APÉNDICE D

SEPARATOR SIZING EXAMPLE CALCULATION

Design Conditions:

Gas flow rate	25 MMSCFD
Oil flow rate	3000 BPD
Operating pressure	800 psig
Operating temperature	80° F
Flowing gas density, d_G (for 20.3 mol. wt. gas)	3.40 lbs/ft³
Flowing oil density, d_L (for 40° API oil)	51.5 lbs/ft³
Separator type	Vertical, two-phase

Tentatively assume 10 feet shell height, 30% liquid full and use K value of 0.3 (see Table C.1 and Equation C.1.1 of Appendix C).

The maximum allowable superficial velocity of the gas is:

$$V_a = K\sqrt{\frac{d_L - d_G}{d_G}} = 0.3\sqrt{\frac{51.5 - 3.4}{3.4}} = 1.128 \text{ ft/sec}$$

Actual volume flow rate of gas =

$$\frac{25{,}000{,}000 \text{ SCF/day} \times 20.3 \text{ lbs/mol}}{379.5 \text{ SCF/mol} \times 86{,}400 \text{ sec/day} \times 3.40 \text{ lbs/ft}^3} = 4.552 \frac{\text{ft}^3}{\text{sec}}$$

$$\text{Min. gas flow area} = \frac{4.552 \text{ ft}^3/\text{sec}}{1.128 \text{ ft/sec}} = 4.035 \text{ ft}^2$$

$$\text{Min. ID of separator} = \sqrt{\frac{4.035 \times 144}{0.7854}} = 27.2 \text{ inches}$$

Use 30 inch ID separator as next largest standard diameter. (Note that 30 inch OD might be preferable, but ID size is used here for simplicity of illustration.) Assume no less than 1 minute retention time for two-phase design with oil gravity exceeding 35° API (equation C.1.6 and Paragraph C.1.7 of Appendix C).

Liquid volume, V (excluding bottom head) =

$$\frac{(30)^2\ 0.7854 \text{ in}^2 \times 3 \text{ feet}}{144 \text{ in}^2/\text{ft}^2 \times 5.615 \text{ ft}^3/\text{bbl}} = 2.62 \text{ Bbls.}$$

The liquid capacity of the separator is:

$$W = \frac{1440\ (V)}{t} = \frac{1440 \times 2.62}{1.0} = 3{,}772 \text{ BPD}$$

Liquid capacity is satisfactory for design based on 30 in. ID × 10 ft. vertical separator size.