270	0.0792
547	0.083	5000	7.80		126835	96386		0.0188	0.0182		38.9	22.4				43.69	47.56	47.06				0.0250	0.0272	0.0270	0.0792
548	0.081	5000	7.80		124721	94779		0.0189	0.0183		38.9	22.4				43.79	47.72	47.06				0.0247	0.0269	0.0265	0.0781
549	0.083	5000	7.80		126835	96386		0.0188	0.0182		38.9	22.4				43.69	47.56	47.06				0.0250	0.0272	0.0270	0.0792
550	0.077	5000	7.80		118955	90397		0.0190	0.0185		38.9	22.4				44.08	48.18	47.06				0.0237	0.0259	0.0253	0.0749

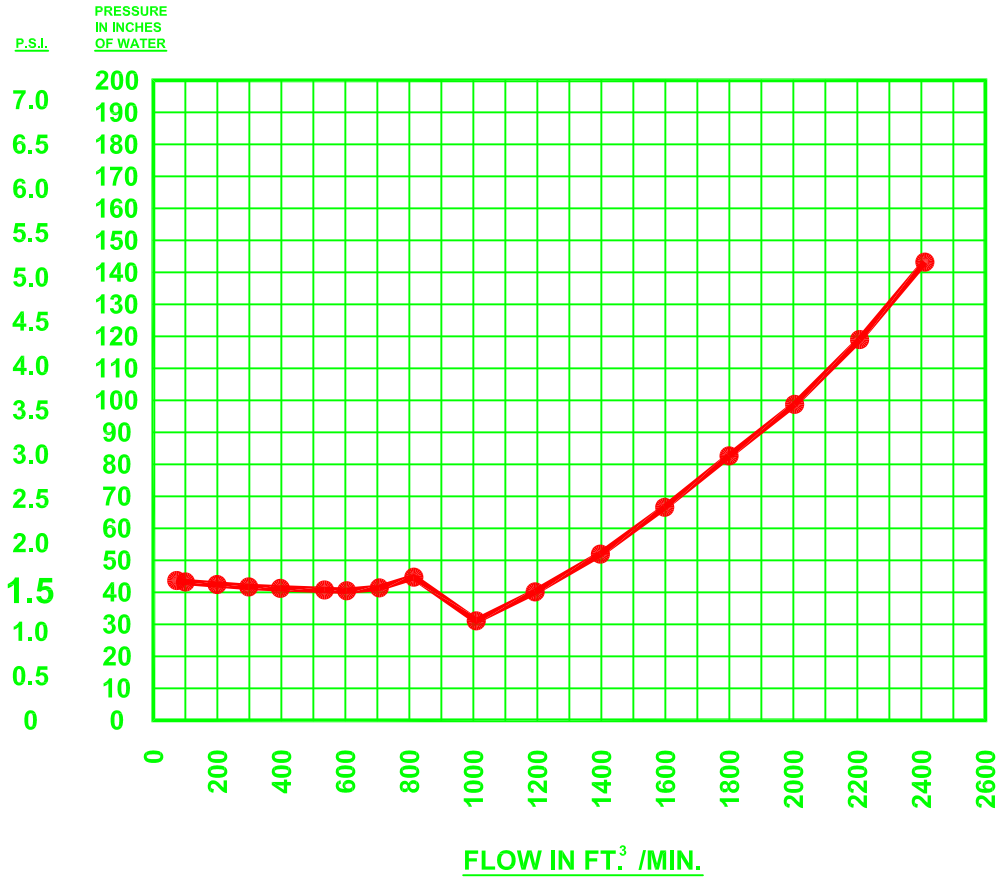
MAX ΔP:	0.2929
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P-V valve vacuum setting: 0.5 psi
80% of P-V valve setting: 0.4 psi

Maximum pressure drop to shore connection: 0.293 psi

TOTAL PRESSURE DROP TO SHORE CONNECTION: 0.293 psi OK

Max. allowable back pressure at facility: 0.107 psi



Curve for PRESSURE side of 6" PV Valve - 1.5 PSI

CEESI - Colorado Engineering
data based on air flow

Barrels Per Hour	Flow FT. ³ per Min.	Pressure In. of H2O
781	73	43.70
1070	100	43.23
2129	199	42.46
3189	298	41.71
4248	397	41.24
5725	535	40.76
6463	604	40.51
7554	706	41.40
8710	814	44.76
10796	1009	31.09
12765	1193	40.15
14948	1397	51.94
17099	1598	66.58
19249	1799	82.64
21443	2004	98.75
23615	2207	118.99
25798	2411	143.23



ELECTROMECHANICAL RESEARCH LABORATORIES, INC.
P.O. 1026 NEW ALBANY, IN 47150

DATE **6/30/09**

TOLERANCES
.0= +/- .030
.00= +/- .015
.000= +/- .005

DRAWN **D. URBAN**

APPROVED

SCALE JOB NO.

PART NAME
Flow Curve 1.5 PSI Pressure

UNIT NAME
6" PV Valve MDII

DRAWING NO. **180U172B** ITEM NO.

P.S.I.
PRESSURE
IN INCHES
OF WATER

1.8
1.7
1.6
1.5
1.4
1.3
1.2
1.1
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0

50
48
46
44
42
40
38
36
34
32
30
28
26
24
22
20
18
16
14
12
10
8
6
4
2
0



BARRELS PER HOUR	FLOW FT. ³ /MIN.	PRESSURE IN. OF H ₂ O
262	25	13.8
524	49	13.3
1048	98	12.8
1571	147	12.4
2095	196	13.0
2619	245	13.3
3143	294	14.5
3667	343	14.3
4190	392	13.5
4714	441	14.0
5238	490	14.0
5762	539	14.0
6286	588	14.0
6810	637	14.0
7333	686	13.9
7857	735	13.7
8381	784	13.8
8905	833	13.8
9429	882	13.8
9953	931	13.7
11001	980	13.6
11525	1029	13.7
12049	1078	13.8
12573	1127	13.8
13097	1176	13.9
13621	1225	14.0

CURVE FOR VACUUM SIDE OF 6" PV VALVE - 0.5 PSI
DATA BASED ON AIR FLOW



**ELECTROMECHANICAL
RESEARCH LABORATORIES, INC.**
P.O. 1026 NEW ALBANY, IN 47150

DATE
3/21/01

TOLERANCES
.0= +/- .030
.00= +/- .015
.000= +/- .005

DRAWN
D. URBAN

APPROVED

SCALE JOB NO.

PART NAME
Flow Curve 0.5 PSI Vacuum

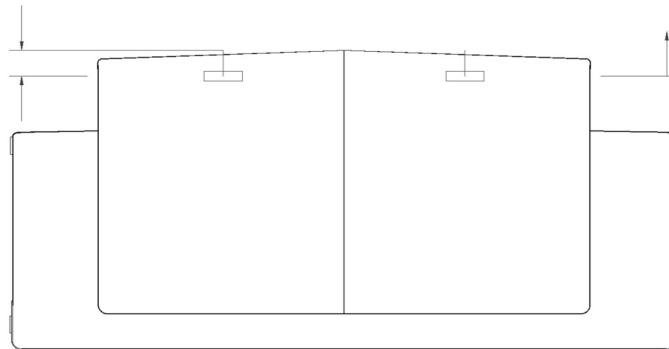
UNIT NAME
Marine 6" PV (MD II)

DRAWING NO.
080M077B

ITEM NO.

High Level and Overflow Alarm Calculations

Recommended High Level Set Point = 20.625 inches (below top of tank at Centerline)
(95% tank level)



Volume Above High Level Set Point = 836 ft³

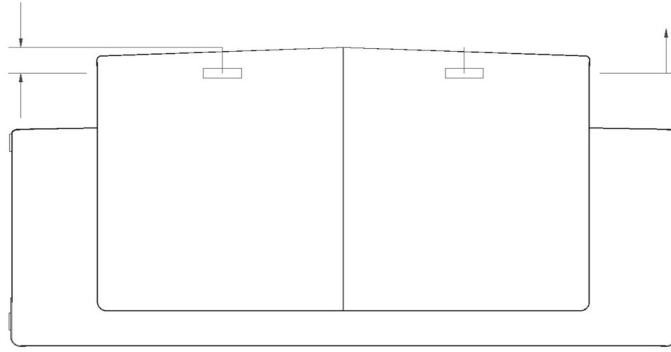
Maximum Cargo Loading Rate (per Tank) = 2500 BBL/hr
= 234.0 ft³/min

Camber Height = 0.50 ft
Trunk Width = 23.50 ft
Trunk Length = 53.33 ft
the Least High Level Set Point = 0.917 ft = 11.00 in

Tank #3 P/S
rounded-up

Total Tank Volume = 16607 ft³
Actual Volume Above High Level Indicator Set Point = 836 ft³
Percentage of Tank Vol Above High Level Set Point = 5%
Percentage of Tank Vol Below High Level Set Point = 95%

Recommended Overfill Alarm Level
 Set Point = 3.75 inches
 (Below top of tank at Centerline)
 (98% tank level)



Volume Above Overfill
 Level Set Point =
 235 ft³

Maximum Cargo Loading Rate (per Tank) = 2500 BBL/hr
 = 234.0 ft³/min

Camber Height = 0.50 ft
 Trunk Width = 23.50 ft
 Trunk Length = 53.33 ft
 the Least High Level Set Point = 0.435 ft
 = 5.25 in

Tank #3 P/S
 rounded-up

Minimum Allowable Time From Alarm to Overflow = 1.00 min
 Actual Time From Alarm to Overflow = 1.00 min

Total Tank Volume = 16607 ft³
 Actual Volume Above High Level Indicator Set Point = 235 ft³
 Percentage of Tank Vol Above High Level Set Point = 1%
 Percentage of Tank Vol Below High Level Set Point = 99%