velocity of the air entering the effective face area of the cleaner and may be expressed by the equation:

$$V = \frac{Q}{A} \tag{1}$$

where

V = face velocity, feet per minute
Q = air flow, cubic feet per minute
A = effective face area, square feet

Effective face area is further defined as that area of the filter face inside the enclosing frame, flanges, or seals, but not corrected for any area occupied by any bracing, and retaining or strengthening grid members, located within the enclosing frame.

The rated capacity of general ventilation filters is often based on face velocities in the range of 250 to 520 fpm. Resistance to air flow, measured

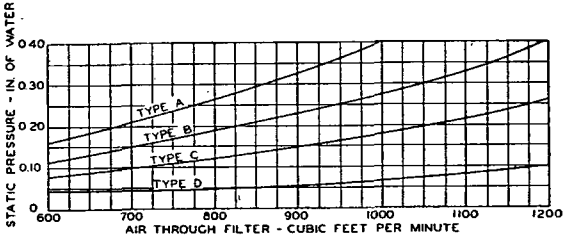


FIG. 3. RESISTANCE TO AIR FLOW OF FOUR UNIT AIR FILTERS

in inches of water column, at rated capacity, is generally available from the manufacturer (see Catalog Data Section). A suitable allowance must be made in the system design for increase in resistance as the filter becomes loaded with dust. Fig. 3 indicates the range of resistance to air flow found on tests of four unit filters. Type A is a dense pack used in bacterium control; Type B is a medium pack used for general ventilation work; Type C is a low resistance unit, for use where low resistance is the important factor and maximum cleaning efficiencies are not essential; and Type D is a high-velocity viscous-impingement filter.

The effectiveness of air cleaners in removing a given dust from the air is called efficiency or arrestance. If the efficiency is denoted by E, then algebraically E is given by:

$$E = \frac{D_1 - D_2}{D_1} \tag{2}$$

where

D_1 = amount of dust per unit volume in uncleaned air.
D_2 = amount of dust per unit volume in cleaned air.

A number of procedures for evaluating air cleaner efficiency have been proposed and are in use. These procedures differ principally in the type

of test dust that is used and in the method of measuring the dust content of the entering and leaving air. The numerical value of the arrestance or efficiency of an air cleaner may be different for different methods of test even when the same test dust is used, and is generally different for different test dusts using the same test method. Caution is to be exercised in interpreting published air filter arrestance data, since the test efficiency may be different from that obtained in an actual installation, or in the space being supplied with air.

The two most common methods for evaluating efficiency are: (1) the weight method, in which the weight concentration of dust in the air entering and leaving the filter is measured by some suitable means, and (2) the dust spot test in which the dust content of the entering and leaving air is measured in terms of its ability to stain filter paper. The particle count method is not used for efficiency evaluation, except in investigation of filter

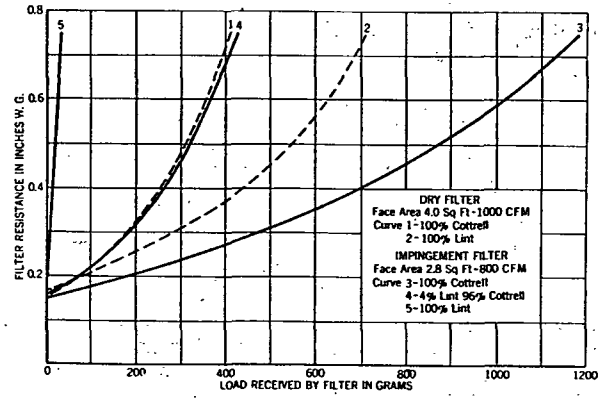


FIG. 4. DUST AND LINT HOLDING CAPACITY OF TWO FILTERS

performance on specific particles such as pollen, or on certain industrial dusts harmful to health. Dust particles can be captured on microscope slides by means of one of the various kinds of impingement devices. The process is useful if inspection and analysis of dust are desired, but particle counting is not sufficiently precise for evaluating the efficiency of a cleaner operating on a heterogeneous dust.

Among the weight methods that have been used are the *Air Filter Institute* Code[6] and modifications of the former ASHVE Code[7]. By the latter test method, a known weight of a prepared dust is injected into air supplied to the filter, and the quantity of dust in the cleaned air is determined by extracting and weighing the dust from a known volume of cleaned air. Dust extraction from the air is accomplished by drawing the air through a porous crucible or thimble by means of a high vacuum. The test dust specified in the ASHVE Code is a mixture of coal ash and carbon black.

The *Air Filter Institute* Code, Section I, specifies a test dust mixture of Standardized Air Cleaner Test Dust-fine, carbon black, and lint. Like the ASHVE Code, the entering concentration (D_1) is determined by feeding a known weight of the prepared test dust. The concentration of dust in the