Fig.4

## Vertical separator dimensions

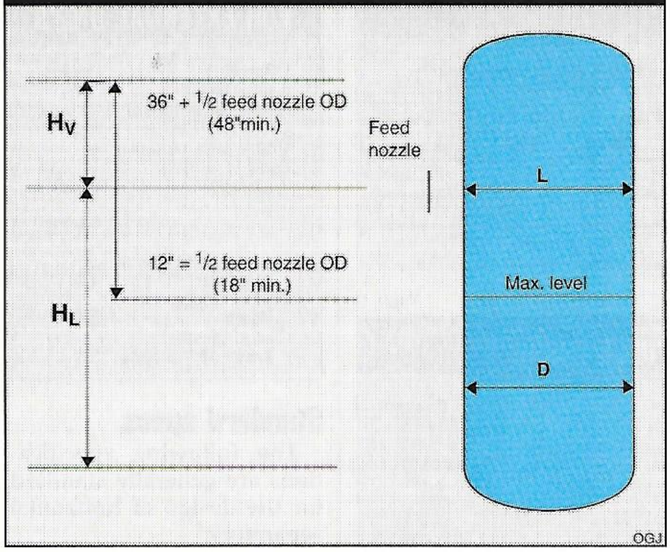
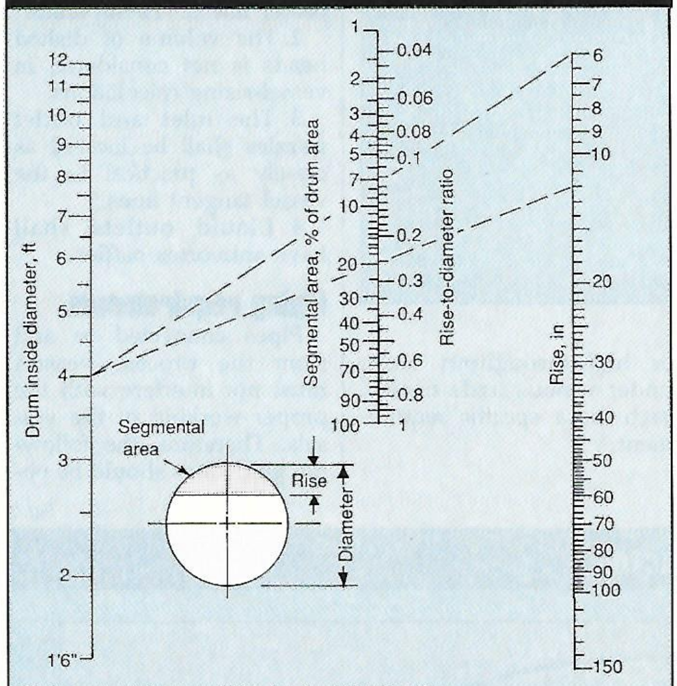



Fig. 5

## Horizontal vessel vapor rise nomograph*




*Finds segmental area available for liquid holding time

OGJ

served:

1. There should be no valves, pipe expansions, or contractions within 10 pipe diameters of the inlet nozzle.

2. There should be no bends within 10 pipe diameters (10D) of the inlet nozzle, except for knockout drums and demisters. A bend in the feed pipe is permitted if it is in a vertical plane through the axis of the feed nozzle.

3. For cyclones, a bend in the feed pipe is allowed if it is in a horizontal plane and the curvature is in the same direction as the cyclone vortex.

4. A pipe reducer may be used in the vapor line leading from the separator, but it should be no nearer to the top of the vessel than twice the outlet pipe diameter.

5. A gate or ball-type valve that is fully opened in normal operation should be used where a valve in the feed line near the separator cannot be avoided.

6. High-pressure drops that cause flashing and atomization should be avoided in the feed pipe.

7. If a pressure-reducing valve in the feed pipe cannot be avoided, it should be located as far upstream of the vessel as practical.

## Design problems

Three design problems will illustrate the use of the calculations given previously.

*Problem 1:*

Size a reflux accumulator for a depropanizer to be installed in an existing large refinery gas plant. Assume that 800 gpm of reflux is pumped back for temperature control, and 400 gpm of product propane is fed to a new ethylene unit. Product flow is on level control with unit alarm.

*Solution:*

The volume of the drum in gal is given by Equation 23.[3] From Tables 1 and 2, $F_1 = 2.0$, $F_2 = 1.0$ (good labor), $F_3 = 2.0$, and $F_4 = 1.5$. Solving Equation 23 yields $V_d = 14{,}400$ gal, full.

The residence time, $\tau$, in minutes, is given by Equation 24. Solving Equation 24 gives 6 min, half-full.

*Problem 2:*

Size a vertical separator under the following conditions:

- $W_L = 5{,}000$ lb/hr
- $W_V = 37{,}000$ lb/hr
- $\rho_L = 61.87$ lb/cu ft
- $\rho_V = 0.374$ lb/cu ft

*Solution:*

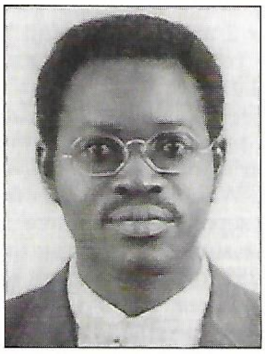
The surge time, T, calculated by Equation 22, is 5 min.

*Problem 3:*

Size a horizontal separator for the following conditions:

- $W_L = 56{,}150$ lb/hr
- $W_V = 40{,}000$ lb/hr
- $\rho_L = 60.0$ lb/cu ft
- $\rho_V = 1.47$ lb/cu ft
- Use $L/D = 3.0$.


## The Author



*Coker*

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*Solution:*

A computer program called Vessel has been developed to size both vertical and horizontal separators. Table 3 shows the results of both separators. Fig. 5 presents a nomograph of the vapor rise in horizontal vessels.[5] A check of the vapor area of 20% of the total cross sectional area and the calculated diameter of 4.13 ft shows that the vapor rise is approximately 12 in.

## References


1. Watkins, R.N., "Sizing Separators and Accumulators," Hydrocarbon Processing, Vol. 46, No. 11, November 1967, pp. 253-56.
2. Blackwell, W.W., Chemical Process Design On A Programmable Calculator, McGraw-Hill Inc.
3. Walas, S.M., Chemical Process Equipment-Selection and Design, Butterworths Series in Chemical Engineering, 1988.
4. Gerunda, A., "How to size liquid-vapor Separators," Chem. Eng., May 1981, pp. 81-84.
5. Evans, F.L. Jr., Equipment Design Handbook for Refineries and Chemical Plants, Vol. 2, 2nd ed., Gulf Publishing Co., Houston, 1980.