air flow. This requires ingenuity in designing enclosures that will not interfere with production [illegible] or hoods with movable sections that can and will be operated as planned. There is no point in [illegible] creating an "ideal" hood that cannot be used without seriously disrupting the production [illegible] schedule, inasmuch as neither worker nor employer will tolerate its use.

Determine Air-Flow Rates for Each Exhaust Hood

3. Estimate the control or "capture" air velocity required for each operation and type of [illegible] hood or enclosure. Tables 8, 9, and 10 suggest control velocities. This part of the design process [illegible] involves a great deal of judgment.

4. Compute the boundary area of the *plane, cylinder,* or *sphere* of influence through [illegible] which the selected "capture" velocity must operate. The ability to conceive hood arrangements [illegible] in three dimensions is an advantage.

5. Compute the total air flow in c.f.m. for each hood (capture velocity times area of [illegible] influence) and put this rate on the sketch or diagram of the system for reference purposes.

6. Summarize the air flow for each section of the branch and main ductwork on some [illegible] form or preferred calculation sheet, or enter the air flows directly upon the diagram or drawing [illegible]

Establish Air Velocities for Each Duct Section

7. Select the minimum effective transport velocity for particulate matter (Table 15). For transporting of gases and vapors, duct velocities can be as low as is consistent with space [illegible] and weight limitations. Velocities in the range of 1000 to 2000 l.f.m. for gases and vapors are [illegible] the usual compromise between excessive duct size and unnecessarily high air-horsepower [illegible] requirements.

8. Figure the nearest practical duct diameter to carry the required c.f.m. at the proper [illegible] velocity. Consideration should be given to the sheet metal fabricator's standard size increments to avoid unnecessary additional expense. If the available duct sizes are much different [illegible] from the theoretically required diameters, compute the actual transport velocity for use in subsequent design steps.

Determine the Entrance or Orifice Loss for Each Hood

9. Compute the velocity pressures corresponding to the air velocities in each branch duct [illegible] connected to an exhaust opening (see page 337).

10. Estimate the orifice loss for each hood in percentage of velocity pressure in the branch [illegible] pipe (see Figure 19).

11. Compute from items 9 and 10 the entrance losses in terms of inches of water [illegible]

Determine Duct Friction and Transition Losses

12. Compute the losses in elbows, branch to main connections, or other transitions, either (*a*) in terms of equivalent straight-pipe diameters (Figures 20 and 21) or (*b*) in terms of [illegible] velocity pressures, whichever form corresponds with the data at hand. The equivalent straight-pipe method has the advantage that such transition losses can be added directly to the [illegible] straight-pipe sections for use with friction charts. The velocity-head method may be preferred by those who are especially familiar with the fundamentals of fluid mechanics.

13. Obtain the duct friction losses from a chart, table, or formula, whichever you prefer [illegible] to use. Figure 22 is used at this point.

Balance the Pressure Drop by Adjusting Duct Sizes

14. Summarize the losses for each branch to determine where to increase or decrease the [illegible] duct sizes to obtain better balance of pressure drop. (This assumes that balancing will not be [illegible] left exclusively to manually operated dampers.) The total pressure drop from any points in the [illegible] system to each upstream opening or exhaust hood should be the same, if balance is to be [illegible] achieved. This is so because in actual operation, the air-flow quantities through all open [illegible] branches automatically adjust themselves to fulfill this requirement of balance. If the flow [illegible]

TABLE 15

Air Velocities for Transporting Various Dusty Materials
(Linear feet per minute)

Material	Dust collecting		Pneumatic conveying	
Aluminum dust	4500	6000	—	—
Asbestos	3000	3500	—	—
Ashes, ground	—	—	6000	8500
Bakelite molding powder	2500	3500	—	—
Barley	—	—	5000	6500
Buffing lint	3000	5000	—	—
Cast-iron dust	4000	5000	—	—
Cement	3500	4000	6000	9000
Clay	3500	4000	—	—
Coal, powdered	3500	4000	4000	5500
Cocoa	3000	3500	—	—
Coffee beans	—	—	3500	5000
Cork, ground	2500	3000	3500	5500
Corn	—	—	5000	7000
Cotton	2500	3000	4000	6000
Cottonseed	—	—	4000	6000
Flour	2500	3500	4000	6000
Foundry dust	3500	5000	—	—
Grain dust	2500	3500	—	—
Granite dust	4000	5000	6000	8000
Grinding dust	3500	5000	—	—
Ground feed (1/4-in. screen)	—	—	4500	6000
Hemp	—	—	4500	6000
Hog waste	3500	4500	4500	6500
Jute butts	—	—	3500	5000
Jute dust	3000	3500	—	—
Jute lint ("flyings")	2500	3000	—	—
Lead dust	4000	5000	—	—
Leather dust	3000	4000	—	—
Lime	3500	4000	5000	7000
Magnesium dust	4500	6000	—	—
Metal turnings	4000	6000	5000	8000
Oats	—	—	4500	6000
Pulp chips	—	—	4500	7000
Rubber dust	2500	4000	—	—
Rye	—	—	5000	7000
Salt	—	—	5500	7500
Sand or silica	3500	4500	6000	9000
Sawdust, light or dry	2500	3000	4000	6000
Sawdust, heavy or wet	3000	5000	—	—
Soap dust or powder	3000	3500	—	—
Sugar	3000	3500	5000	6000
Tanbark, dry	—	—	4500	7000
Tanbark, damp or leached	—	—	5500	7500
Wheat	—	—	5000	7000
Wood blocks (edgings)	3500	5000	4500	6000
Wood flour (sander dust)	2500	3000	4000	6000
Wool fibers	3000	4500	4500	6000