2.19

2.19 (See Fluids in the News article titled "Weather, barometers, and bars," Section 2.5.) The record low sea-level barometric pressure ever recorded is 25.8 in. of mercury. At what altitude in the standard atmosphere is the pressure equal to this value?

For record low pressure,

$$p = \gamma_{Hg} h_{Hg} = \left(847 \frac{lb}{ft^3}\right)\left(\frac{25.8 \text{ in.}}{12 \frac{\text{in.}}{ft}}\right)\left(\frac{ft^2}{144 \text{ in.}^2}\right) = 12.6 \frac{lb}{in.^2}$$

From Table C.1 in Appendix C

@ 0 ft altitude $p = 14.696 \frac{lb}{in.^2}$

@ 5000 ft altitude $p = 12.228 \frac{lb}{in.^2}$

Assume linear variation change in pressure per foot. Thus,

$$\text{pressure change per foot} = \frac{14.696 \frac{lb}{in.^2} - 12.228 \frac{lb}{in.^2}}{5000 \text{ ft}}$$

$$= 4.936 \times 10^{-4} \frac{lb}{in.^2} \text{ per ft}$$

and

$$14.696 \frac{lb}{in.^2} - d\,(ft)\left[4.936 \times 10^{-4} \frac{\frac{lb}{in.^2}}{ft}\right] = 12.6 \frac{lb}{in.^2}$$

so that $d = \underline{4,250 \text{ ft}}$