

Date: May 31, 2019

Sheet 1 of 2

**MARINE SAFETY CENTER PLAN APPROVAL EXTENSION REQUEST FORM**

**Directions:**

1. Complete the table below with all approved plans and corresponding MSC approval letters for which plan approval extension is requested.
2. Electronically submit this form with a copy of the vessel's Application for Inspection directly to the MSC (MSC@USCG.mil), or submit a paper copy to our mailing address:

Commanding Officer (MSC)  
2703 Martin Luther King Jr. Ave SE  
Washington, DC 20593-7430

|  |
|--|
| <b>NAME AND IDENTIFICATION (O.N., CG NUMBER) OF VESSEL FOR WHICH PLANS WERE PREVIOUSLY APPROVED:</b><br>CBC1400 THRU CBC1409, O.N.: 1284530 THRU 1284539 |
| <b>NAME AND IDENTIFICATION OF VESSEL(S) TO WHICH PLAN APPROVAL IS TO BE EXTENDED:</b><br>CBC1420 THRU CBC1424 (Southwest Hulls 9823 thru 9827)           |

| Drawing Number             | # of Sheets | Rev. # | Drawing Title                          | MSC Project Number | Approval Date | Approval Letter Serial Number | Denied (MSC Use) |
|----------------------------|-------------|--------|--|--------------------|---------------|-------------------------------|------------------|
| -                          | -           | -      | Stability                              | P021416            | 03/16/18      | C1-1800956                    |                  |
| 111702 GA-1 , Sheet 1 of 2 | 1           | 2      | General Arrangement                    | P021416            | 02/07/18      | C1-1800481                    |                  |
| 111702 GA-1 , Sheet 2 of 2 | 1           | 0      | General Arrangement                    | P021416            | 02/07/18      | C1-1800481                    |                  |
| -                          | -           | -      | Scantling Calculations                 | P021416            | 02/07/18      | C1-1800481                    |                  |
| 111702 CP-1                | 2           | 1      | Cargo Piping                           | P021416            | 01/08/18      | E1-1800077                    |                  |
| 111702 DP-1                | 1           | 1      | 4 Barrel Drip Pan                      | P021416            | 01/08/18      | E1-1800077                    |                  |
| 111702 FP-1                | 1           | 0      | Fuel Oil Piping                        | P021416            | 01/08/18      | E1-1800077                    |                  |
| 111702 STP-1               | 1           | 0      | Stripping Piping                       | P021416            | 01/08/18      | E1-1800077                    |                  |
| 111702TK-1                 | 1           | 0      | 500 Gallon Diesel Oil Tank             | P021416            | 01/08/18      | E1-1800077                    |                  |
| -                          | -           | -      | Design Calculations of 500 Gallon Tank | P021416            | 01/08/18      | E1-1800077                    |                  |

**By submission of this form, I hereby certify that I am the legal owner of the plans and documents listed herein; or, have the permission of the legal owner to request plan approval extension on their behalf.**

(MSC Use) This PAE Request is addressed in MSC letter Serial No. C1-1901864 \_\_\_\_\_

Date: May 31, 2019

Sheet 2 of 2

**MARINE SAFETY CENTER PLAN APPROVAL EXTENSION REQUEST FORM**

**Directions:**

1. Complete the table below with all approved plans and corresponding MSC approval letters for which plan approval extension is requested.
2. Electronically submit this form with a copy of the vessel's Application for Inspection directly to the MSC (MSC@USCG.mil), or submit a paper copy to our mailing address:

Commanding Officer (MSC)  
 2703 Martin Luther King Jr. Ave SE  
 Washington, DC 20593-7430

|  |
|--|
| <b>NAME AND IDENTIFICATION (O.N., CG NUMBER) OF VESSEL FOR WHICH PLANS WERE PREVIOUSLY APPROVED:</b><br>CBC1400 THRU CBC1409, O.N.: 1284530 THRU 1284539 |
| <b>NAME AND IDENTIFICATION OF VESSEL(S) TO WHICH PLAN APPROVAL IS TO BE EXTENDED:</b><br>CBC1420 THRU CBC1424 (Southwest Hulls 9823 thru 9827)           |

| Drawing Number | # of Sheets | Rev. # | Drawing Title                         | MSC Project Number | Approval Date | Approval Letter Serial Number | Denied (MSC Use) |
|----------------|-------------|--------|---------------------------------------|--------------------|---------------|-------------------------------|------------------|
| 111702 EL-1    | 1           | 0      | Electrical Arrangement                | P021416            | 02/22/18      | E2-1800628                    |                  |
| 111702 HZ-1    | 1           | 0      | Hazardous Area Plan                   | P021416            | 02/22/18      | E2-1800628                    |                  |
| 111702 HL-1    | 1           | 0      | High Level/Overfill Alarm System      | P021416            | 02/22/18      | E2-1800628                    |                  |
| -              | -           | -      | Capacitance & Inductance Calculations | P021416            | 02/22/18      | E2-1800628                    |                  |
| 111702 VP-1    | 2           | 1      | Vapor Piping Plan                     | P021416            | 02/13/18      | C1-1800528                    |                  |
| -              | -           | -      | Vapor Collection System Calculations  | P021416            | 02/13/18      | C1-1800528                    |                  |
|                |             |        |                                       |                    |               |                               |                  |
|                |             |        |                                       |                    |               |                               |                  |
|                |             |        |                                       |                    |               |                               |                  |

**By submission of this form, I hereby certify that I am the legal owner of the plans and documents listed herein; or, have the permission of the legal owner to request plan approval extension on their behalf.**

(MSC Use) This PAE Request is addressed in MSC letter Serial No. C1-1901864\_\_\_\_\_

**VAPOR COLLECTION SYSTEM CALCULATIONS**

**FOR**

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

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

**USCG PROJECT P021416**

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

**CANAL BARGE COMPANY, INC.**

**January 16, 2018**

**Prepared by:**

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

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

# MARINE SOLUTIONS, INC.

Rev. 0 dated JANUARY 16, 2018

## VCS SYSTEM INFORMATION:

### 1. GENERAL DESCRIPTION OF VESSEL:

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

### 2. VAPOR CONTROL SYSTEM

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

### C. P/V VALVE VENTING CAPACITY:

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

D. SPILL VALVE RELIEVING CAPACITY: NON INSTALLED

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

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

G. DARCY FRICTION FACTOR: 0.014

H. VCS CARGOES: SEE TABLE 1 & TABLE 4

### I. ADDITIONAL MIS. INFORMATION:

SYSTEM IS DESIGNED TO ACCOMMODATE INTERNAL VISUAL INSPECTION.

## VCS CALCULATIONS

### 1. CARGO AUTHORITY::

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

### 2. DETERMINING VAPOR\_AIR MIXTURE DENSITY AND VAPOR GROWTH RATE:

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

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

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

TABLE 2

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

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

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

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

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

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

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

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

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

**TABLE 3**

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

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

TABLE 1 (SUB CHAPTER "D" CARGOES)

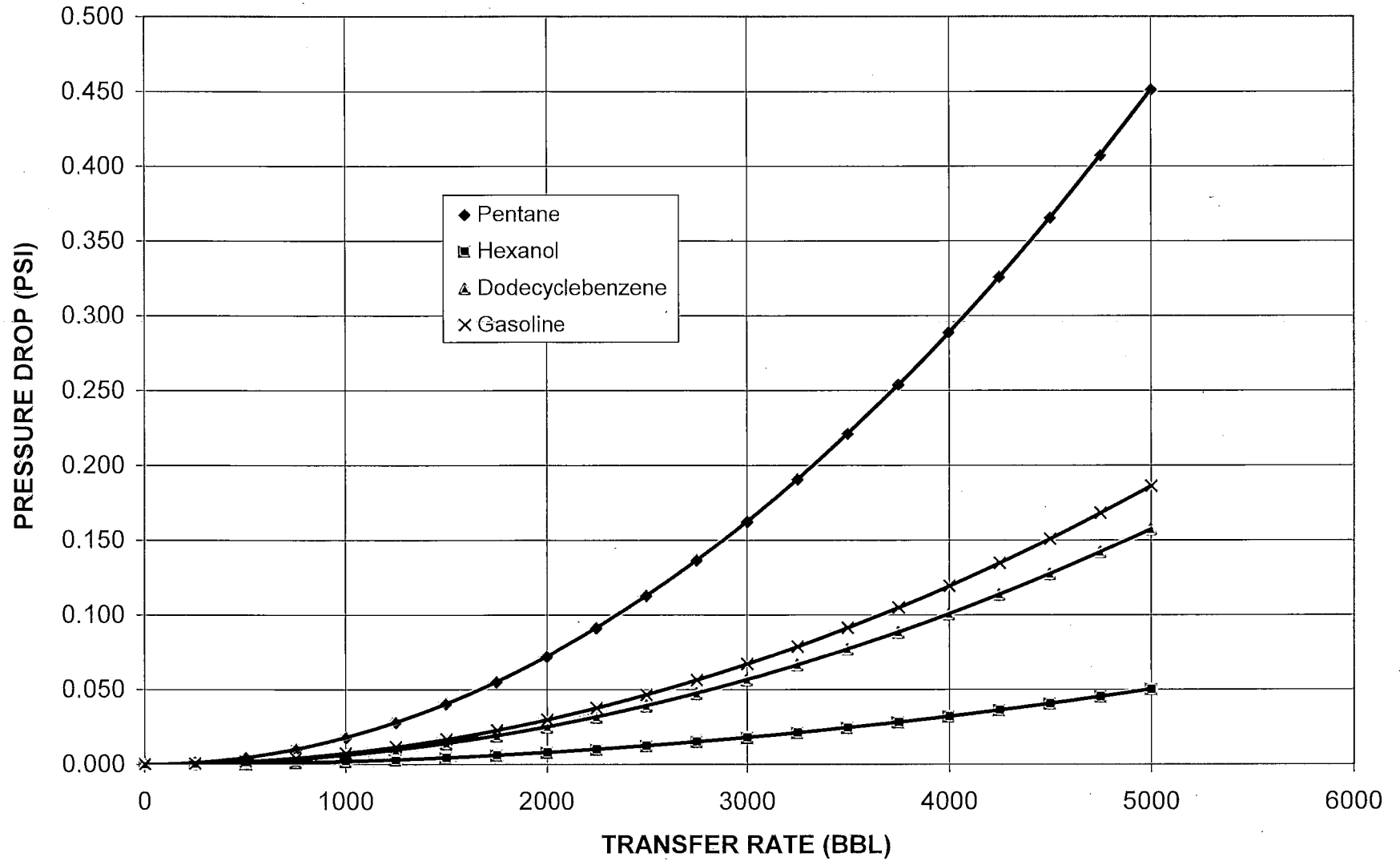
| CHRIS<br>CODE | NAME | VCS<br>CAT   | LIQ<br>SG | VAPOR<br>PRESS | VAPOR<br>SG | VAPOR<br>AIR<br>WEIGHT<br>DENSITY | VAPOR<br>GROWTH<br>RATE | PRESSURE<br>DROP TO PV<br>VALVE IN<br>VCS(psig)<br>(LOADING) | VAPOR<br>VOLUMETRIC<br>FLOW RATE<br>(bbl/h) | AIR<br>EQUIVALENT<br>VOLUMETRIC<br>FLOW RATE | PRESSURE<br>DROP TO<br>SHORE<br>CONNECTION<br>IN VCS (psig)<br>(LOADING)* | PRESSURE<br>DROP TO PV<br>VALVE IN<br>VCS(psig)<br>(UNLOADING) | PRESSURE<br>DROP TO<br>SHORE<br>CONNECTION<br>IN VCS (psig)<br>(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            | BPB  | Butyl Benzyl Phthalate                               | 1         | 1.12           | 0.01        | 10.8                              | 0.076                   | 1.0002   | 0.018                                       | 3501   | 3510  | 0.021  | 0.001   | 0.001 |
| 64            | CLS  | Caprolactam Solutions                                | 1         | 1.02           | 0.05        | 3.9                               | 0.077                   | 1.0010   | 0.018                                       | 3504   | 3518  | 0.021  | 0.001   | 0.001 |
| 70            | CUM  | Cumene   | 1         | 0.86           | 0.60        | 4.20                              | 0.085                   | 1.0120   | 0.020                                       | 3542   | 3745  | 0.023  | 0.001   | 0.001 |
| 72            | CHX  | Cyclohexane  | 1         | 0.78           | 4.5         | 2.9                               | 0.116                   | 1.0900   | 0.032                                       | 3815   | 4714  | 0.037  | 0.002   | 0.002 |
| 73            | CHN  | Cyclohexanol   | 1         | 0.95           | 0.15        | 3.45                              | 0.078                   | 1.0030   | 0.018                                       | 3511   | 3549  | 0.021  | 0.001   | 0.001 |
| 74            | CPD  | 1,3-Cyclopentadiene dimer (molten)                   | 1         | 0.69           | 0.25        | 4.55                              | 0.080                   | 1.0050   | 0.019                                       | 3518   | 3612  | 0.022  | 0.001   | 0.001 |
| 76            | CMP  | Cymene (para-)                                       | 1         | 0.86           | 0.11        | 4.62                              | 0.078                   | 1.0022   | 0.018                                       | 3508   | 3550  | 0.021  | 0.001   | 0.001 |
| 77            | DHN  | Decahydronaphthalene                                 | 1         | 0.89           | 0.1         | 4.76                              | 0.078                   | 1.0020   | 0.018                                       | 3507   | 3546  | 0.021  | 0.001   | 0.001 |
| 78            | IDA  | Decaldehyde (iso-)                                   | 1         | 0.83           | 0.01        | 5                                 | 0.076                   | 1.0002   | 0.018                                       | 3501   | 3504  | 0.021  | 0.001   | 0.001 |
| 79            | DAL  | Decaldehyde (n-)                                     | 1         | 0.83           | 0           | 5.01                              | 0.076                   | 1.0000   | 0.018                                       | 3500   | 3499  | 0.020  | 0.001   | 0.001 |
| 81            | DCE  | Decane   | 1         | 0.74           | 0.12        | 4.8                               | 0.078                   | 1.0024   | 0.018                                       | 3508   | 3556  | 0.021  | 0.001   | 0.001 |
| 82            | DAX  | Decyl Alcohol (all isomers) (Decanol)                | 1         | 0.83           | 0.01        | 5.3                               | 0.076                   | 1.0002   | 0.018                                       | 3501   | 3504  | 0.021  | 0.001   | 0.001 |
| 83            | ISA  | Decyl Alcohol (iso-)                                 | 1         | 0.83           | 0.01        | 5.3                               | 0.076                   | 1.0002   | 0.018                                       | 3501   | 3504  | 0.021  | 0.001   | 0.001 |
| 84            | DAN  | Decyl Alcohol (n-)                                   | 1         | 0.83           | 0.01        | 5.3                               | 0.076                   | 1.0002   | 0.018                                       | 3501   | 3504  | 0.021  | 0.001   | 0.001 |
| 85            | DBZ  | Decylbenzene (n-)                                    | 1         | 0.86           | 0.01        | 7.52                              | 0.076                   | 1.0002   | 0.018                                       | 3501   | 3507  | 0.021  | 0.001   | 0.001 |
| 87            | DAA  | Diacetone Alcohol                                    | 1         | 0.97           | 0.1         | 4                                 | 0.077                   | 1.0020   | 0.018                                       | 3507   | 3538  | 0.021  | 0.001   | 0.001 |
| 91            | DPA  | Dibutyl Phthalate (ortho-)                           | 1         | 1.05           | 0           | 9.59                              | 0.076                   | 1.0000   | 0.018                                       | 3500   | 3499  | 0.020  | 0.001   | 0.001 |
| 92            | DPT  | Dicyclopentadiene, See 1,3-Cyclopentadiene Dime      | 2         | 0.98           | 0.25        | 4.55                              | 0.080                   | 1.0050   | 0.019                                       | 3518   | 3612  | 0.022  | 0.001   | 0.001 |
| 93            | DEB  | Diethylbenzene                                       | 1         | 0.87           | 0.08        | 4.62                              | 0.077                   | 1.0016   | 0.018                                       | 3506   | 3536  | 0.021  | 0.001   | 0.001 |
| 94            | DEG  | Diethylene Glycol                                    | 1         | 1.12           | 0.01        | 3.66                              | 0.076                   | 1.0002   | 0.018                                       | 3501   | 3503  | 0.021  | 0.001   | 0.001 |
| 95            | DME  | Diethylene Glycol Butyl Ether                        | 1         | 0.95           | 0.01        | 5.5                               | 0.076                   | 1.0002   | 0.018                                       | 3501   | 3505  | 0.021  | 0.001   | 0.001 |
| 100           | DGA  | Diethylene Glycol Ethyl Ether Acetate                | 1         | 0.99           | 0.02        | 4.62                              | 0.076                   | 1.0004   | 0.018                                       | 3501   | 3508  | 0.021  | 0.001   | 0.001 |
| 101           | DGM  | Diethylene Glycol Methyl Ether                       | 1         | 1.03           | 0.03        | 4.14                              | 0.076                   | 1.0006   | 0.018                                       | 3502   | 3511  | 0.021  | 0.001   | 0.001 |
| 111           | DBC  | Diisobutylcarbinol                                   | 1         | 0.81           | 0.09        | 4.97                              | 0.078                   | 1.0018   | 0.018                                       | 3506   | 3544  | 0.021  | 0.001   | 0.001 |
| 112           | DBL  | Diisobutylene  | 1         | 0.72           | 2           | 3.86                              | 0.103                   | 1.0400   | 0.026                                       | 3640   | 4233  | 0.030  | 0.001   | 0.002 |
| 113           | DIX  | Diisobutyl Ketone                                    | 1         | 0.81           | 0.16        | 4.9                               | 0.079                   | 1.0032   | 0.019                                       | 3511   | 3577  | 0.021  | 0.001   | 0.001 |
| 119           | DIX  | Diisopropylbenzene (all isomer)                      | 1         | 0.86           | 0.03        | 5.6                               | 0.077                   | 1.0006   | 0.018                                       | 3502   | 3516  | 0.021  | 0.001   | 0.001 |
| 124           | DTL  | Dimethyl Phthalate                                   | 1         | 1.19           | 0           | 6.69                              | 0.076                   | 1.0000   | 0.018                                       | 3500   | 3499  | 0.020  | 0.001   | 0.001 |
| 130           | DOP  | Diethyl Phthalate                                    | 1         | 0.98           | 0           | 13.47                             | 0.076                   | 1.0000   | 0.018                                       | 3500   | 3499  | 0.020  | 0.001   | 0.001 |
| 131           | DPN  | Dipentene  | 1         | 0.84           | 0.1         | 4.9                               | 0.078                   | 1.0020   | 0.018                                       | 3507   | 3548  | 0.021  | 0.001   | 0.001 |
| 132           | DIL  | Diphenyl   | 1         | 0.99           | 0.01        | 5.31                              | 0.076                   | 1.0002   | 0.018                                       | 3501   | 3504  | 0.021  | 0.001   | 0.001 |
| 133           | DDO  | Diphenyl, Diphenyl Ether Mixture                     | 1         | 1.07           | 0.01        | 5.86                              | 0.076                   | 1.0002   | 0.018                                       | 3501   | 3505  | 0.021  | 0.001   | 0.001 |
| 134           | DPE  | Diphenyl Ether                                       | 1         | 1.07           | 0.01        | 5.87                              | 0.076                   | 1.0002   | 0.018                                       | 3501   | 3505  | 0.021  | 0.001   | 0.001 |
| 136           | DPG  | Dipropylene Glycol                                   | 1         | 1.03           | 0.07        | 4.63                              | 0.077                   | 1.0014   | 0.018                                       | 3505   | 3531  | 0.021  | 0.001   | 0.001 |
| 139           | DFR  | 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           | DOB  | Dodecylbenzene                                       | 1         | 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    | 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    | 1 | 0.71 | 12.5  | 3.4  | 0.217 | 1.2500 | 0.079 | 4375 | 7386 | 0.091 | 0.004 | 0.005 |
| 201 | GCS | Gasolines: Casinghead                                    | 1 | 0.67 | 12.5  | 3.4  | 0.217 | 1.2500 | 0.079 | 4375 | 7386 | 0.091 | 0.004 | 0.005 |
| 202 | GPL | Gasolines: Polymer                                       | 1 | 0.75 | 12.5  | 3.4  | 0.217 | 1.2500 | 0.079 | 4375 | 7386 | 0.091 | 0.004 | 0.005 |
| 203 | GSR | Gasolines: Straight Run                                  | 1 | 0.75 | 12.5  | 3.4  | 0.217 | 1.2500 | 0.079 | 4375 | 7386 | 0.091 | 0.004 | 0.005 |
| 204 | GCR | Glycerine  | 1 | 1.26 | 0     | 3.17 | 0.076 | 1.0000 | 0.018 | 3500 | 3499 | 0.020 | 0.001 | 0.001 |
| 217 | HMX | Heptane (all isomers) (Methylhexane)                     | 1 | 0.68 | 2.5   | 3.45 | 0.105 | 1.0500 | 0.027 | 3675 | 4313 | 0.031 | 0.001 | 0.002 |
| 218 | HPT | Heptane (n-)   | 1 | 0.68 | 2.5   | 3.45 | 0.105 | 1.0500 | 0.027 | 3675 | 4313 | 0.031 | 0.001 | 0.002 |
| 220 | HTX | Heptanol (all isomers)                                   | 1 | 0.82 | 0.04  | 4    | 0.077 | 1.0008 | 0.018 | 3503 | 3515 | 0.021 | 0.001 | 0.001 |
| 221 | HTN | Heptanol (all isomers)                                   | 1 | 0.82 | 0.04  | 4    | 0.077 | 1.0008 | 0.018 | 3503 | 3515 | 0.021 | 0.001 | 0.001 |
| 222 | HPX | Heptene (all isomers)                                    | 2 | 0.7  | 2.9   | 3.4  | 0.109 | 1.0580 | 0.028 | 3703 | 4426 | 0.033 | 0.001 | 0.002 |
| 223 | THE | Heptene (1-)   | 1 | 0.7  | 2.8   | 3.4  | 0.107 | 1.0560 | 0.028 | 3696 | 4395 | 0.032 | 0.001 | 0.002 |
| 229 | HXS | Hexane (all isomers)                                     | 1 | 0.66 | 7     | 3    | 0.142 | 1.1400 | 0.043 | 3990 | 5446 | 0.050 | 0.002 | 0.003 |
| 230 | HXA | Hexane   | 1 | 0.66 | 7     | 3    | 0.142 | 1.1400 | 0.043 | 3990 | 5446 | 0.050 | 0.002 | 0.003 |
| 231 | HXO | Hexanoic Acid  | 1 | 0.93 | 0.01  | 4    | 0.076 | 1.0002 | 0.018 | 3501 | 3503 | 0.021 | 0.001 | 0.001 |
| 232 | HXN | Hexanol  | 1 | 0.82 | 1     | 3.52 | 0.088 | 1.0200 | 0.021 | 3570 | 3837 | 0.025 | 0.001 | 0.001 |
| 234 | HEX | Hexene (all isomers)                                     | 2 | 0.67 | 8     | 2.9  | 0.147 | 1.1600 | 0.046 | 4060 | 5651 | 0.053 | 0.002 | 0.003 |
| 235 | HXE | Hexene (1-)  | 1 | 0.67 | 8.2   | 2.9  | 0.149 | 1.1640 | 0.047 | 4074 | 5705 | 0.054 | 0.002 | 0.003 |
| 236 | HXT | Hexene (2-)  | 1 | 0.67 | 8.2   | 2.9  | 0.149 | 1.1640 | 0.047 | 4074 | 5705 | 0.054 | 0.002 | 0.003 |
| 238 | HXG | Hexylene Glycol  | 4 | 0.92 | 0.01  | 1.1  | 0.076 | 1.0002 | 0.018 | 3501 | 3500 | 0.020 | 0.001 | 0.001 |
| 243 | IPH | Isophorone   | 1 | 0.93 | 0.01  | 4.75 | 0.076 | 1.0002 | 0.018 | 3501 | 3504 | 0.021 | 0.001 | 0.001 |
| 244 | JPO | Jet Fuels: JP-1 (Kerosene)                               | 1 | 0.8  | 0.14  | 4.5  | 0.078 | 1.0028 | 0.018 | 3510 | 3561 | 0.021 | 0.001 | 0.001 |
| 245 | JPT | Jet Fuels: JP-3  | 1 | 0.8  | 8.51  | 4.5  | 0.216 | 1.1702 | 0.069 | 4096 | 6899 | 0.080 | 0.004 | 0.004 |
| 246 | JPF | Jet Fuels: JP-4  | 1 | 0.81 | 3.4   | 4    | 0.124 | 1.0680 | 0.033 | 3738 | 4770 | 0.038 | 0.002 | 0.002 |
| 247 | JPV | Jet Fuels: JP-5 (Kerosene, heavy)                        | 1 | 0.82 | 0.1   | 4    | 0.077 | 1.0020 | 0.018 | 3507 | 3538 | 0.021 | 0.001 | 0.001 |
| 249 | KRS | Kerosene   | 1 | 0.81 | 0.15  | 4.5  | 0.078 | 1.0030 | 0.018 | 3511 | 3566 | 0.021 | 0.001 | 0.001 |
| 263 | MTT | Methyl Acetate   | 1 | 0.92 | 6.1   | 2.6  | 0.122 | 1.1220 | 0.036 | 3927 | 4970 | 0.041 | 0.002 | 0.002 |
| 265 | MAL | Methyl Alcohol (See Methanol)                            | 1 | 0.79 | 6.63  | 1.1  | 0.079 | 1.1326 | 0.024 | 3964 | 4043 | 0.027 | 0.001 | 0.001 |
| 266 | MAC | Methyl Amyl Acetate                                      | 1 | 0.86 | 0.33  | 4.97 | 0.082 | 1.0066 | 0.019 | 3523 | 3662 | 0.022 | 0.001 | 0.001 |
| 267 | MAA | Methyl Amyl Alcohol                                      | 1 | 0.81 | 0.43  | 3.52 | 0.081 | 1.0086 | 0.019 | 3530 | 3645 | 0.022 | 0.001 | 0.001 |
| 271 | MBK | Methyl n-Butyl Ketone                                    | 1 | 0.81 | 0.97  | 3.5  | 0.087 | 1.0194 | 0.021 | 3568 | 3825 | 0.024 | 0.001 | 0.001 |
| 273 | MBU | Methyl Butyrate  | 1 | 0.9  | 1.26  | 3.53 | 0.091 | 1.0252 | 0.022 | 3588 | 3924 | 0.026 | 0.001 | 0.001 |
| 274 | MEK | Methyl Ethyl Ketone                                      | 1 | 0.8  | 4.5   | 2.5  | 0.108 | 1.0900 | 0.030 | 3815 | 4539 | 0.034 | 0.002 | 0.002 |
| 275 | MTF | Methyl Formal (Dimethyl Formal)                          | 1 | 0.86 | 15.42 | 2.6  | 0.192 | 1.3084 | 0.076 | 4579 | 7272 | 0.088 | 0.004 | 0.005 |
| 276 | MHK | Methyl Heptyl Ketone                                     | 1 | 0.83 | 0.06  | 4.9  | 0.077 | 1.0012 | 0.018 | 3504 | 3528 | 0.021 | 0.001 | 0.001 |
| 278 | MIK | Methyl Isobutyl Ketone                                   | 1 | 0.8  | 1.15  | 3.45 | 0.089 | 1.0230 | 0.022 | 3581 | 3878 | 0.025 | 0.001 | 0.001 |
| 281 | MNA | 1-Methyl Naphthalene                                     | 1 | 1.02 | 0.01  | 4.91 | 0.076 | 1.0002 | 0.018 | 3501 | 3504 | 0.021 | 0.001 | 0.001 |
| 283 | MPN | 2-Methyl-1-Pentene                                       | 1 | 0.69 | 6.3   | 2.9  | 0.132 | 1.1260 | 0.039 | 3941 | 5195 | 0.045 | 0.002 | 0.002 |
| 284 | MTN | 5-Methyl-1-Pentene                                       | 1 | 0.67 | 8.49  | 2.9  | 0.152 | 1.1698 | 0.048 | 4094 | 5782 | 0.056 | 0.003 | 0.003 |
| 286 | MBE | Methyl Tert-Butyl Ether (MTBE)                           | 1 | 0.74 | 0.04  | 3.1  | 0.076 | 1.0008 | 0.018 | 3503 | 3511 | 0.021 | 0.001 | 0.001 |
| 288 | MNS | Mineral Spirits  | 1 | 0.75 | 0.2   | 4.3  | 0.079 | 1.0040 | 0.019 | 3514 | 3584 | 0.021 | 0.001 | 0.001 |
| 289 | MRE | Myrcene  | 1 | 0.8  | 0.17  | 4.7  | 0.079 | 1.0034 | 0.019 | 3512 | 3578 | 0.021 | 0.001 | 0.001 |
| 295 | NSV | Naphtha: Solvent   | 1 | 0.87 | 0.2   | 3.5  | 0.078 | 1.0040 | 0.018 | 3514 | 3567 | 0.021 | 0.001 | 0.001 |
| 296 | NSS | Naphtha: Stoddard Solvant                                | 1 | 0.78 | 0.2   | 4.3  | 0.079 | 1.0040 | 0.019 | 3514 | 3584 | 0.021 | 0.001 | 0.001 |
| 297 | NVM | Naphtha: Varnish Maker's and Painters (75%)              | 1 | 0.77 | 0.19  | 4.3  | 0.079 | 1.0038 | 0.019 | 3513 | 3580 | 0.021 | 0.001 | 0.001 |
| 300 | NAX | Nonane (all isomers)                                     | 1 | 0.72 | 0.27  | 4.4  | 0.080 | 1.0054 | 0.019 | 3519 | 3616 | 0.022 | 0.001 | 0.001 |
| 301 | NAN | Nonane   | 1 | 0.72 | 0.27  | 4.4  | 0.080 | 1.0054 | 0.019 | 3519 | 3616 | 0.022 | 0.001 | 0.001 |
| 304 | NON | Nonene   | 1 | 0.73 | 0.35  | 4.3  | 0.081 | 1.0070 | 0.019 | 3525 | 3647 | 0.022 | 0.001 | 0.001 |
| 305 | NNS | Nonyl Alcohol (all isomers)                              | 1 | 0.94 | 0.1   | 5    | 0.078 | 1.0020 | 0.018 | 3507 | 3549 | 0.021 | 0.001 | 0.001 |
| 306 | NNN | Nonyl Alcohol  | 1 | 0.94 | 0.1   | 5    | 0.078 | 1.0020 | 0.018 | 3507 | 3549 | 0.021 | 0.001 | 0.001 |
| 307 | NNI | Nonyl Alcohol (iso-)                                     | 1 | 0.94 | 0.1   | 5    | 0.078 | 1.0020 | 0.018 | 3507 | 3549 | 0.021 | 0.001 | 0.001 |
| 309 | NNP | Nonyl Phenol   | 1 | 0.95 | 0.01  | 7.6  | 0.076 | 1.0002 | 0.018 | 3501 | 3507 | 0.021 | 0.001 | 0.001 |
| 316 | OAX | Octane (all isomers)                                     | 1 | 0.7  | 0.79  | 3.9  | 0.087 | 1.0158 | 0.021 | 3555 | 3797 | 0.024 | 0.001 | 0.001 |
| 317 | OAN | Octane   | 1 | 0.7  | 0.79  | 3.9  | 0.087 | 1.0158 | 0.021 | 3555 | 3797 | 0.024 | 0.001 | 0.001 |
| 320 | OTA | Octanol  | 1 | 0.83 | 0.01  | 4.48 | 0.076 | 1.0002 | 0.018 | 3501 | 3503 | 0.021 | 0.001 | 0.001 |
| 322 | OTE | Octene (1-)  | 1 | 0.72 | 1     | 3.86 | 0.089 | 1.0200 | 0.022 | 3570 | 3871 | 0.025 | 0.001 | 0.001 |
| 324 | OCX | Octyl Alcohol (iso-, n-) ( all isomers), See Octanol ( 1 | 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 Entry    | 1 | 0.77  | 0.01   | 6.77   | 0.076 | 1.0002 | 0.018 | 3501 | 3506  | 0.021 | 0.001 | 0.001 |
| 496 TTG | Tetraethylene Glycol                                   | 1 | 1.12  | 0.01   | 6.7    | 0.076 | 1.0002 | 0.018 | 3501 | 3506  | 0.021 | 0.001 | 0.001 |
| 497 THN | Tetrahydronaphthalene                                  | 1 | 0.97  | 0.04   | 4.56   | 0.077 | 1.0008 | 0.018 | 3503 | 3517  | 0.021 | 0.001 | 0.001 |
| 499 TOL | Toluene  | 1 | 0.87  | 1.5    | 3.14   | 0.091 | 1.0300 | 0.023 | 3605 | 3945  | 0.026 | 0.001 | 0.001 |
| 502 TCP | Tricresyl Phosphate (less than 1% of the ortho isomer) | 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 | Trimethylbenzenes (all isomers)                        | 1 | 0.89  | 0.14   | 4.2    | 0.078 | 1.0028 | 0.018 | 3510 | 3557  | 0.021 | 0.001 | 0.001 |
| 520 TMB | Trimethyl Benzene (1,2,5-)                             | 1 | 0.89  | 0.14   | 4.14   | 0.078 | 1.0028 | 0.018 | 3510 | 3556  | 0.021 | 0.001 | 0.001 |
| 521 TMD | Trimethyl Benzene (1,2,3-)                             | 1 | 0.89  | 0.14   | 4.14   | 0.078 | 1.0028 | 0.018 | 3510 | 3556  | 0.021 | 0.001 | 0.001 |
| 522 TME | Trimethyl Benzene (1,2,4-) (Pseudocumene)              | 1 | 0.89  | 0.14   | 4.14   | 0.078 | 1.0028 | 0.018 | 3510 | 3556  | 0.021 | 0.001 | 0.001 |
| 529 TRP | Trixylynyl Phosphate                                   | 1 | 1.16  | 0      | 14.2   | 0.076 | 1.0000 | 0.018 | 3500 | 3499  | 0.020 | 0.001 | 0.001 |
| 546 XLX | Xylenes (Ortho-, meta-, para-)                         | 1 | 0.89  | 0.51   | 3.66   | 0.082 | 1.0102 | 0.020 | 3536 | 3680  | 0.023 | 0.001 | 0.001 |
| 547 XLM | Xylene (M-)  | 1 | 0.87  | 0.51   | 3.66   | 0.082 | 1.0102 | 0.020 | 3536 | 3680  | 0.023 | 0.001 | 0.001 |
| 548 XLO | Xylene (O-)  | 1 | 0.89  | 0.4    | 3.66   | 0.081 | 1.0080 | 0.019 | 3528 | 3641  | 0.022 | 0.001 | 0.001 |
| 549 XLP | Xylene (P-)  | 1 | 0.86  | 0.51   | 3.66   | 0.082 | 1.0102 | 0.020 | 3536 | 3680  | 0.023 | 0.001 | 0.001 |
| 550 XYL | Xylenol  | 1 | 1.01  | 0.1    | 3.66   | 0.077 | 1.0020 | 0.018 | 3507 | 3535  | 0.021 | 0.001 | 0.001 |
| 551     | Zinc Dialkylidithiophosphate                           |   |       |        |        |       |        |       |      |       |       |       |       |
|         | Max.   |   | 1.260 | 27.000 | 79.300 | 0.346 | 1.540  | 0.191 | 5390 | 11501 | 0.221 | 0.010 | 0.012 |
|         | Min.   |   | 0.000 | 0.000  | 1.000  | 0.000 | 1.000  | 0.018 | 3500 | 3499  | 0.020 | 0.000 | 0.000 |

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

### LIQUID TRANSFER RATE vs PRESSURE DROP



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

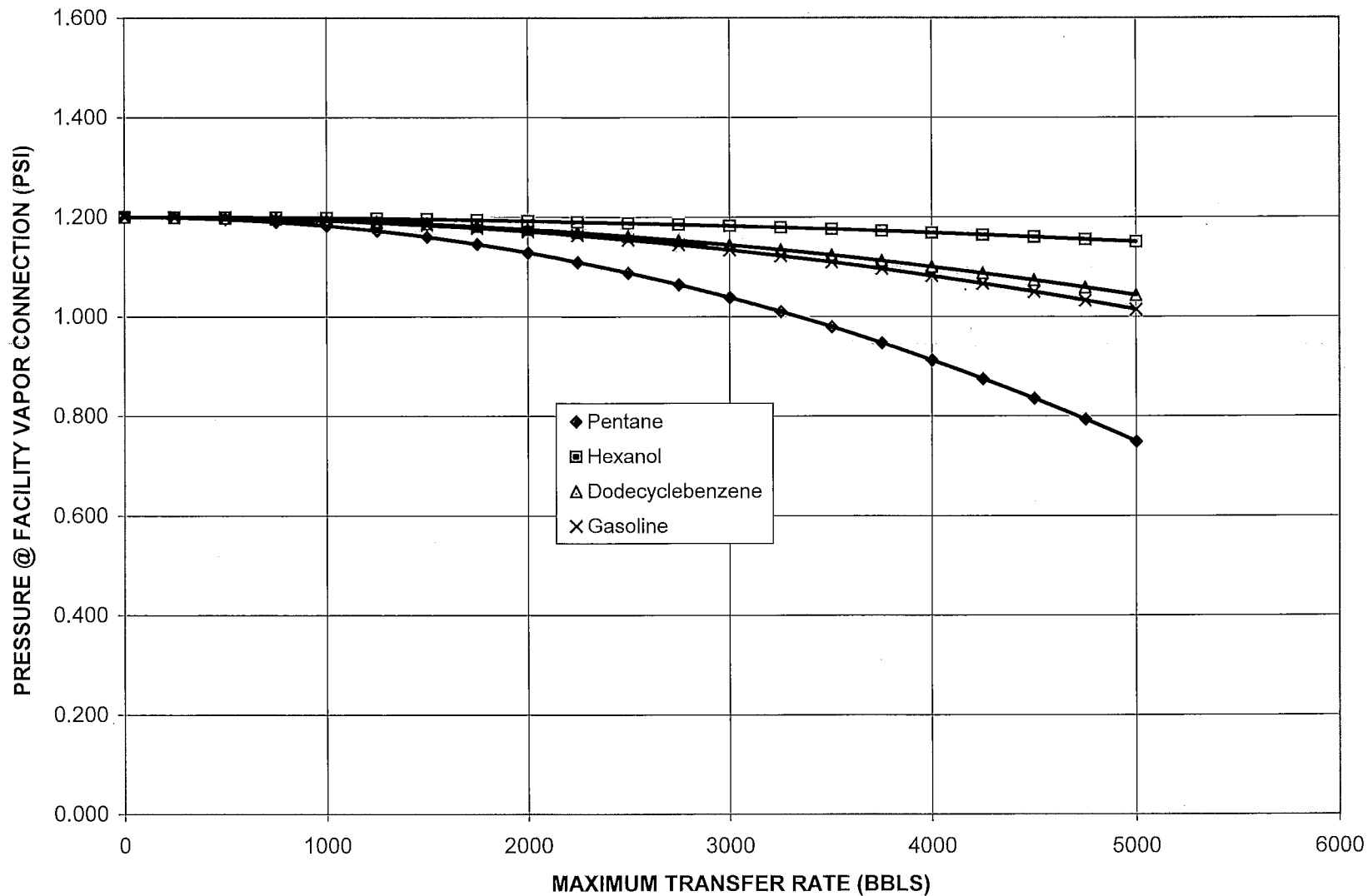
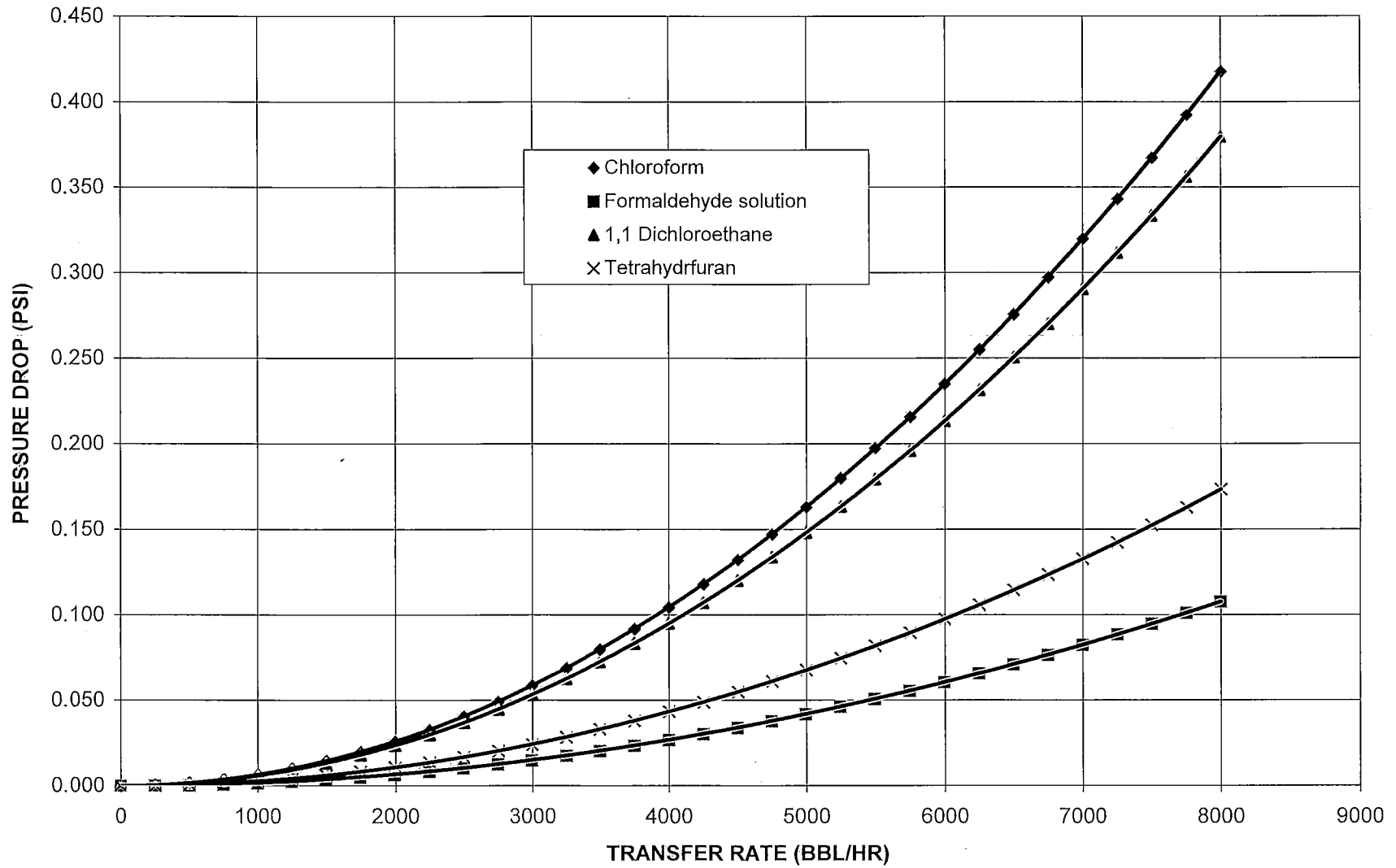


TABLE 4 (SUBCHAPTER "O" CARGOES)

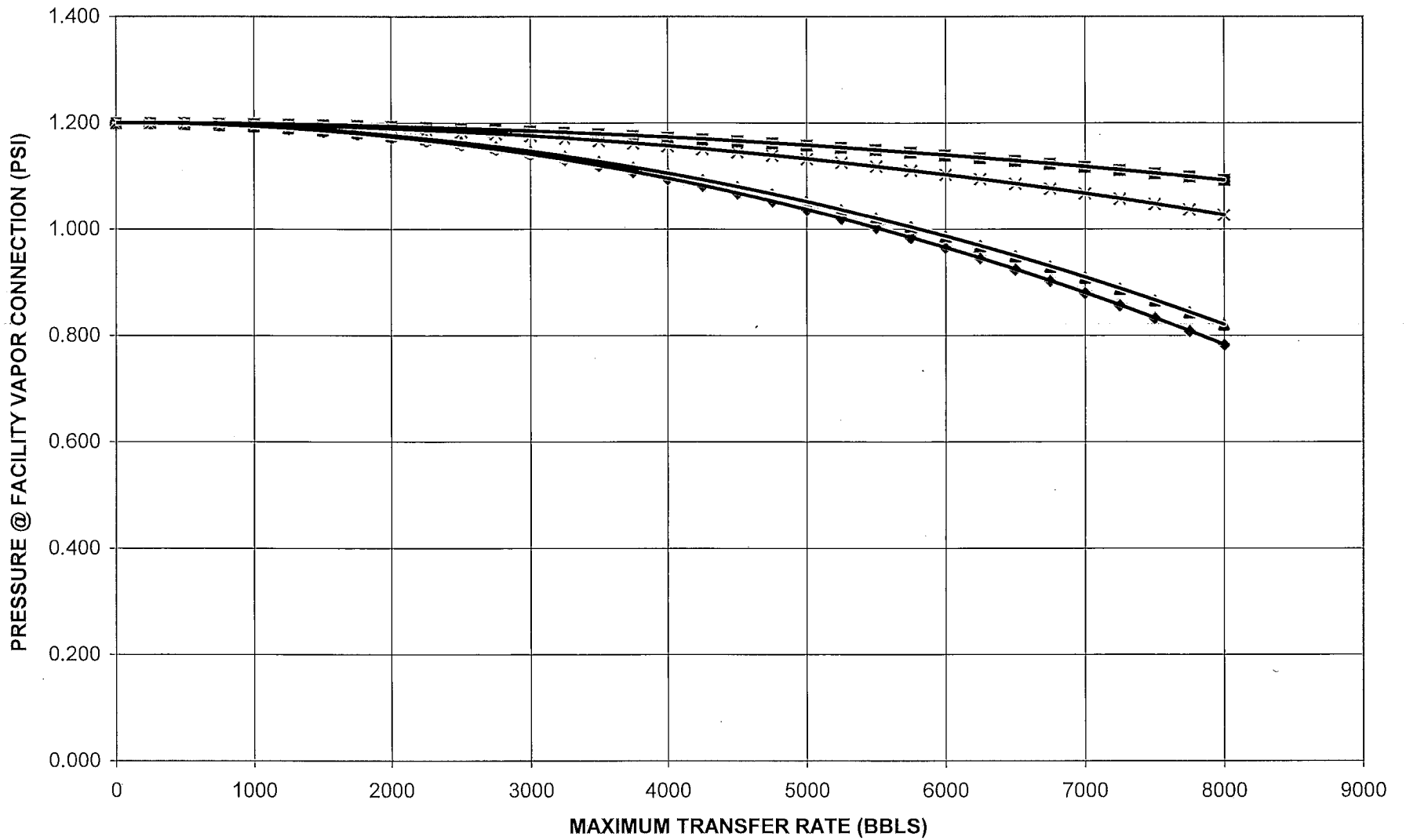
| CHRIS CODE | NAME | VCS CAT   | LIQ SG | VAPOR PRESS | VAPOR SG | VAPOR AIR WEIGHT DENSITY | VAPOR GROWTH RATE | PRESSURE DROP TO PV          | VAPOR VOLUMETRIC FLOW RATE (bbl/h) | AIR EQUIVALENT VOLUMETRIC FLOW RATE | PRESSURE DROP TO SHORE CONNECTION | PRESSURE DROP TO PV VALVE IN VCS | PRESSURE DROP TO SHORE CONNECTION |       |
|------------|------|---|--------|-------------|----------|--------------------------|-------------------|------------------------------|------------------------------------|-------------------------------------|-----------------------------------|----------------------------------|-----------------------------------|-------|
|            |      |   |        |             |          |                          |                   | VALVE IN VCS(psig) (LOADING) |                                    |                                     | IN VCS (psig) (LOADING)*          | IN VCS (psig) (UNLOADING)        | IN VCS (psig) (UNLOADING)*        |       |
| 1          | ACN  | Acrylonitrile   | 4      | 0.81        | 5.00     | 1.80                     | 0.095             | 1.1000                       | 0.027                              | 3850                                | 4298                              | 0.031                            | 0.001                             | 0.002 |
| 2          | ADN  | Adiponitrile  | 1      | 0.95        | 0.01     | 3.73                     | 0.076             | 1.0002                       | 0.018                              | 3501                                | 3503                              | 0.021                            | 0.001                             | 0.001 |
| 3          | ATN  | Acetonitrile  | 3      | 0.78        | 0.03     | 1.41                     | 0.076             | 1.0006                       | 0.018                              | 3502                                | 3502                              | 0.021                            | 0.001                             | 0.001 |
| 4          | BAD  | Iso-Butyraldehyde                                       | 1      | 0.80        | 7.80     | 2.50                     | 0.131             | 1.1560                       | 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         | GTA  | Crotonaldehyde  | 4      | 0.85        | 2        | 2.41                     | 0.089             | 1.0400                       | 0.022                              | 3640                                | 3943                              | 0.026                            | 0.001                             | 0.001 |
| 17         | DCH  | 1,1-Dichloroethane                                      | 1      | 1.18        | 9.90     | 3.41                     | 0.188             | 1.1980                       | 0.063                              | 4193                                | 6592                              | 0.073                            | 0.003                             | 0.004 |
| 18         | DPP  | 1,2-Dichloropropane                                     | 3      | 1.16        | 2.5      | 3.89                     | 0.110             | 1.0500                       | 0.028                              | 3675                                | 4418                              | 0.033                            | 0.001                             | 0.002 |
| 19         | DPU  | 1,3-Dichloropropane                                     | 4      | 1.23        | 5.5      | 3.84                     | 0.149             | 1.1100                       | 0.043                              | 3885                                | 5443                              | 0.050                            | 0.002                             | 0.003 |
| 20         | DEN  | Diethylamine  | 3      | 0.71        | 1.00     | 2.50                     | 0.083             | 1.0200                       | 0.020                              | 3570                                | 3731                              | 0.023                            | 0.001                             | 0.001 |
| 21         | DIP  | Diisopropanolamine                                      | 1      | 0.98        | 0.01     | 4.59                     | 0.076             | 1.0002                       | 0.018                              | 3501                                | 3504                              | 0.021                            | 0.001                             | 0.001 |
| 22         | DMF  | Dimethylformamide                                       | 2      | 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         | MISO | Mesityl Oxide   | 1      | 0.86        | 0.67     | 3.5                      | 0.084             | 1.0134                       | 0.020                              | 3547                                | 3725                              | 0.023                            | 0.001                             | 0.001 |
| 32         | MAM  | Methyl acrylate   | 2      | 0.95        | 4.10     | 3.00                     | 0.114             | 1.0820                       | 0.031                              | 3787                                | 4646                              | 0.036                            | 0.002                             | 0.002 |
| 33         | MBE  | Methylcyclopentadiene dimer                             | 1      | 0.74        | 0.04     | 3.10                     | 0.076             | 1.0008                       | 0.018                              | 3503                                | 3511                              | 0.021                            | 0.001                             | 0.001 |
| 34         | MMM  | Methyl methacrylate                                     | 2      | 0.94        | 2.02     | 3.45                     | 0.099             | 1.0404                       | 0.025                              | 3641                                | 4159                              | 0.029                            | 0.001                             | 0.002 |
| 35         | MPL  | Morpholine  | 1      | 1.00        | 0.80     | 3.00                     | 0.083             | 1.0160                       | 0.020                              | 3556                                | 3726                              | 0.023                            | 0.001                             | 0.001 |
| 36         | NPM  | 1- or 2-Nitropropane                                    | 1      | 0.99        | 1.05     | 3.06                     | 0.086             | 1.0210                       | 0.021                              | 3574                                | 3804                              | 0.024                            | 0.001                             | 0.001 |
| 37         | PRD  | Pyridine  | 1      | 0.98        | 1.30     | 2.72                     | 0.086             | 1.0260                       | 0.021                              | 3591                                | 3830                              | 0.025                            | 0.001                             | 0.001 |
| 38         | STY  | Styrene   | 2      | 0.92        | 0.40     | 3.60                     | 0.081             | 1.0080                       | 0.019                              | 3528                                | 3638                              | 0.022                            | 0.001                             | 0.001 |
| 39         | TCN  | 1,2,3-Trichloropropane                                  | 3      | 1.39        | 0.15     | 5.60                     | 0.079             | 1.0030                       | 0.019                              | 3511                                | 3583                              | 0.021                            | 0.001                             | 0.001 |
| 40         | TEN  | Triethylamine   | 3      | 0.73        | 2.50     | 3.49                     | 0.105             | 1.0500                       | 0.027                              | 3675                                | 4323                              | 0.031                            | 0.001                             | 0.002 |
| 41         | THF  | Tetrahydrofuran   | 1      | 0.89        | 8.50     | 1.35                     | 0.090             | 1.1700                       | 0.029                              | 4095                                | 4454                              | 0.033                            | 0.001                             | 0.002 |
| 42         | VAM  | Vinyl acetate   | 2      | 0.94        | 5.80     | 2.97                     | 0.130             | 1.1160                       | 0.038                              | 3906                                | 5099                              | 0.043                            | 0.002                             | 0.002 |
|            |      |   | Max.   | 1.39        | 12.5     | 8.40                     | 0.213             | 1.198                        | 0.069                              | 4193                                | 6916                              | 0.080                            | 0.004                             | 0.004 |
|            |      |   | Min.   | 0.63        | 0.01     | 1.03                     | 0.076             | 1.000                        | 0.018                              | 3501                                | 3502                              | 0.021                            | 0.001                             | 0.001 |

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

# LIQUID TRANSFER RATE vs PRESSURE DROP



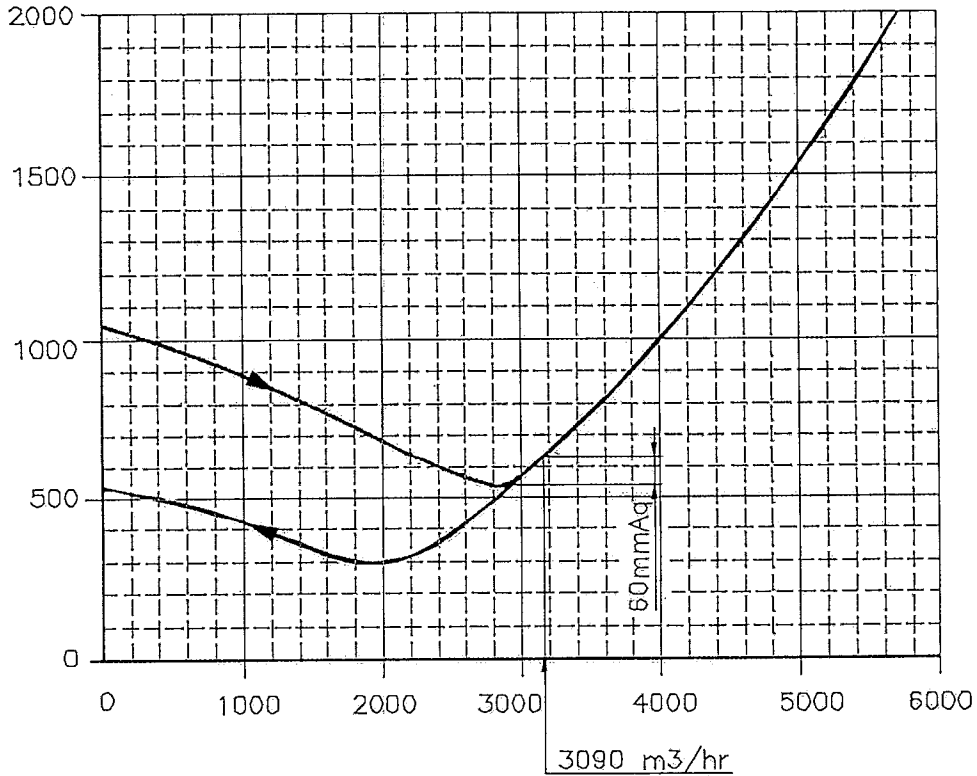
### PRESSURE vs MAXIMUM TRANSFER RATE (FOR SUB-CHAPTER "O" CARGOES)



# HIGH VELOCITY VENT VALVE FLOW CAPACITY CURVE

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

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

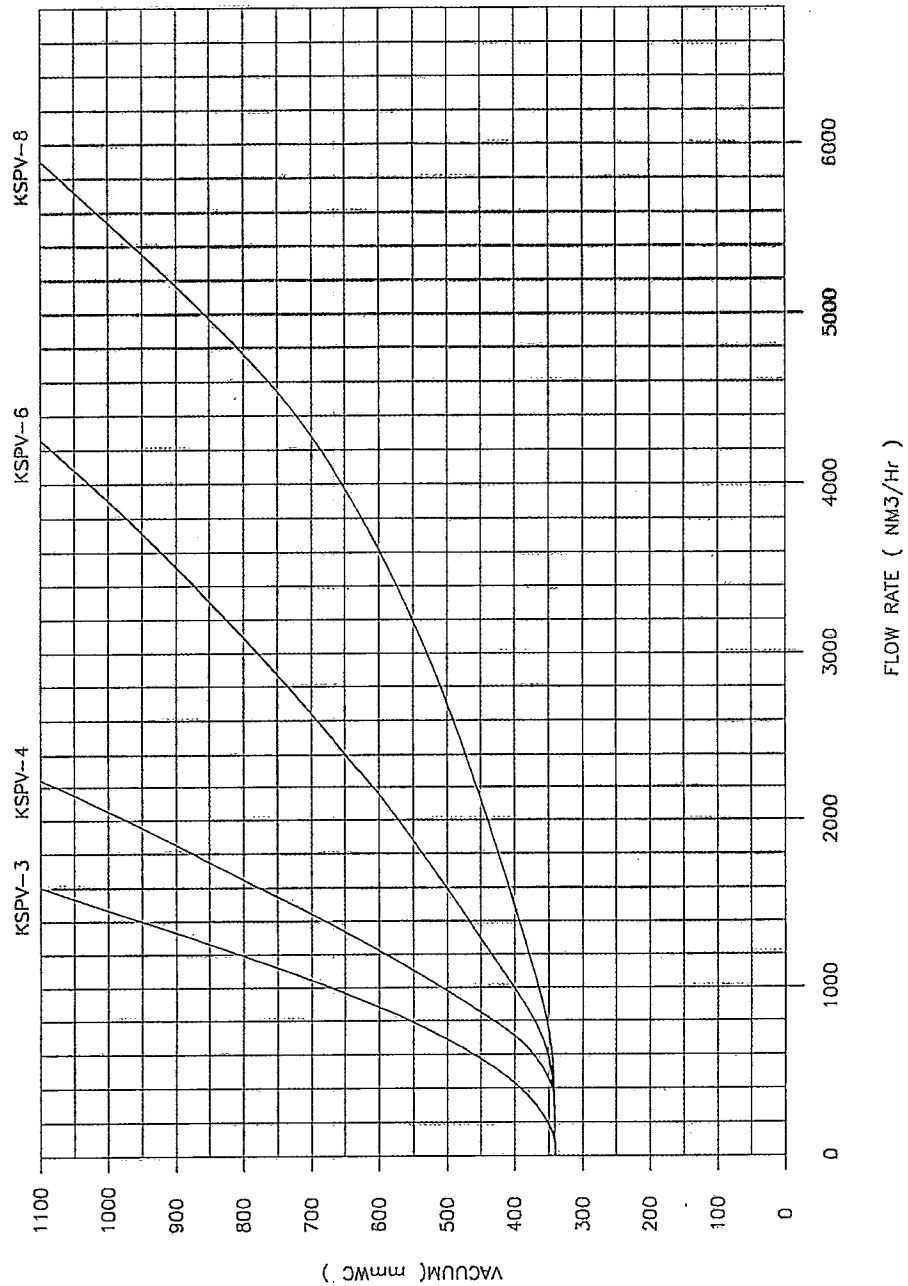


FLOW CAPACITY CURVE, SCM(H Standard cubic meter per hour)  
 (1SCMH = 6.289BBL/hr)

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

# FLOW CAPACITY CURVE GRAPH

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



**TANKTECH**

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

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

| 1. Vessel Identification                                 | Hull Type | Service | ABS<br>classified? |
|--|-----------|---------|--------------------|
| CBC 1420, O.N. 1299143, Southwest Shipyard Hull No. 9823 | I/II/III  | O/D     | No                 |
| CBC 1421, O.N. 1298895, Southwest Shipyard Hull No. 9824 | I/II/III  | O/D     | No                 |
| CBC 1422, O.N. 1298896, Southwest Shipyard Hull No. 9825 | I/II/III  | O/D     | No                 |
| CBC 1423, O.N. 1298897, Southwest Shipyard Hull No. 9826 | I/II/III  | O/D     | No                 |
| CBC 1424, O.N. 1298898, Southwest Shipyard Hull No. 9827 | 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     |
| 33 CFR Sub. O Authority: | Part 151.47  | No  | Part 151.49a    | 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<br>Wgt/Each<br>Tank (ST) | Max Density<br>(lbs/gal) |
|------|------------------------------------|--------------------------|
| 1C   | 579                                | 13.33                    |
| 2C   | 730                                | 13.33                    |
| 3C   | 657                                | 13.33                    |

Loading Constraints - Stability

| Hull<br>Type | Route | Max. Load<br>(ST) | Max Draft<br>(ft, in) | Max Density<br>(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                    |



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



|                           |                          |                    |                |
|---------------------------|--------------------------|--------------------|----------------|
| <b>Vessel Name</b>        | CBC 1420 thru CBC 1424   | <b>Shipyard</b>    | Southwest      |
| <b>Coast Guard Number</b> | CG1562194 thru CG1562194 | <b>Hull Number</b> | 9823 thru 9827 |

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

2. Tank Maximum Design Working Pressure 3.50 psig Raised Trunk   
Flush Deck

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

4. Authorized Maximum Vapor-Air Mixture Density 0.346 lbm/ft<sup>3</sup>

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]

|   |   |  |  |
|---|---|--|--|
| <b>7. Pressure Vacuum Valve:</b>  |   | <b>8. VCS Pipe Sizes:</b>  |  |
| Manufacturer <span style="border: 1px solid black; padding: 2px;">Tanktech</span>   | Settings in psig:   | Approx. Inside Diameter  |  |
| Size <span style="border: 1px solid black; padding: 2px;">KLPH-6</span>   | Pressure-side <span style="border: 1px solid black; padding: 2px;">1.5</span> | Longitudinal Header (inches) <span style="border: 1px solid black; padding: 2px;">8</span> |  |
| CG Approval <span style="border: 1px solid black; padding: 2px;">162.017/144/3</span>   | Vacuum-side <span style="border: 1px solid black; padding: 2px;">0.5</span>   | Transverse Header (Inches) <span style="border: 1px solid black; padding: 2px;">8</span>   |  |
| Required Venting Capacity of Pressure-Side of P/V valve <span style="border: 1px solid black; padding: 2px;">9337</span> bbl/hr (air) |   |  |  |
| Required Venting Capacity of Vacuum-Side of P/V valve <span style="border: 1px solid black; padding: 2px;">800</span> bbl/hr (air)    |   |  |  |

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

|   |   |  |
|---|---|--|
| a. High Level/Tank Overfill Alarm <input checked="" type="checkbox"/> | Type <span style="border: 1px solid black; padding: 2px;">BERGAN</span> | Meets ASTM F1271 <span style="border: 1px solid black; padding: 2px; float: right;">Setting in psig<br/>N/A</span> |
| b. Overfill Control Shutdown <input checked="" type="checkbox"/>      | Type <span style="border: 1px solid black; padding: 2px;">BERGAN</span> |  |
| c. Spill Valve <input type="checkbox"/>                               | Type <span style="border: 1px solid black; padding: 2px;">N/A</span>    |  |
| d. Rupture Disk <input type="checkbox"/>                              | Type <span style="border: 1px solid black; padding: 2px;">N/A</span>    |  |

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-C1-1901864 dated June 19, 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-C1-1901864 dated July 2, 2019 | MSC Plan Reviewer | LT A. L. Mohnke |
|---------------------|---|-------------------|-----------------|