8.6.2.1 Cyclone Operating Principles

A cyclone separator imparts a rotary motion to the gases and thereby enhances the settling rate to many times that induced by gravity alone. A cyclone separator is essentially a gravitational separator that has been enhanced by a centrifugal force component. The cyclone separator grade efficiency curve, Fig. 8-4, applies to all cyclone separators, as well as to inertial and gravitational collectors.

Cyclone performance is rated in terms of particle cut diameter or cut size. The cut size, d_{p50}, is the particle size which is captured 50%.

The relationship between particle cut diameters for this type separator is given by Eq. (8-4), where d_p is the particle diameter and the numerical subscript denotes the collection efficiency of that size particle.

8.6.2.2 Cyclone Design Principles

The proportions for high-efficiency cyclone separators are shown in Fig. 8-5.

The particle size that can be separated with 50% efficiency is predicted for general cyclones and for the high-efficiency cyclone proportions of Fig. 8-6 by

$$d_{pc} = \sqrt{9\,\mu_G\, b/[2\pi\, N_e\, V_i\, (\rho_p - \rho_G)]} \qquad (8\text{-}5)$$

From Eq. (8-5) we can derive the relationship between the cyclone separator's particle cut size d_{p50} and the cyclone inlet width b for a given pressure drop as shown in Fig. 8-6. Notice that the effect of temperature

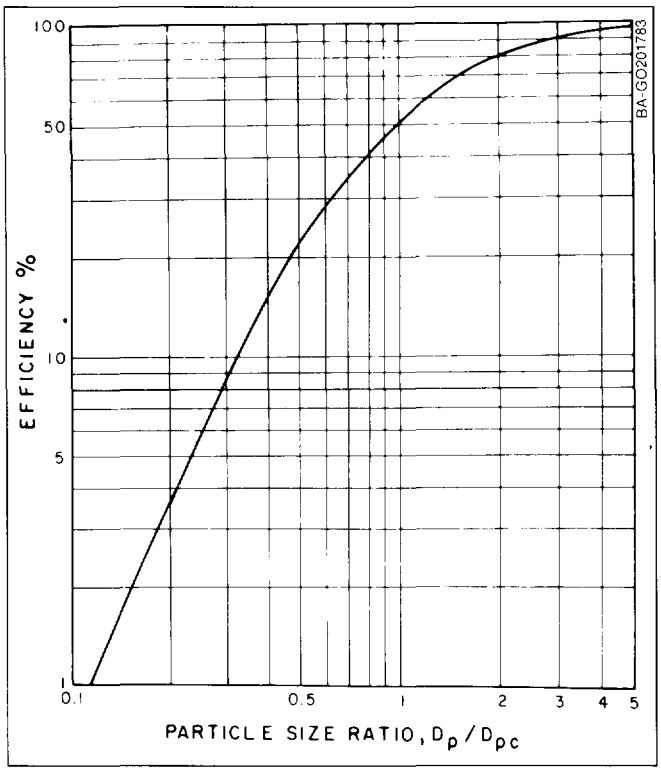

Fig. 8-4. Cyclone grade efficiency curve (Source: Kaupp 1984a, Fig. 138)

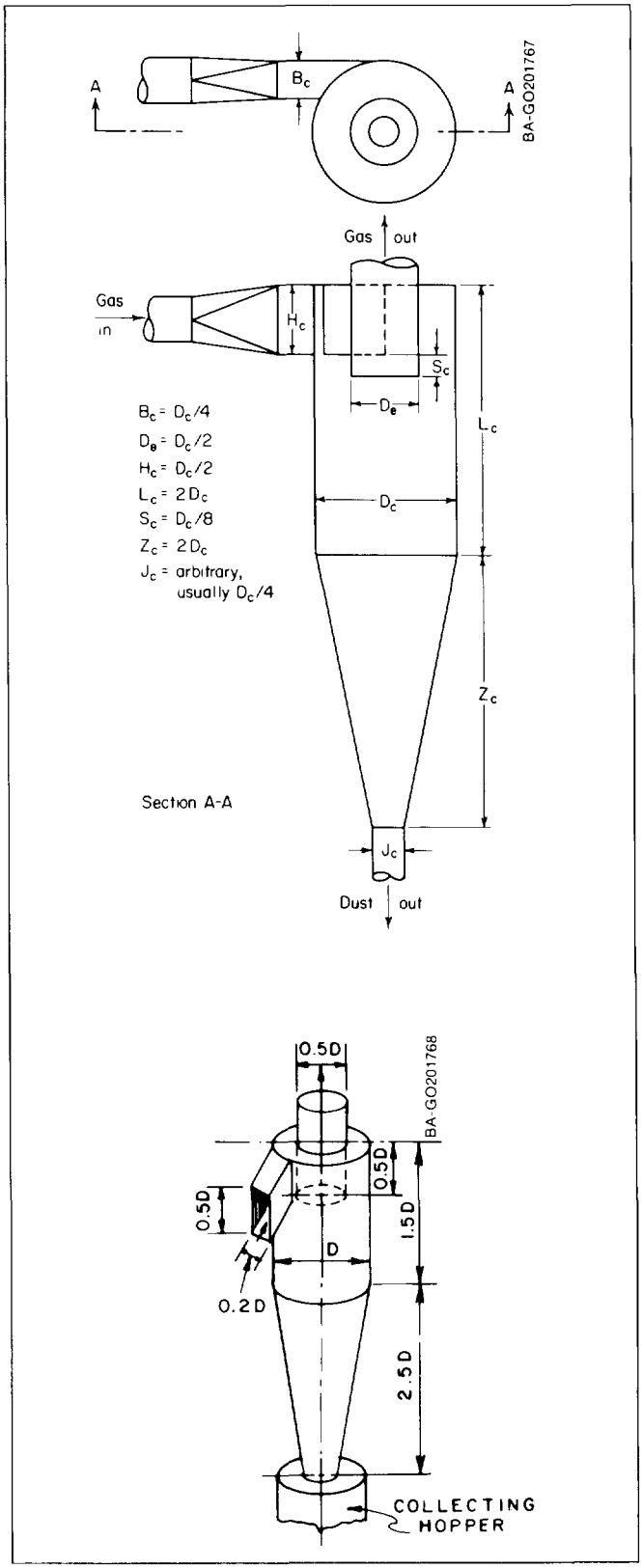

Fig. 8-5. High-efficiency cyclone proportions (Source: Perry 1973, Fig. 20-96. © 1973. Used with permission of McGraw Hill Book Co.; Kaupp 1984a, Fig. 134)