U.S. Department of Homeland Security
United States Coast Guard

Commanding Officer
United States Coast Guard
Marine Safety Center

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16710/P021416/ama
Serial: C1-1900021
January 29, 2019

Marine Solutions, Inc.
Attn: Mr. Chetan Kumaria
P.O. Box 218197
Nashville, TN 37221-8197
marinesolinc@aol.com

Subj: CBC 1410, O.N. 1292054, Southwest Shipyard Hull No. 9813
CBC 1411, O.N. 1292050, Southwest Shipyard Hull No. 9814
CBC 1412, O.N. 1292051, Southwest Shipyard Hull No. 9815
CBC 1413, O.N. 1292052, Southwest Shipyard Hull No. 9816
CBC 1414, O.N. 1292053, Southwest Shipyard Hull No. 9817
200′ x 35′ x 12.5′ Unmanned Type (I, II and III) Tank Barges (O/D)
Grade A (max. 25 psia Reid) and Lower Flammable or Combustible Liquids Identified in 46 CFR Table 30.25-1 or 46 CFR Part 153 Table 2, and Specified Hazardous Cargos
Design Density 8.7 lbs/gal; Maximum Density (slack load) 13.33 lbs/gal
Rivers; Lakes, Bays, and Sounds
Plan Approval Extension

Ref: (a) Your letter "Plan Approval Extension Request" dated December 8, 2018
(b) Navigation and Vessel Inspection Circular no. 14-81, Stability Tests; Waiving of for "Sister Vessels"
(c) Marine Safety Manual, Volume IV, 6.D.2; "Sister Vessels"

Dear Mr. Kumaria:

We reviewed reference (a), submitted by your email dated December 9, 2018 (MSC Document No. 1821383), wherein you request plan approval extension for plans previously approved under Marine Safety Center Project Number P021416 for CBC 1400, Southwest Shipyard Hull No. 9780 through CBC 1409, Southwest Shipyard Hull No. 9789, to be used for the construction of the subject vessels.

Enclosure (1) includes details regarding MSC approval letters for previously approved plans you wish to use for the construction of the subject vessels. Accordingly, your request for plan approval extension of all drawings addressed in enclosure (1) is granted. This extension of plan approval is based on our understanding that:

a. The subject vessels will be built to the same plans as those specified in enclosure (1),
b. The regulations used for the original plan approval have not changed since the original plan approval,

c. The owner of the original plans specifically authorizes the use of the plans for new construction,
d. There are no modifications to the subject vessels or any of the installed systems which would require additional review, and
e. All comments provided in the original approval letters, accompanying the approved plans, still apply.

You must provide the cognizant Officer in Charge, Marine Inspection (OCMI) with a copy of the plans and calculations listed in enclosure (1) and their corresponding MSC approval letters. All plan review comments in the corresponding MSC approval letters must be addressed to the satisfaction of the OCMI. Plans that do not conform to any part of bullets (a) through (e) above shall be submitted to our office for approval. The installation, workmanship, and testing shall be to the satisfaction of the OCMI. Any vessel system, arrangement, structure, or other item that requires plan approval but is not covered by an extension must be either submitted to the MSC for review or reviewed by the OCMI.

We have reviewed the information submitted with reference (a), requesting sister vessel status for Southwest Shipyard Hull Nos. 9780 through 9789, and Southwest Shipyard Hull Nos. 9780 through 9789. In accordance with reference (b) and reference (c), we find Southwest Shipyard Hull Nos. 9813 through 9817 are to be sister to Southwest Shipyard Hull Nos. 9780 through 9789. Since the deadweight survey was conducted for the parent vessel, neither the stability test nor the deadweight survey of Southwest Shipyard Hull Nos. 9813 through 9817 will be required and we will use result from Southwest Shipyard Hull Nos. 9780 through 9789. The stability of Southwest Shipyard Hull Nos. 9780 through 9789 is extended to Southwest Shipyard Hull Nos. 9813 through 9817.

During construction, the Marine Safety Center must be notified of all modifications to the subject vessels which alter any plan listed in enclosure (1) be provided a detailed analysis of their impact to the lightship characteristics of the vessel. The Marine Safety Center will evaluate these modifications and determine if a deadweight survey will be necessary to reaffirm sister vessel status.

The Plan Review Information Sheet (PRIS) and Vapor Control System (VCS) PRIS for the subject vessels are included as enclosures (2) and (3). In addition, we have generated each vessel's cargo authority. The updated Cargo Authority Attachment (CAA), which contains the cargoes found in enclosures (4) and (5), is now available in the Coast Guard's Marine Information for Safety and Law Enforcement (MISLE) for issuance by the Officer in Charge, Marine Inspection (OCMI).

Please note that only the local OCMI can issue a vessel's CAA, which is valid only when referenced by and attached to a valid Certificate of Inspection (COI). For the OCMI's convenience, we have included the following recommended COI endorsements:

> Only those hazardous cargoes named in the vessel's Cargo Authority Attachment, Serial No. C1-1900021 dated January 29, 2019, may be carried and only in the tanks indicated.

When the vessel is carrying cargoes containing greater than 0.5% benzene, the person in charge is responsible for ensuring the provisions of 46 US Code of Federal Regulations Part 197, Subpart C are applied.

As an agreed-upon condition of your participation in the Marine Safety Center's electronic commerce program, you must provide the OCMI with a copy of this letter and a copy of reference (a).

Our Project Number for these vessels is P021416. Please ensure that all future correspondence includes the Project Number and the Official Number numbers that are shown in the subject line.

Please contact Mr. Ahmed Adam at (202) 795-6774 with questions concerning our review.

Sincerely,

A. L. MOHNKE
Lieutenant, U. S. Coast Guard
Acting, Chief, Vessel and Cargo Branch
By direction

Encl: (1) Plan Approval Extension Request Form, dated December 8, 2018
(2) Plan Review Information Sheet (PRIS) for Southwest Shipyard Hull Nos. 9813 through 9817, dated January 29, 2019
(3) VCS PRIS for Southwest Shipyard Hull Nos. 9813 through 9817, dated January 29, 2019
(4) VCS List of Cargoes for Southwest Shipyard Hull Nos. 9813 through 9817, dated January 29, 2019
(5) 46 CFR Part 151 Cargo List for Southwest Shipyard Hull Nos. 9813 through 9817, dated January 29, 2019

Copy: Commander, Coast Guard Sector Houston/Galveston, Prevention Department

# VAPOR COLLECTION SYSTEM CALCULATIONS

# FOR

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

## SOUTHWEST SHIPYARD HULL(s): 9780 thru 9789

## USCG PROJECT P021416

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

## CANAL BARGE COMPANY, INC.

**January 16, 2018**

**Prepared by:**

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

## VCS SYSTEM INFORMATION:

### 1. GENERAL DESCRIPTION OF VESSEL:

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

### 2. VAPOR CONTROL SYSTEM

A. PIPE DIAMETER: 7.981 INCHES IPS

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

C. P/V VALVE VENTING CAPACITY:

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

D. SPILL VALVE RELIEVING CAPACITY: NON INSTALLED

E. MAX. VAPOR-AIR MIXTURE DENSITY: 0.346 LBM/FT^3 FOR SUB D
0.213 LBM/FT^3 FOR SUB O

F. MAX. LIQUID LOADING RATE: 3500 BBLS/HR

G. DARCY FRICTION FACTOR: 0.014

H. VCS CARGOES: SEE TABLE 1 & TABLE 4

I. ADDITIONAL MIS. INFORMATION:

SYSTEM IS DESIGNED TO ACCOMMODATE INTERNAL VISUAL INSPECTION.

## VCS CALCULATIONS

### 1. CARGO AUTHORITY::

The vapor collection system installed on this barge is designed to carry the cargoes listed in Table 1, Table 4 and Crude Oil and Gasoline Blends. These Cargoes are to be listed on the barge's Certificate of Inspection.

### 2. DETERMINING VAPOR_AIR MIXTURE DENSITY AND VAPOR GROWTH RATE:

Pentane (iso-) has the heaviest vapor-air mixture density and the heighest vapor growth rate (see Table 1)

### 3. THE MAXIMUM LIQUID TRANSFER RATE AS IMPOSED BY THE CAPACITY OF THE CARGO VENTING SYSTEM:

Tank 1 is the farthest tank from the P/V valve. Using Crane's Technical Paper No. 410, the total equivalent length (L) for the path is shown in Table 2.

**TABLE 2**

| PIPE/FITTINGS | QUANTITY | UNIT EQ. LENGHT (FT) | TOTAL EQ. LENGTH (FT) |
|---|---|---|---|
| Straight Pipe | 1 | 99.471 | 99.471 |
| Entrance | 1 | 37.05 | 37.05 |
| T Branch | 4 | 39.91 | 159.64 |
| 8"X6"RED | 1 | 39.88 | 39.88 |
| T Run Thru | 6 | 13.3 | 79.8 |
| | | Total | 415.841 |

Using Darcy's Equation, with a 0.014 friction factor and the maximum liquid transfer rate, the pressure drop along the VCS piping between the #1 cargo tank and the P/V valve for each cargo is shown in Table 1 & Table 4.

Using a 3500 bbl/h liquid transfer rate, the vapor-air mixture and air-equivalent volumetric flow rate for each cargo are given in Table 1 & Table 4. At a setting of 1.5 psig, the Bergan KLPH-6 PV Valve has an adequate pressure relieving capacity of air for each cargo listed in Table 1 & Table 4. The greatest pressure drop in the venting system (1.691 psig) does not exceed the cargo tank maximum design working pressure of 3.5 psi.

The maximum vacuum that can exist in a tank is 0.512 psig. The barges are constructed as per ABS rules and regulations for a pressure of 3.5 psig and are tested for a pressure of 3.5 psig. Therefor the maximum vacuum of 0.512 psig is with in the design capacity of these barges and an unloading rate of 800 bbl/h is acceptable.

**4. THE MAXIMUM LIQUID TRANSFER RATE AS IMPOSED BY THE RELIEVING CAPACITY OF THE CARGO TANK SPILL VALVE.** Non-installed

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

The #1 cargo tank has a trunk top dimension of 40'-0" x 27'-0". The set point of the overfill alarm is set at 9" below the trunk top at tank centerline. With a liquid transfer rate of 3500 bbl/h, the person in charge of transfer of transfer operation has more than 2 minutes to stop the transfer operation before tank overflows. Thus VCS meets 46 CFR 39.20-9.

**6. THE MAXIMUM LIQUID TRANSFER RATE AS IMPOSED BY 46 CFR 39.30-1(d)(3).**

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

**TABLE 3**

| PIPE/FITTINGS | QUANTITY | UNIT EQ. LENGTH (FT) | TOTAL EQ. LENGTH (FT) |
|---|---|---|---|
| Straight Pipe | 1 | 158.667 | 158.667 |
| Entrance | 1 | 37.05 | 37.05 |
| T Branch | 4 | 39.91 | 159.64 |
| T Run | 9 | 13.33 | 119.97 |
| 8" Gate Valve | 1 | 5.32 | 5.32 |
| | | Total | 480.647 |

Pressure drop at the maximum liquid transfer rate of 3500 bbl/h along this path for each cargo is given in Tables 1 & 4. The largest pressure drop does not exceed 80 percent of the P/V valve pressure setting (1.2 psig).

TABLE 1 (SUB CHAPTER "D" CARGOES)

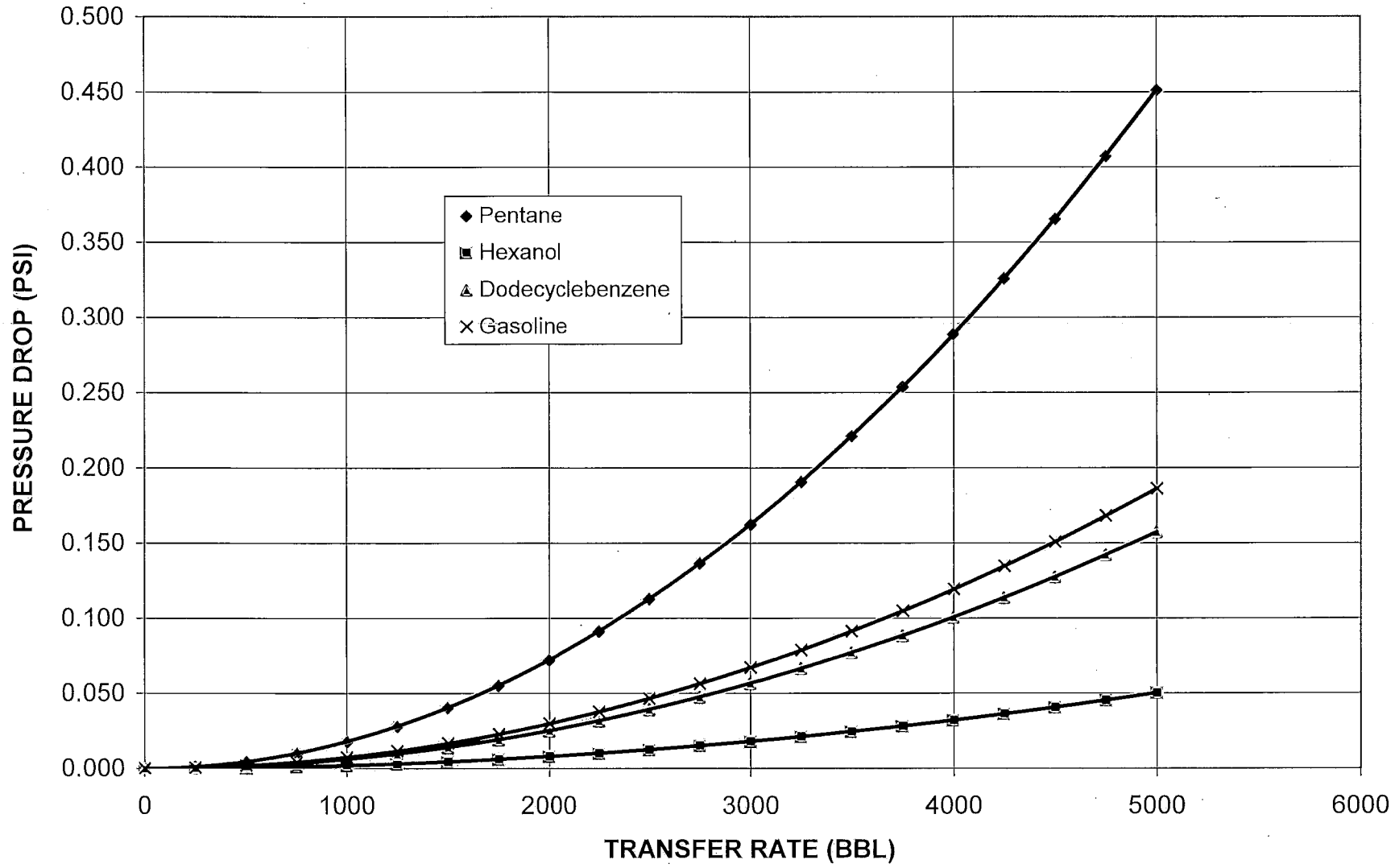
| CHRIS CODE | NAME | VCS CAT | LIQ SG | VAPOR PRESS | VAPOR SG | VAPOR AIR WEIGHT DENSITY | VAPOR GROWTH RATE | PRESSURE DROP TO PV VALVE IN VCS(psig) (LOADING) | VAPOR VOLUMETRIC FLOW RATE (bbl/h) | AIR EQUIVALENT VOLUMETRIC FLOW RATE | PRESSURE DROP TO SHORE CONNECTION IN VCS (psig) (LOADING)* | PRESSURE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

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

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 383 | ODS | OIL, Misc: Diesel | 1 | 0.9 | 0.69 | 3.4 | 0.084 | 1.0138 | 0.020 | 3548 | 3724 | 0.023 | 0.001 | 0.001 |
| 389 | OLB | OIL, Misc: Lubricating | 1 | 0.9 | 0.15 | 1 | 0.076 | 1.0030 | 0.018 | 3511 | 3510 | 0.021 | 0.001 | 0.001 |
| 403 | ORS | OIL, Misc: Resin | 1 | 1.02 | 0.15 | 1 | 0.076 | 1.0030 | 0.018 | 3511 | 3510 | 0.021 | 0.001 | 0.001 |
| 418 | OTB | OIL, Misc: Turbine | 1 | 0.87 | 0.3 | 5.4 | 0.082 | 1.0060 | 0.019 | 3521 | 3661 | 0.022 | 0.001 | 0.001 |
| 429 | PDC | Pentadecanol, See Alcohols (C13 and above) | 1 | 0.83 | 0.01 | 7.88 | 0.076 | 1.0002 | 0.018 | 3501 | 3507 | 0.021 | 0.001 | 0.001 |
| 433 | IPT | Pentane (iso-) | 5 | 0.62 | 27 | 2.48 | 0.346 | 1.5400 | 0.191 | 5390 | 11501 | 0.221 | 0.010 | 0.012 |
| 434 | PTA | Pentane (n-) | 5 | 0.63 | 20.44 | 2.5 | 0.264 | 1.4088 | 0.122 | 4931 | 9191 | 0.141 | 0.006 | 0.007 |
| 437 | PTE | Pentene (1-) | 5 | 0.64 | 24.9 | 2.4 | 0.309 | 1.4980 | 0.162 | 5243 | 10568 | 0.187 | 0.008 | 0.010 |
| 442 | PIN | Pinene | 1 | 0.86 | 0.35 | 4.7 | 0.082 | 1.0070 | 0.019 | 3525 | 3662 | 0.022 | 0.001 | 0.001 |
| 448 | PLB | Polybutene | 1 | 0.91 | 0.01 | 79.3 | 0.080 | 1.0002 | 0.019 | 3501 | 3583 | 0.021 | 0.001 | 0.001 |
| 457 | PGC | Polypropylene Glycol | 1 | 1.01 | 0.1 | 1 | 0.076 | 1.0020 | 0.018 | 3507 | 3506 | 0.021 | 0.001 | 0.001 |
| 464 | IAC | Propyl Acetate (iso-) | 1 | 0.89 | 1.8 | 3.52 | 0.097 | 1.0360 | 0.024 | 3626 | 4101 | 0.028 | 0.001 | 0.001 |
| 465 | PAT | Propyl Acetate (n-) | 1 | 0 | 1.85 | 3.52 | 0.098 | 1.0370 | 0.025 | 3630 | 4118 | 0.028 | 0.001 | 0.001 |
| 466 | IPA | Propyl Alcohol (iso-) | 1 | 0.79 | 3 | 2.07 | 0.091 | 1.0600 | 0.024 | 3710 | 4060 | 0.028 | 0.001 | 0.001 |
| 467 | PAL | Propyl Alcohol (n-) | 1 | 0.8 | 1.2 | 2.07 | 0.082 | 1.0240 | 0.020 | 3584 | 3722 | 0.023 | 0.001 | 0.001 |
| 468 | PBZ | Propylbenzene (n-) | 1 | 0.86 | 0.2 | 4.14 | 0.079 | 1.0040 | 0.019 | 3514 | 3580 | 0.021 | 0.001 | 0.001 |
| 469 | IPX | Iso-Propylcyclohexane | 1 | 0.8 | 0.01 | 4.35 | 0.076 | 1.0002 | 0.018 | 3501 | 3503 | 0.021 | 0.001 | 0.001 |
| 473 | PPG | Propylene Glycol (1,2-Propandiol) | 1 | 1.04 | 0.01 | 2.62 | 0.076 | 1.0002 | 0.018 | 3501 | 3501 | 0.020 | 0.001 | 0.001 |
| 476 | PME | Propylene Glycol Methyl Ether | 1 | 0.92 | 0.7 | 3.11 | 0.083 | 1.0140 | 0.020 | 3549 | 3706 | 0.023 | 0.001 | 0.001 |
| 488 | SFL | Sulfolane | 1 | 1.26 | 0.01 | 4.14 | 0.076 | 1.0002 | 0.018 | 3501 | 3503 | 0.021 | 0.001 | 0.001 |
| 493 | TTN | Tetradecanol | 1 | 0.82 | 0 | 7.39 | 0.076 | 1.0000 | 0.018 | 3500 | 3499 | 0.020 | 0.001 | 0.001 |
| 494 | TTD | 1-Tetradecene, See the olefin or Alpha-Olefin Entri | 1 | 0.77 | 0.01 | 6.77 | 0.076 | 1.0002 | 0.018 | 3501 | 3506 | 0.021 | 0.001 | 0.001 |
| 496 | TTG | Tetraethylene Glycol | 1 | 1.12 | 0.01 | 6.7 | 0.076 | 1.0002 | 0.018 | 3501 | 3506 | 0.021 | 0.001 | 0.001 |
| 497 | THN | Tetrahydronaphthalene | 1 | 0.97 | 0.04 | 4.56 | 0.077 | 1.0008 | 0.018 | 3503 | 3517 | 0.021 | 0.001 | 0.001 |
| 499 | TOL | Toluene | 1 | 0.87 | 1.5 | 3.14 | 0.091 | 1.0300 | 0.023 | 3605 | 3945 | 0.026 | 0.001 | 0.001 |
| 502 | TCP | Tricresyl Phosphate (less than 1% of the ortho ison | 1 | 1.16 | 0.01 | 12.69 | 0.077 | 1.0002 | 0.018 | 3501 | 3512 | 0.021 | 0.001 | 0.001 |
| 503 | TRD | Tridecane | 1 | 0.76 | 0.02 | 6.4 | 0.076 | 1.0004 | 0.018 | 3501 | 3512 | 0.021 | 0.001 | 0.001 |
| 505 | TDN | Tridecanol , See Alcohols (C13 and above) | 1 | 0.85 | 0.01 | 6.91 | 0.076 | 1.0002 | 0.018 | 3501 | 3506 | 0.021 | 0.001 | 0.001 |
| 506 | TDC | 1-Tridecene | 1 | 0.77 | 0.01 | 6.29 | 0.076 | 1.0002 | 0.018 | 3501 | 3505 | 0.021 | 0.001 | 0.001 |
| 508 | TEB | Triethylbenzene | 1 | 0.86 | 0.02 | 5.6 | 0.076 | 1.0004 | 0.018 | 3501 | 3510 | 0.021 | 0.001 | 0.001 |
| 509 | TEG | Triethylene Glycol | 1 | 1.12 | 0.01 | 5.17 | 0.076 | 1.0002 | 0.018 | 3501 | 3504 | 0.021 | 0.001 | 0.001 |
| 519 | TRE | Trimathylbenzenes (all isomers) | 1 | 0.89 | 0.14 | 4.2 | 0.078 | 1.0028 | 0.018 | 3510 | 3557 | 0.021 | 0.001 | 0.001 |
| 520 | TMB | Trimethyl Benzene (1,2,5-) | 1 | 0.89 | 0.14 | 4.14 | 0.078 | 1.0028 | 0.018 | 3510 | 3556 | 0.021 | 0.001 | 0.001 |
| 521 | TMD | Trimethyl Benzene (1,2,3-) | 1 | 0.89 | 0.14 | 4.14 | 0.078 | 1.0028 | 0.018 | 3510 | 3556 | 0.021 | 0.001 | 0.001 |
| 522 | TME | Trimethyl Benzene (1,2,4-) (Pseudocumene) | 1 | 0.89 | 0.14 | 4.14 | 0.078 | 1.0028 | 0.018 | 3510 | 3556 | 0.021 | 0.001 | 0.001 |
| 529 | TRP | Trixylenyl Phosphate | 1 | 1.16 | 0 | 14.2 | 0.076 | 1.0000 | 0.018 | 3500 | 3499 | 0.020 | 0.001 | 0.001 |
| 546 | XLX | Xylenes (Ortho-, meta-, para-) | 1 | 0.89 | 0.51 | 3.66 | 0.082 | 1.0102 | 0.020 | 3536 | 3680 | 0.023 | 0.001 | 0.001 |
| 547 | XLM | Xylene (M-) | 1 | 0.87 | 0.51 | 3.66 | 0.082 | 1.0102 | 0.020 | 3536 | 3680 | 0.023 | 0.001 | 0.001 |
| 548 | XLO | Xylene (O-) | 1 | 0.89 | 0.4 | 3.66 | 0.081 | 1.0080 | 0.019 | 3528 | 3641 | 0.022 | 0.001 | 0.001 |
| 549 | XLP | Xylene (P-) | 1 | 0.86 | 0.51 | 3.66 | 0.082 | 1.0102 | 0.020 | 3536 | 3680 | 0.023 | 0.001 | 0.001 |
| 550 | XYL | Xylenol | 1 | 1.01 | 0.1 | 3.66 | 0.077 | 1.0020 | 0.018 | 3507 | 3535 | 0.021 | 0.001 | 0.001 |
| 551 | | Zinc Dialkyldithiophosphate | | | | | | | | | | | | |
| | | | Max. | 1.260 | 27.000 | 79.300 | 0.346 | 1.540 | 0.191 | 5390 | 11501 | 0.221 | 0.010 | 0.012 |
| | | | Min. | 0.000 | 0.000 | 1.000 | 0.000 | 1.000 | 0.018 | 3500 | 3499 | 0.020 | 0.000 | 0.000 |

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

## LIQUID TRANSFER RATE vs PRESSURE DROP



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

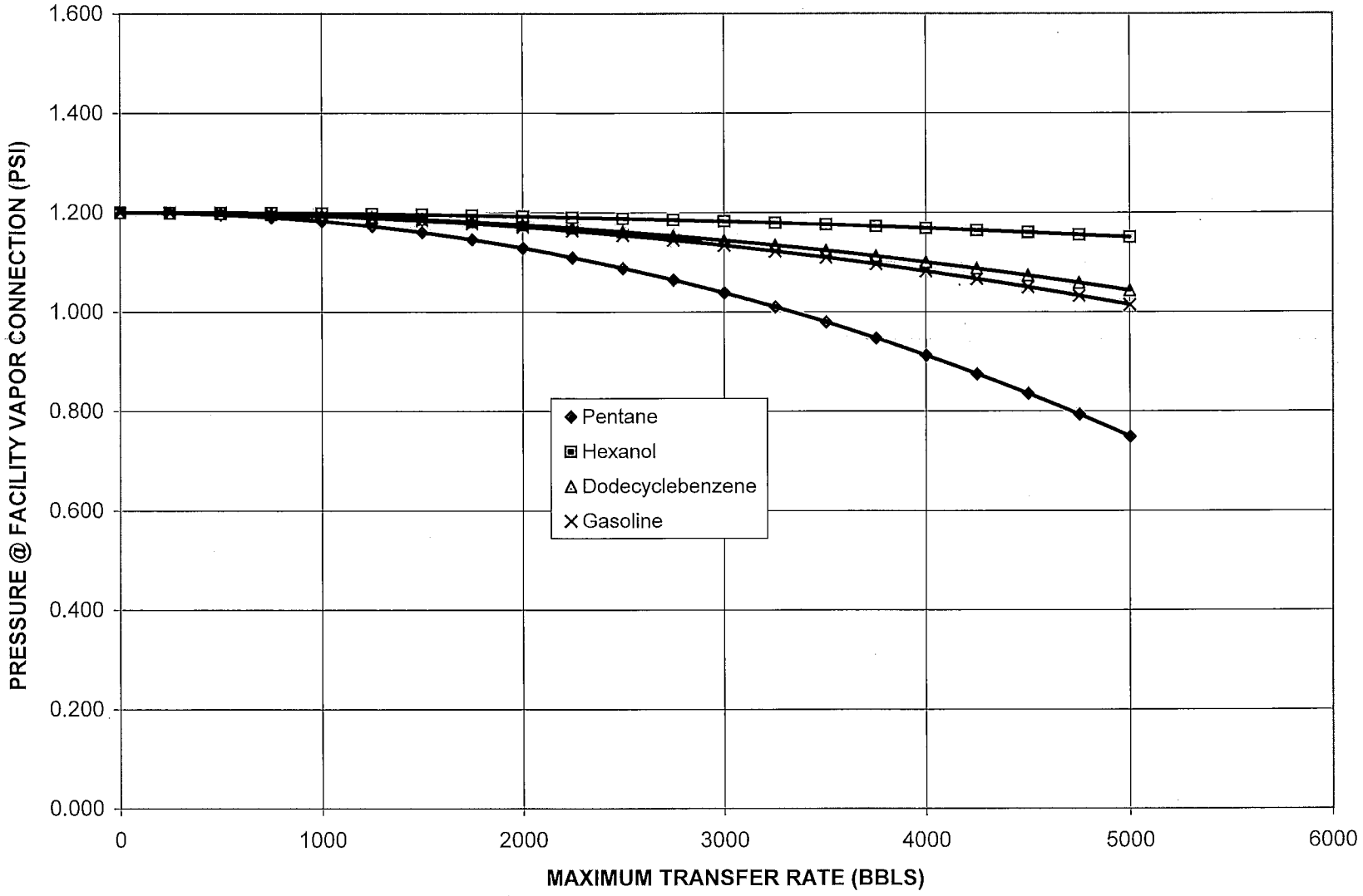
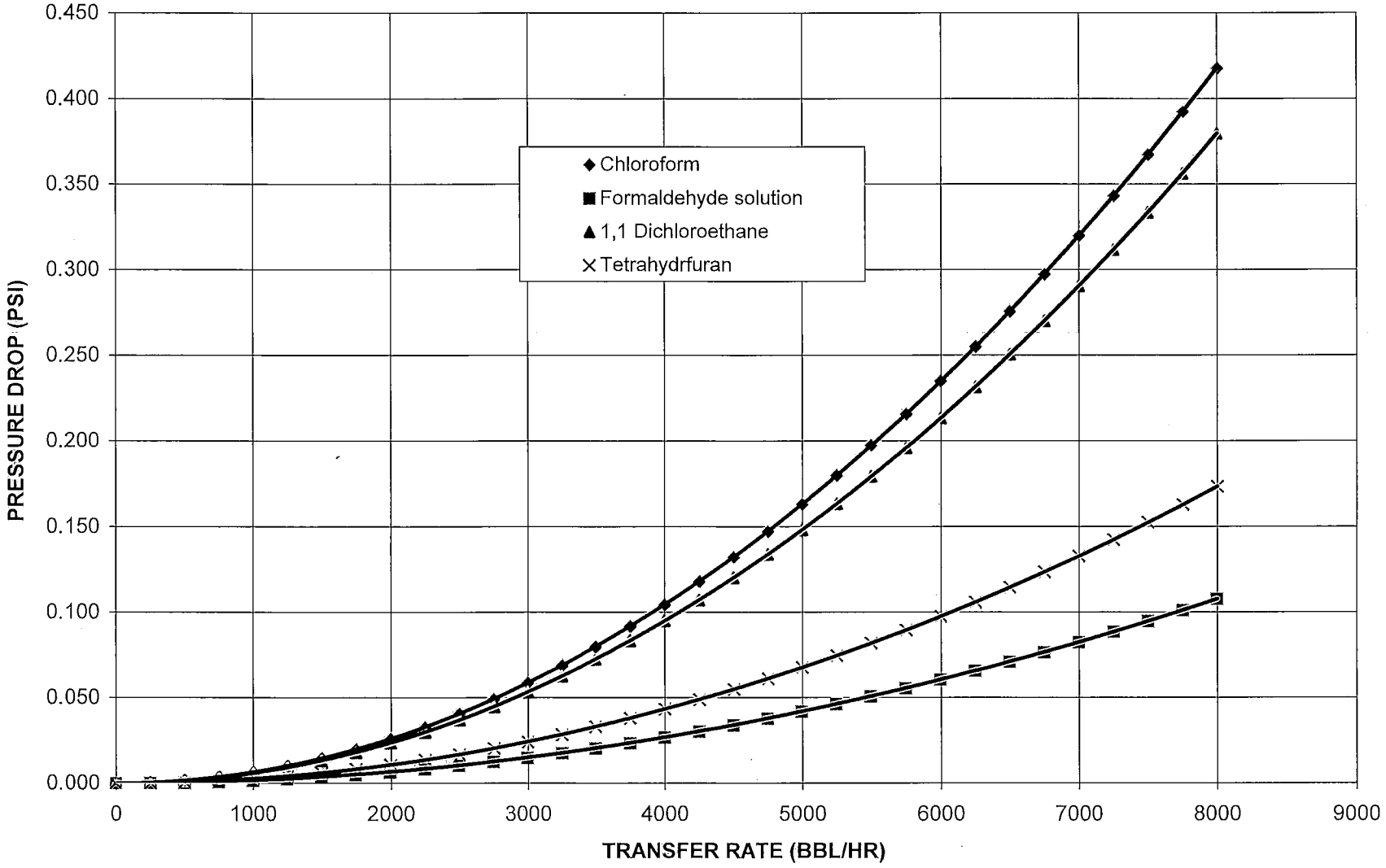


TABLE 4 (SUBCHAPTER "O" CARGOES)

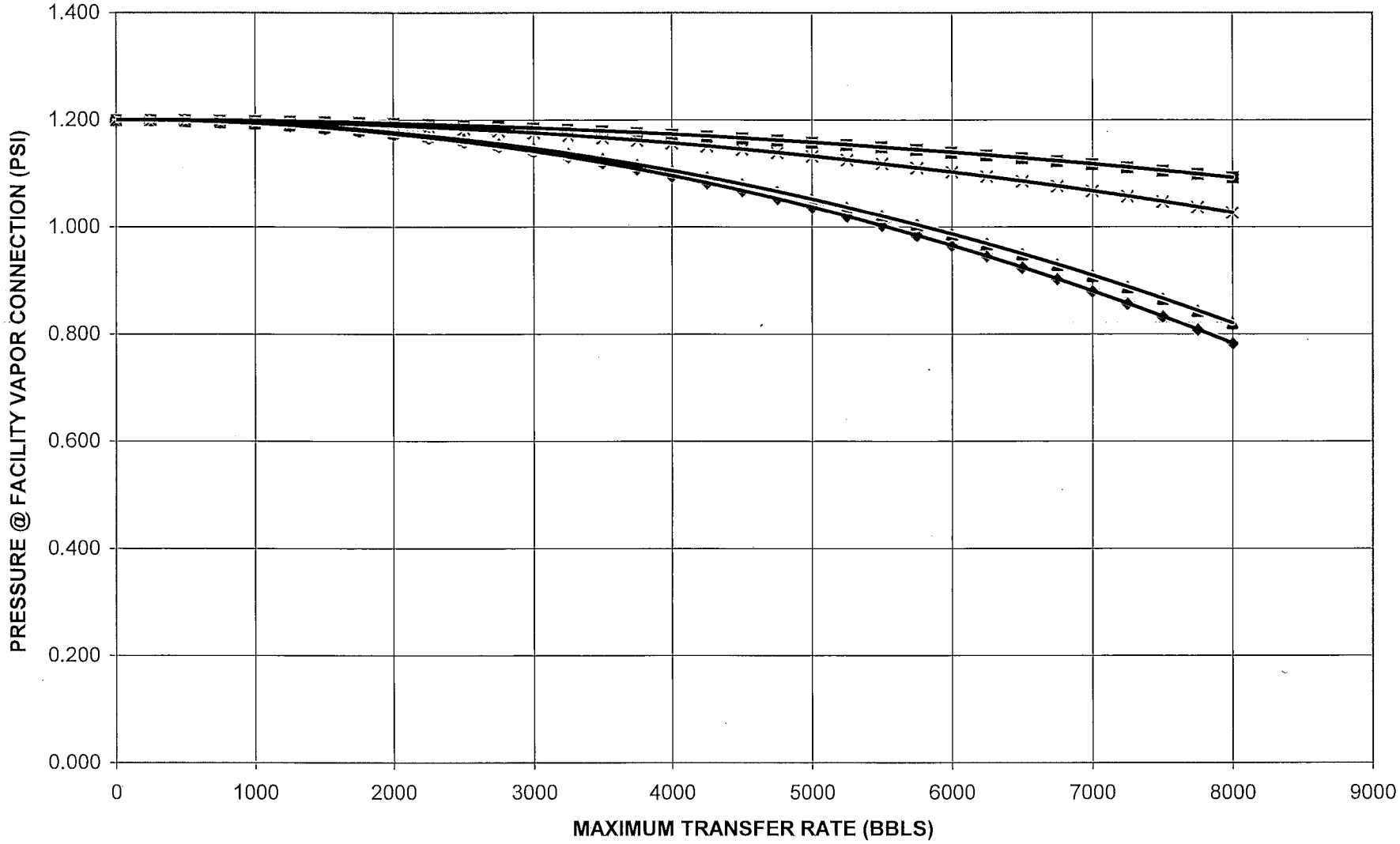
| | CHRIS CODE | NAME | VCS CAT | LIQ SG | VAPOR PRESS | VAPOR SG | VAPOR AIR WEIGHT DENSITY | VAPOR GROWTH RATE | PRESSURE DROP TO PV VALVE IN VCS(psig) (LOADING) | VAPOR VOLUMETRIC FLOW RATE (bbl/h) | AIR EQUIVALENT VOLUMETRIC FLOW RATE | PRESSURE DROP TO SHORE CONNECTION IN VCS (psig) (LOADING)* | PRESSURE DROP TO PV VALVE IN VCS(psig) (UNLOADING) | PRESSURE DROP TO SHORE CONNECTION IN VCS (psig) (UNLOADING)* |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | ACN | Acrylonitrile | 4 | 0.81 | 5.00 | 1.80 | 0.095 | 1.1000 | 0.027 | 3850 | 4298 | 0.031 | 0.001 | 0.002 |
| 2 | ADN | Adipontrile | 1 | 0.95 | 0.01 | 3.73 | 0.076 | 1.0002 | 0.018 | 3501 | 3503 | 0.021 | 0.001 | 0.001 |
| 3 | ATN | Acetonitrile | 3 | 0.78 | 0.03 | 1.41 | 0.076 | 1.0006 | 0.018 | 3502 | 3502 | 0.021 | 0.001 | 0.001 |
| 4 | BAD | Iso-Butyraldehyde | 1 | 0.80 | 7.80 | 2.50 | 0.131 | 1.1560 | 0.041 | 4046 | 5308 | 0.047 | 0.002 | 0.002 |
| 5 | BAR | Butyl acrylate (iso-, n-) | 2 | 0.90 | 0.60 | 4.42 | 0.086 | 1.0120 | 0.020 | 3542 | 3759 | 0.024 | 0.001 | 0.001 |
| 6 | BMH | Butyl Methacrylate | 2 | 0.88 | 0.29 | 4.9 | 0.081 | 1.0058 | 0.019 | 3520 | 3640 | 0.022 | 0.001 | 0.001 |
| 7 | BNZ | Benzene | 1 | 0.88 | 4.50 | 2.80 | 0.114 | 1.0900 | 0.032 | 3815 | 4671 | 0.036 | 0.002 | 0.002 |
| 8 | BTR | n-Butyraldehyde | 1 | 0.80 | 7.80 | 2.50 | 0.131 | 1.1560 | 0.041 | 4046 | 5308 | 0.047 | 0.002 | 0.002 |
| 9 | BTX | Benzene, Toluene, Xylene mixtures (10% Benzene or more) | 1 | 0.84 | 7.30 | 2.80 | 0.138 | 1.1460 | 0.042 | 4011 | 5396 | 0.049 | 0.002 | 0.003 |
| 10 | CCH | Cyclohexanone | 1 | 0.95 | 0.20 | 3.40 | 0.078 | 1.0040 | 0.018 | 3514 | 3565 | 0.021 | 0.001 | 0.001 |
| 11 | CHA | Cyclohexylamine | 1 | 0.87 | 0.62 | 3.42 | 0.083 | 1.0124 | 0.020 | 3543 | 3703 | 0.023 | 0.001 | 0.001 |
| 12 | CRB | Chlorobenzene | 1 | 1.11 | 0.80 | 3.88 | 0.087 | 1.0160 | 0.021 | 3556 | 3799 | 0.024 | 0.001 | 0.001 |
| 13 | CRF | Chloroform | 3 | 1.48 | 9 | 4.25 | 0.213 | 1.1800 | 0.069 | 4130 | 6916 | 0.080 | 0.004 | 0.004 |
| 14 | NCT | Coal Tar Naphtha Solvent | 1 | 0.86 | 0.2 | 4 | 0.079 | 1.0040 | 0.019 | 3514 | 3577 | 0.021 | 0.001 | 0.001 |
| 15 | CRS | Cresols | 1 | 1.05 | 0.06 | 3.72 | 0.077 | 1.0012 | 0.018 | 3504 | 3521 | 0.021 | 0.001 | 0.001 |
| 16 | CTA | Crotonaldehyde | 4 | 0.85 | 2 | 2.41 | 0.089 | 1.0400 | 0.022 | 3640 | 3943 | 0.026 | 0.001 | 0.001 |
| 17 | DCH | 1,1-Dichloroethane | 1 | 1.18 | 9.90 | 3.41 | 0.188 | 1.1980 | 0.063 | 4193 | 6592 | 0.073 | 0.003 | 0.004 |
| 18 | DPP | 1,2-Dichloropropane | 3 | 1.16 | 2.5 | 3.89 | 0.110 | 1.0500 | 0.028 | 3675 | 4418 | 0.033 | 0.001 | 0.002 |
| 19 | DPU | 1,3-Dichloropropene | 4 | 1.23 | 5.5 | 3.84 | 0.149 | 1.1100 | 0.043 | 3885 | 5443 | 0.050 | 0.002 | 0.003 |
| 20 | DEN | Diethylamine | 3 | 0.71 | 1.00 | 2.50 | 0.083 | 1.0200 | 0.020 | 3570 | 3731 | 0.023 | 0.001 | 0.001 |
| 21 | DIP | Diisopropanolamine | 1 | 0.98 | 0.01 | 4.59 | 0.076 | 1.0002 | 0.018 | 3501 | 3504 | 0.021 | 0.001 | 0.001 |
| 22 | DMF | Dimethylformamide | 1 | 0.95 | 0.30 | 2.51 | 0.078 | 1.0060 | 0.018 | 3521 | 3569 | 0.021 | 0.001 | 0.001 |
| 23 | DPX | 1,1-,1,2-, or 1,3-Dichloropropane | 3 | 1.16 | 6.30 | 3.90 | 0.162 | 1.1260 | 0.048 | 3941 | 5747 | 0.055 | 0.002 | 0.003 |
| 24 | EAC | Ethyl acrylate | 2 | 0.93 | 2.00 | 3.50 | 0.099 | 1.0400 | 0.025 | 3640 | 4163 | 0.029 | 0.001 | 0.002 |
| 25 | EAI | 2-Ethylhexyl acrylate | 2 | 0.89 | 0.02 | 6.35 | 0.076 | 1.0004 | 0.018 | 3501 | 3512 | 0.021 | 0.001 | 0.001 |
| 26 | EDC | Ethylene dichloride | 1 | 1.26 | 4.00 | 3.42 | 0.121 | 1.0800 | 0.033 | 3780 | 4776 | 0.038 | 0.002 | 0.002 |
| 27 | ETM | Ethyl Methacrylate | 2 | 0.92 | 1 | 3.94 | 0.090 | 1.0200 | 0.022 | 3570 | 3879 | 0.025 | 0.001 | 0.001 |
| 28 | EPA | 2-Ethyl-3-propylacrolein | 1 | 0.85 | 0.12 | 4.5 | 0.078 | 1.0024 | 0.018 | 3508 | 3553 | 0.021 | 0.001 | 0.001 |
| 29 | FFA | Furfural | 1 | 1.20 | 0.15 | 3.31 | 0.078 | 1.0030 | 0.018 | 3511 | 3547 | 0.021 | 0.001 | 0.001 |
| 30 | FMS | Formaldehyde solution (37% to 50%) | 1 | 1.13 | 0.15 | 1.03 | 0.076 | 1.0030 | 0.018 | 3511 | 3510 | 0.021 | 0.001 | 0.001 |
| 31 | MSO | Mesityl Oxide | 1 | 0.86 | 0.67 | 3.5 | 0.084 | 1.0134 | 0.020 | 3547 | 3725 | 0.023 | 0.001 | 0.001 |
| 32 | MAM | Methyl acrylate | 2 | 0.95 | 4.10 | 3.00 | 0.114 | 1.0820 | 0.031 | 3787 | 4646 | 0.036 | 0.002 | 0.002 |
| 33 | MBE | Methylcyclopentadiene dimer | 1 | 0.74 | 0.04 | 3.10 | 0.076 | 1.0008 | 0.018 | 3503 | 3511 | 0.021 | 0.001 | 0.001 |
| 34 | MMM | Methyl methacrylate | 2 | 0.94 | 2.02 | 3.45 | 0.099 | 1.0404 | 0.025 | 3641 | 4159 | 0.029 | 0.001 | 0.002 |
| 35 | MPL | Morpholine | 1 | 1.00 | 0.80 | 3.00 | 0.083 | 1.0160 | 0.020 | 3556 | 3726 | 0.023 | 0.001 | 0.001 |
| 36 | NPM | 1- or 2-Nitropropane | 1 | 0.99 | 1.05 | 3.06 | 0.086 | 1.0210 | 0.021 | 3574 | 3804 | 0.024 | 0.001 | 0.001 |
| 37 | PRD | Pyridine | 1 | 0.98 | 1.30 | 2.72 | 0.086 | 1.0260 | 0.021 | 3591 | 3830 | 0.025 | 0.001 | 0.001 |
| 38 | STY | Styrene | 2 | 0.92 | 0.40 | 3.60 | 0.081 | 1.0080 | 0.019 | 3528 | 3638 | 0.022 | 0.001 | 0.001 |
| 39 | TCN | 1,2,3-Trichloropropane | 3 | 1.39 | 0.15 | 5.60 | 0.079 | 1.0030 | 0.019 | 3511 | 3583 | 0.021 | 0.001 | 0.001 |
| 40 | TEN | Triethylamine | 3 | 0.73 | 2.50 | 3.49 | 0.105 | 1.0500 | 0.027 | 3675 | 4323 | 0.031 | 0.001 | 0.002 |
| 41 | THF | Tetrahydrfuran | 1 | 0.89 | 8.50 | 1.35 | 0.090 | 1.1700 | 0.029 | 4095 | 4454 | 0.033 | 0.001 | 0.002 |
| 42 | VAM | Vinyl acetate | 2 | 0.94 | 5.80 | 2.97 | 0.130 | 1.1160 | 0.038 | 3906 | 5099 | 0.043 | 0.002 | 0.002 |
| | | | Max. | 1.39 | 12.5 | 8.40 | 0.213 | 1.198 | 0.069 | 4193 | 6916 | 0.080 | 0.004 | 0.004 |
| | | | Min. | 0.63 | 0.01 | 1.03 | 0.076 | 1.000 | 0.018 | 3501 | 3502 | 0.021 | 0.001 | 0.001 |

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

## LIQUID TRANSFER RATE vs PRESSURE DROP

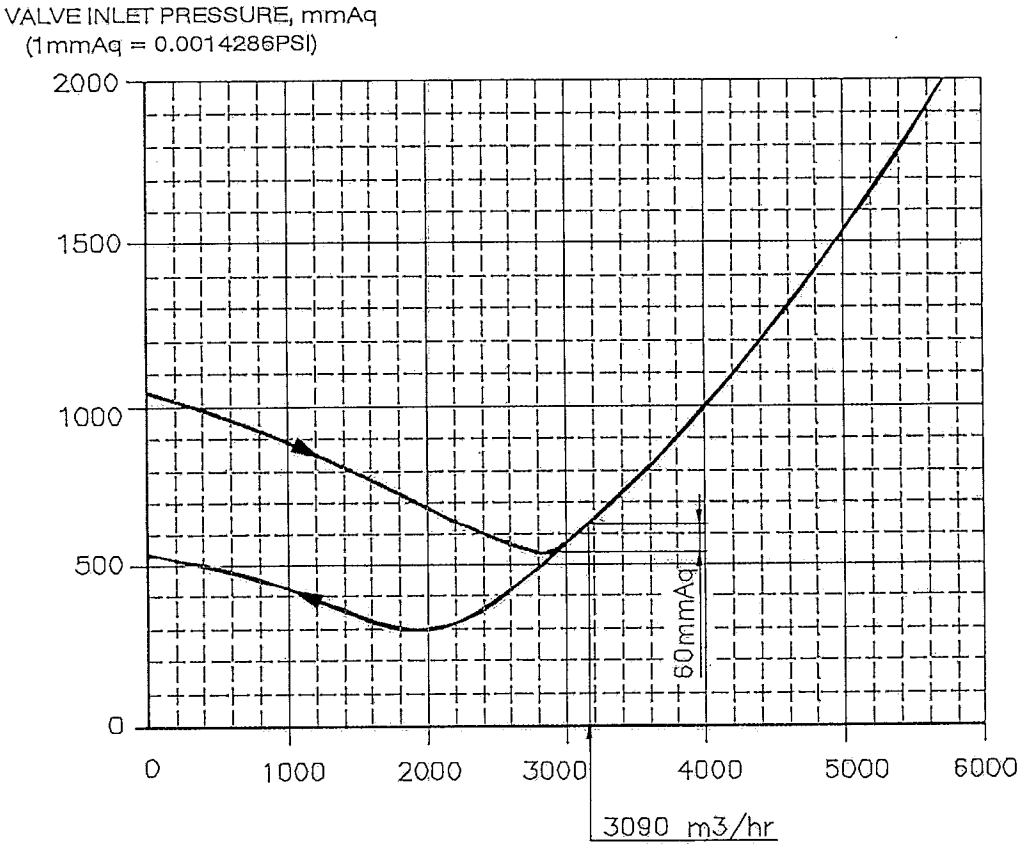


## PRESSURE vs MAXIMUM TRANSFER RATE (FOR SUB-CHAPTER "O" CARGOES)



# HIGH VELOCITY VENT VALVE FLOW CAPACITY CURVE

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

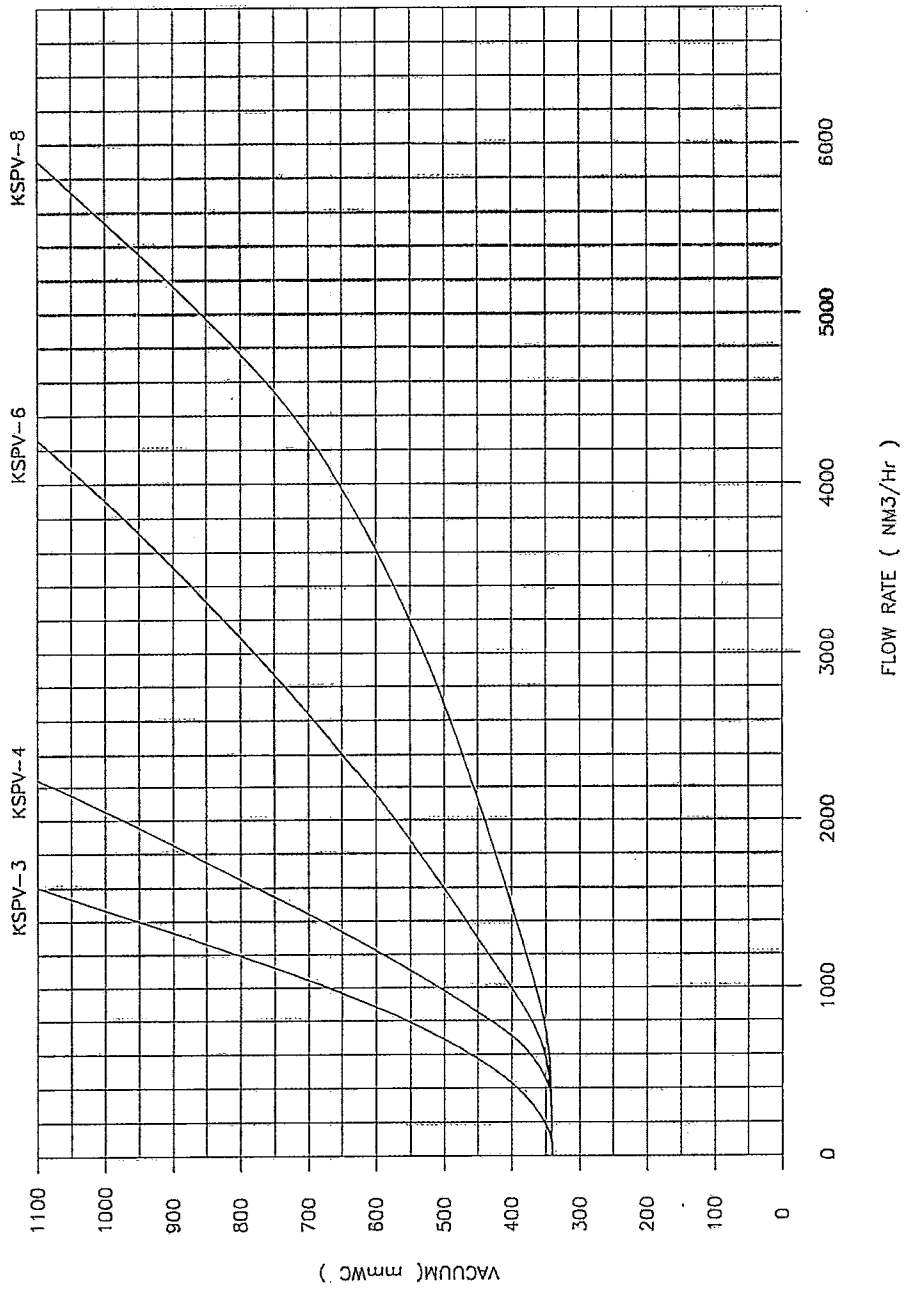



FLOW CAPACITY OURVE, SCMH(Standard cubic meter per hour)
(1SCMH = 6.289BBL/hr)

| APPLICABLE STANDARD | TEST CONDITION | |
|---|---|---|
| IMO MSC/Circ.677<br>API Standard 2000 | FLOW TEST PERFORMED ON EQUIPMENT USING AIR,<br>AT TEMP.T=15.6℃ AND AMBIENT PRESSURE P=1.0332Kg/cm² | SHEET NO. 1/1 |

# FLOW CAPACITY CURVE GRAPH

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




TANKTECH

TITLE *HIGH VELOCITY VACUUM RELIEF VALVE*

*KSPV TYPE*

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

| | | | |
|---|---|---|---|
| **Vessel Name** | CBC 1410 thru CBC 1414 | **Shipyard** | Southwest |
| **Official Number** | 1292050 thru 1292054 | **Hull Number** | 9813 thru 9817 |

**1.** This sheet consolidates critical VCS parameters for MSC Staff Engineers and CG Field Inspectors dealing with Vapor Control Systems. CG Inspectors should verify the vessel's VCS design is consistent with the information listed in boxes 2, 6, 7 & 8 prior to updating the vapor control endorsement on the vessel's Certificate of Inspection. For cases where the information in the VCS PRIS does not reflect the vessel's design the CG Inspector should contact the MSC's Cargo Authority branch.

**2. Tank Maximum Design Working Pressure** 3.50 psig — **Raised Trunk** [X] **Flush Deck** [ ]

**3. Authorized Maximum Cargo Transfer Rate(s)** 3,500 bbl/hr loading; 800 bbl/hr discharging

**4. Authorized Maximum Vapor-Air Mixture Density** 0.346 $lbm/ft^3$

**5. Authorized VCS Categories** 1 through 5

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

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

b. Cargo Name **Pentane (all isomers) [PTY]**

**7. Pressure Vacuum Valve:**

| | |
|---|---|
| **Manufacturer** | **Tanktech** |
| **Size** | **KLPH-6** |
| **CG Approval** | **162.017/144/3** |

**Settings in psig:**

| | |
|---|---|
| Pressure-side | 1.5 |
| Vacuum-side | 0.5 |

**8. VCS Pipe Sizes:**

Approx. Inside Diameter

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

| | | |
|---|---|---|
| **Required Venting Capacity of Pressure-Side of P/V valve** | **9337** | **bbl/hr (air)** |
| **Required Venting Capacity of Vacuum-Side of P/V valve** | **800** | **bbl/hr (air)** |

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

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

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

**11. Instructions/Guidelines for the OCMI:**

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

In accordance with 46 CFR Part 39, excluding part 39.4000, this vessel's vapor collection system has been inspected to the plans approved by MSC Letter C1-1900021 dated January 29 2019, and has been found acceptable for the collection of bulk liquid cargo vapors annotated with "Yes" in the CAA's VCS column of the vessel's Cargo Authority Attachment. The VCS system has been approved with a pressure side 1.5 psig P/V valve with Coast Guard Approval 162.017/144/3. The cargo tank top is suitable for a maximum allowable working pressure (MAWP) of 3.5 psi. When the vessel is carrying cargoes containing greater than 0.5% benzene, the person in charge is responsible for ensuring the provisions of 46 US Code of Federal Regulations Part 197, Subpart C are applied.

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

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

| | | | |
|---|---|---|---|
| VCS Approval Letter | MSC Letter C1-1900021 dated January 29 2019 | MSC Plan Reviewer | LT A. L. Mohnke |

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

| 1. Vessel Identification | Hull Type | Service | ABS classed? |
|---|---|---|---|
| CBC 1410, O.N. 1292054, Southwest Shipyard Hull No. 9813 | I/II/III | O/D | No |
| CBC 1411, O.N. 1292050, Southwest Shipyard Hull No. 9814 | I/II/III | O/D | No |
| CBC 1412, O.N. 1292051, Southwest Shipyard Hull No. 9815 | I/II/III | O/D | No |
| CBC 1413, O.N. 1292052, Southwest Shipyard Hull No. 9816 | I/II/III | O/D | No |
| CBC 1414, O.N. 1292053, Southwest Shipyard Hull No. 9817 | I/II/III | O/D | No |

## 2. Route Permitted - Routes and Conditions

| | |
|---|---|
| R | Rivers |
| LBS | Lakes, Bays, and Sounds |

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

Authorization:

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

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

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

Only those cargoes named in the vessel's Cargo Authority Attachment may be carried, and then only in the tanks indicated. When the vessel is carrying cargoes containing greater than 0.5% benzene, the person in charge is responsible for ensuring the provisions of 46 US Code of Federal Regulations Part 197, Subpart C are applied.

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

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

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

## 5. Loading Constraints

**Loading Constraints - Structural**

| Tank | Max Cargo Wgt/Each Tank (ST) | Max Density (lbs/gal) |
|---|---|---|
| 1C | 579 | 13.33 |
| 2C | 730 | 13.33 |
| 3C | 657 | 13.33 |

**Loading Constraints - Stability**

| Hull Type | Route | Max. Load (ST) | Max Draft (ft, in) | Max Density (lbs/gal) |
|---|---|---|---|---|
| I | R | 1580 | 9'-0" | 13.33 |
| II | R | 1689 | 9'-6" | 12.49 |
| III | R | 1799 | 10'-0" | 11.66 |
| III | R | 1871 | 10'-4" | 9.16 |
| I | LBS | 1580 | 9'-0" | 12.41 |
| II | LBS | 1689 | 9'-6" | 10.99 |