(5) type of motive power (AC, DC, compressed air, or heat engine); (6) ... or belt driven, and whether drive must be protected against air contaminants, heat, or excessive moisture; (7) kind of contaminants in air to pass through ... (8) quantity of contaminants in air to pass through fan; (9) contaminants in the atmosphere *surrounding* the fan and motor, including potential explosion or fire hazard; (10) temperature of air or gas to pass *through* fan; (11) ... ture of atmosphere *surrounding* fan and motor; (12) possibility of condensation within fan housing or scroll; (13) whether to be located before or after ... cleaning equipment; (14) size and shape of available space; (15) ... charge direction for centrifugal fan to avoid unnecessary bends in ductwork.

e. Fan laws. These relationships or physical laws apply when ... fan and ventilating system are operated together under variable conditions of fan speed and air density:

Variable fan speed—constant air density

(1) Air volume (c.f.m.) varies directly with fan speed (r.p.m.).
(2) Static, velocity, and total pressures (S.P., V.P., T.P.) vary directly with the square of fan speed (r.p.m.)².
(3) Horsepower (H.P.) varies directly with the cube of the fan speed (r.p.m.)³.

Constant fan speed—variable air density

(4) Air volume (c.f.m.) remains constant as air density varies.
(5) Static, velocity, and total pressures (S.P., V.P., T.P.) vary directly with air density ...
(6) Horsepower (H.P.) varies directly with air density (d).

Constant weight of air delivered

(7) Fan speed (r.p.m.) varies inversely with air density (1/d).
(8) Static, velocity, and total pressures (S.P., V.P., T.P.) vary inversely with air density (1/d).
(9) Horsepower (H.P.) varies inversely with the square of air density (1/d²).

f. Standard air. Unless conditions require otherwise, the ventilating engineer usually assumes a standard air density of 0.075 pound per cubic foot, which is the approximate weight of air at sea level barometric pressure of 29.92 inches Hg and 70° F. from 0 to 50 per cent relative humidity.

g. Air horsepower. The horsepower output of an air-moving device is known as "air horsepower." It is easily estimated by the formula:

$$\text{AHP} = \frac{(\text{c.f.m.})\ (h)}{6350}$$

where AHP = horsepower, c.f.m. = cubic feet of air per minute, and ... pressure in inches of water.

Air horsepower is sometimes further qualified as either "total air horsepower" or "static air horsepower." Either of these may be computed from the above equation by using for head (h) the "total pressure" or "static pressure," respectively. The choice between these two methods of rating must depend on whether the over-all fan efficiency is to be expressd as "total efficiency" (also called ... efficiency"), or "static efficiency," inasmuch as fan manufacturers ... both in their detailed statements of performance.

2. Ejectors, Venturi Ejectors, or Syphon Jets

... venturi ejector is a low-efficiency air-moving device selected as a last ... when the ventilating system must handle excessive temperatures, corrosive ... flammable vapors, or viscous or sticky air contaminants that would quickly ... the effectiveness of axial or centrifugal fans. The air-moving efficiency ... sensitive to the physical proportions of the outer conduit, and the ... and air velocity through, the inner jet. Both straight-tube and venturi-... conduits are used, but the latter can be made more efficient. Efficiencies range ... to 20 per cent.

... designers who are in a position to compute and specify a high-quality ... on the basis of the best available aerodynamic data are referred to the ... comprehensive treatment prepared by McElroy.[19] Less precise information ... been offered by other writers, which is satisfactory for applications ... high jet velocities can be produced (8000 to 10,000 l.f.m.) and where one is ... reconciled to efficiencies in the range of 5 to 10 per cent. The "straight-tube" ... with a jet diameter one sixth of the straight duct diameter can be used ... with reasonable success when the connected system has a very low resistance, ... inch of water.

V. Design of Ducts for Exhaust Systems

Many special forms and charts have been created and published for the purpose of facilitating the aerodynamic design of ductwork for ventilating ... Unfortunately, some of these devices consume more time than they ... particularly if the designer or estimator is not in constant practice.

No single form or procedure is offered here as superior to all others, but ... the reader is advised to adopt one that best suits his requirements. If ... exhaust system calculations are infrequent, special tabulating and computing ... are less important than a complete list of individual steps for the essential ... mathematical operations.

A plan of design sequence is now outlined, and this is followed by a brief ... of its application.

A. PROCEDURE FOR DESIGN OF EXHAUST SYSTEMS

... the Ductwork and Design the Hoods

... Prepare a sketch or layout of the exhaust system; use single lines for ducts if simplicity ... The layout is more helpful if approximately to scale, although subsequent steps in ... ing duct sizes can be carried out even with a very poor drawing.

... Select the type of hood that will do the best possible job with the smallest amount of

[19] ... McElroy, *U. S. Bur. Mines Tech. Paper* No. 678, 1945.