

VOC MANAGEMENT PLAN  
Chapter 5 – Pressure Calculation

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5.1 Pressure Drop Calculation

Pressure drop calculation is carried out for following two cases as the most severe situation.

THIS PRESSURE DROP IS CALCULATED ON THE BASIS OF NO. 1 Cargo Tank (P), WHICH IS THE FARTHEST CARGO TANK FROM VAPOUR CONNECTING MANIFOLD.

- $\rho$  ; Density of the vapour gas : 3.0 KG/M<sup>3</sup>
- Vapour growth rate : 1.25
- Maximum loading capacity per each segregation : 6,840 M<sup>3</sup>/H
- Maximum loading rate per each cargo tank : About 3,420 M<sup>3</sup>/H
- ( If two(2) tanks are engaged in each segregation)
- $f$  ; Friction factor
- Re: Reynold's number [  $Re = (V \times D) / \nu$  ]
- $V$  ; Velocity [ M/S ]
- $\nu$  : Kinematics viscosity :  $0.175 \times 10^{-4}$  M<sup>2</sup> / S
- $\epsilon$  ; Pipe roughness height : 0.00004572 M
- $L$  ; Pipe length [M]
- $D$  ; Pipe inner diameter [M]
- $K$  ; Loss coefficient

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5.2 Major pressure loss for vapour collection pipe

$$\Delta P_1 = (\rho \times V^2 \times f \times L) / (2 \times D)$$

\* Here, friction factor will be obtained through following formula.

$$f = 1.325 / \{ [ \ln (\epsilon / 3.7D + 5.74 / Re^{0.9}) ] \}^2$$

$$\Delta H_1 = \Delta P_1 \times (0.102 \text{ MMAQ} / 1 \text{ Pa})$$

Segment	D(m)	L(m)	Q(m3)	V	f	dP	dH
1~4	0.293	13.90	3420	14.13	0.0164	233.46	23.81
4~5	0.431	2.50	3420	6.53	0.0170	6.31	0.64
5~8	0.584	50.90	6840	7.11	0.0158	104.36	10.64
8~11	0.584	41.40	13680	14.23	0.0143	307.70	31.38
11~13	0.584	14.90	13680	14.23	0.0143	110.74	11.30
13~19	0.584	21.30	20520	21.34	0.0136	339.59	34.64
					74.9466	93.68	112.42

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5.3 Minor pressure loss for valve and fitting

$$\Delta P_t = K \times g \times V^2 / 2$$

<i>Point</i>	<i>Description</i>	<i>K</i>	<i>V</i>	<i>dP</i>	<i>dH</i>
1	Entrance	0.50	14.13	149.78	15.28
2	90 D Elbow (300A)	0.24	14.13	71.90	7.33
3	Butterfly valve (300A)	0.28	14.13	83.88	8.56
4	Reducer(450A X 300A)	0.26	6.53	16.64	1.70
5	Tee(600A X 450A)	0.21	7.11	15.94	1.63
6	Tee(600A X 350A)	0.21	7.11	15.94	1.63
7	Tee(600A X 300A)	0.21	14.23	63.77	6.51
8	Tee(600A X 350A)	0.21	14.23	63.77	6.51
9	Tee(600A X 350A)	0.21	21.34	143.49	14.64
10	Tee(600A X 600A)	0.40	21.34	273.32	27.88
11	Tee(600A X 600A)	0.40	21.34	273.32	27.88
12	Tee(600A X 600A)	0.40	21.34	273.32	27.88
13	Tee(600A X 300A)	0.21	21.34	143.49	14.64
14	45 D Elbow (600A)	0.14	21.34	95.66	9.76
15	Tee(600A X 600A)	0.21	21.34	143.49	14.64
16	45 D Elbow (600A)	0.19	21.34	129.83	13.24
17	90 D Elbow (600A)	0.24	21.34	163.99	16.73
18	Butterfly valve (600A)	0.28	21.34	191.32	19.52
19	Vapor connection	0.38	21.34	259.65	26.48
TOTAL			174.93	218.66	<b>262.40</b>

Total minor pressure loss: **262.40 MMAQ**

**TOTAL PRESSURE LOSS ( $\Delta P_1 + \Delta P_t$ )**

**$\Delta H = 112.42 + 262.40 = 374.82 \text{ MMAQ}$**

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### PRESSURE DROP CALCULATION

SIMULTANEOUSLY ONE GRADE CARGO LOADING THROUGH THREE (3) CARGO MANIFOLD.  
THIS PRESSURE DROP CALCULATION IS CARRIED OUT ON THE BASIS OF NO.1 C.O.TK (P)  
WHICH IS THE FARTHEST CARGO TANK FROM VAPOR CONNECTION MANIFOLD.

