Table 3 . . . . A Guide to Ventilation Rates for Typical Industrial Equipment (Continued)

State or Local Regulations Should be Consulted and Followed Where Higher Ventilation Rates are Specified

Operation	Ventilation: Type of Hood	Ventilation: Air Flow	Usual Transport Velocity Fpm	Remarks and References
Pouring hoods Foundry	Side hood	200 to 300 cfm per linear ft of hood with slot velocities of 1500 fpm. Exhaust take-off every 8 to 10 ft	3500	Ref. 20
Rock drilling Dry drilling (rock)	Special trap (see references)	60 cfm—vertical (downward) work 200 cfm—horizontal work	3500	Ref. 26, 27. May vary with size and speed of drill. Wet drilling offers alternate control methods
Rubber calender rolls	Canopy—side panels	75–100 fpm indraft	3500	Ref. 24, 31
Quarts fusing	Booth on bench	150–200 fpm at face		Ref. 34, 35
Screens Vibrating Flat deck	Enclosure	150–200 fpm indraft through hood openings but not less than 25–50 cfm per sq ft of screen area	3500	Ref. 15, 19
Shakeouts Foundry	Enclosure	200 fpm through all openings in enclosure, but not less than 200 cfm per sq ft of grate area	3500	Ref. 20, 22
Spray coating	Booth—operator inside Booth—operator outside Booth—downdraft	100–200 fpm at booth cross-section 150–200 fpm at booth cross-section 100–200 fpm downdraft	1500–2000 1500–2000 1500–2000	Ref. 15 Use higher ventilation rate for small booths 4 sq ft or less
Tanks, open surface	See Table 6			Ref. 36, 37, 38, 39
Tumbling mills Hollow trunnion type	Exhaust connection by manufacturer	Use branch diameter same size as exhaust outlet. For round mills branch dia should be ⅙ dia of mill; for square mills branch dia should be 1 in. plus ⅙ side dimension of mill	3500–5000	Ref. 14
Tumbling mills, drums, cages, barrels	Enclosure	400 fpm through openings but not less than 75 cfm per sq ft plan area	3500	Where equipment is enclosed and dust tight during rotation, enclosure may not be needed if feed and discharge operations can be otherwise controlled
Welding	Local hood with flange Downdraft bench Booth	6 in. from arc—150 cfm 6–9 in. from arc—275 cfm 8–10 in. from arc—425 cfm 10–12 in. from arc—600 cfm 150–250 cfm per sq ft grille area 100 fpm at booth face	2000–4000 2000 2000	Ref. 40
Woodworking	See Table 7			Ref. 22, 41
Miscellaneous Packaging, machines, granulators, enclosed dust producing units Packaging, weighing, container filling, inspection	Complete enclosure Booth Downdraft	100–400 fpm indraft through inspection or working openings, but not less than 25 cfm per sq ft of enclosed plan area 50–150 cfm per sq ft of open face area 75–150 cfm per sq ft of dust producing plan area	3000 3000 3500	Ref. 19

For high canopy hoods, Equation 5 may be used:

$$q_s = 7.4\, L_e^{3/2}\, H_s^{1/3} \tag{5}$$

where

L_e = effective height, feet.

The effective height L_e may be taken as the actual vertical distance from hood to hot surface plus twice the width of the hot surface.

Where it is necessary to have openings at the top of a hood that is filled with heated air, leakage of the hood contents through these openings may be prevented by using sufficient ventilation to obtain a face velocity V as calculated from the following equation:

$$V = C\sqrt[3]{\frac{L_a H_s}{A_f}} \tag{6}$$

where

L_a = height of the air column, feet.
A_f = area of the (sharp-edged) openings, square feet.
H_s = sensible heat released to air stream, Btu per minute.
C = a coefficient depending on the excess of temperature inside the hood above room temperature with values as follows:

Temperature excess (F deg)	0–200	200–400	400–600	600–800
Value of C	20	18	16	14

The American Society of Heating, Refrigerating and Air-Conditioning Engineers has recognized the need for design criteria for determining exhaust ventilation requirements for hot process in industry. Research studies on this subject have been in progress since 1952, and the results to date have been published.[illegible]

Induced Air Flow

Where quantities of individual particles are projected through an air space by gravity or by process forces, volumes of room air in proportion to the momentum of the particles are set in motion with resulting intermixing and flow in the same direction as the particles. Exhausted volumes from hoods or enclosures must be sufficient to include this induced air flow if control is to be effective. Induced air flow should be evaluated from high speed rotating machines including pulverizers, from material handling systems employing high speed belts or involving large tonnages of falling granular material, and from escaping compressed air jets from pneumatic tools. The energy represented by material of various particle sizes and falling heights has been computed by Hemeon.[illegible] The theoretical equivalent induced air flow resulting from unenclosed air streams is summarized in Table 4.

Where falling streams occur largely within an enclosure such as a storage bin, it should be recognized that much of the air set in motion is recirculated within the bin. Exhaust volumes from the enclosure need only include the extra air induced before the falling material enters the enclosure although the recirculating induced air can cause localized positive pressures and outward leakage if the enclosure is not of airtight construction.

The amount of air induced by falling material is much less if the space through which the material falls is enclosed effectively than if not enclosed, and can be reduced to a minimum by enclosing as well as possible the openings at the feed point of the material.

Table 4 . . . . Induced-Air-Flow Equivalent of the Energy in Falling, Unenclosed Streams of Particles

(For a solids flow rate R of 1 lb per sec and a specific gravity z = 1 referred to water)

Falling Distance, s	Stream Area, sq ft	Air Flow Equivalent, Cfm, to be multiplied by $(R/z)^{1/3}$ — Particle Size, Millimeters: 1	2	5	10	20	50	100
3 ft	½	450	350	220	180	150	80	65
	1	750	550	350	300	250	150	100
	2	1200	850	550	450	350	200	170
	4	1900	1400	850	700	600	350	250
	8	3000	2200	1400	1100	900	500	400
	15	4600	3300	2000	1700	1400	800	650
	25	6400	4600	3000	2500	2000	1000	900
	50	10000	7500	4700	4000	3200	1800	1400
6 ft	½			350	300	250	200	150
	1			600	500	350	300	200
	2			900	700	600	400	350
	4			1500	1200	900	700	500
	8			2300	1800	1500	1000	900
	15			3500	2800	2200	1500	1300
	25			5000	4000	3200	2300	1800
	50			8000	6000	5000	3700	3000
12 ft	½			560	450	350	270	220
	1			900	700	600	420	350
	2			1500	1100	900	700	550
	4			2300	1800	1500	1000	850
	8			3600	2900	2300	1700	1300
	15			5300	4200	3500	2600	2100
	25			7800	6000	5000	3600	2900
	50			—	10000	8000	6000	4700
20 ft	½			800	650	500	370	300
	1			1300	1000	800	600	500
	2			2000	1600	1300	960	760
	4			3300	2600	2000	1500	1200
	8			5000	4100	3200	2400	1900
	15			8000	6400	5000	3700	2900
	25			—	9000	7000	5000	4000
30 ft	½			1000	850	650	500	400
	1			1700	1400	1100	800	600
	2			2700	2100	1700	1300	1000
	4			4400	3500	2700	2000	1600
	8			6800	5400	4200	3200	2500
	15			10000	8200	6600	4800	4000
	25			—	—	9000	6800	5400

From *Plant and Process Ventilation* by W. C. L. Hemeon, The Industrial Press New York (1955).

DUCT SYSTEM DESIGN

The duct system will consist of branch ducts connected to a main duct that will convey the air from the hoods to the exhaust fan and the air cleaning equipment, if used. Round ducts should be used wherever possible. Their gage size and construction differ from air supply practice due to the rougher usage encountered, and in the case of dusts, to the abrasive effect. (See later section on Construction Specifications for Local Exhaust Systems.) Usual conveying velocities are shown in Table 8. Where solid contaminants are handled, recommended velocities must be maintained throughout the system to prevent material from settling in the ducts and obstructing