TABLE 4. MAXIMUM ALLOWABLE CONCENTRATIONS OF DUSTS, FUMES AND MISTS[b]

SUBSTANCE	MILLIGRAMS PER CUBIC METER, DAILY EXPOSURES[a]
Arsenic; arsenic trioxide	0.15[c]
Cadmium, and compounds	0.1[c]
Chlorodiphenyls	1.0
Chromic acid mist	0.1
Lead; lead carbonate; lead chloride; lead nitrate; lead oxides; lead sulfate	0.15[c]
Manganese, and compounds	6.0[c]
Mercury, and compounds	0.1
Pentachloronaphthalene	0.5
Trichloronaphthalene	5.0
Zinc oxide fume	15.0

[a]1 milligram per cubic meter = 0.44 grain per 1000 cu ft.

[b]Adapted from: Manual of Industrial Hygiene, by W. M. Gafafer, et al, U. S. Public Health Service (W. B. Saunders Company, 1943); and other authoritative sources.

[c]Adopted by the *American Standards Association* (American Standard Z-37).

TABLE 5. MAXIMUM ALLOWABLE CONCENTRATIONS OF DUSTS[a]

SUBSTANCE	MILLION PARTICLES PER CUBIC FOOT OF AIR, DAILY EXPOSURES[b]
Aluminum oxide abrasive	15– 50
Asbestos	5
Carborundum (silicon carbide)	15– 50
Cement (Portland)	50–100
Coal (less than 5 per cent quartz)	50–100
Dusts containing less than 10 per cent *free* silica	15–100
Granite (Barre)	10– 20
Gypsum (hydrated calcium sulfate)	50–100
Limestone (calcium carbonate)	50–100
Marble (calcium carbonate)	50–100
Mica	10– 50
Nuisance dusts (non-toxic, non-silica)	50–100
Quartz (silicon dioxide)	5
Sand (silica, silicon dioxide)	5
Sandstone	5
Silica (*free* or uncombined silicon dioxide)	5
Silicates (combined silicon dioxide)	15–100
Slate	15– 50
Talc	10– 50
Total (maximum concentration for mixed dusts)	50–100

[a]Adapted from: Study of Asbestosis in Asbestos Textile Industry, U. S. Public Health Service Bulletin No. 241, 1938; Industrial Dust, by Drinker and Hatch (McGraw Hill Book Co., 1936); Industrial Code Bulletin No. 35, New York State Department of Labor; recommendations of state and local industrial hygiene agencies compiled by the National Conference of Governmental Industrial Hygienists; and other authoritative sources.

[b]Includes only particles from 1 to 10 microns approximately, as determined by the light field microscope counting technic, using the 10× objective. Dark field counts (and the corresponding allowable concentrations) are anywhere from 2 to 100 times the light field counts for the same sample, according to the proportion of dust smaller than 1 micron (See Industrial Dust, Chapter VII, by Drinker and Hatch, McGraw Hill Book Co.).

Flash point is a convenient method of expressing this property in terms of the temperature scale. It may be defined as the temperature to which a combustible liquid must be heated to produce a flash of flame when a small flame is passed across the surface of the liquid. The higher the flash point, the more safely can the liquid be handled. Liquids with flash points under 70 F should be regarded as highly flammable.

The upper and lower limits of flammability of gases and vapors, and the flash points of the corresponding liquids are given in Table 6.

Methods for estimating the flammable limits of mixtures of gases or vapors must be applied with caution; the reader is referred to other publications for this information [12, 13].

Design of equipment for the control of combustible anesthetics is outlined in Chapter 13. Construction of equipment for handling air containing flammable substances, or operating in atmospheres so contaminated, is discussed in Chapter 46.

It is customary to report the concentrations of flammable gases or vapors in per cent by volume, or *volume per cent.* Comparison with concentrations on the *part per million* scale used in chemical, medical or industrial hygiene literature is readily made by the conversion: 1 per cent = 10,000 ppm (parts of contaminant per million parts of air, or in other words, cubic feet of contaminant per million cubic feet of air). It will be noted in Table 6 that nearly all of the substances listed have lower explosive limits above 1.0 per cent, while the *maximum allowable concentrations* for gases and vapors in Table 3 are below 1000 ppm or 0.1 per cent in most cases. Therefore, control of toxic or injurious vapors in workrooms to levels below their maximum allowable concentrations for health usually requires much more effective ventilation than for the prevention of a fire hazard.

COMBUSTIBLE DUSTS

A dust explosion is essentially a sudden pressure rise caused by the very rapid burning of airborne dust. The primary explosion often originates from a small amount of dust in suspension exposed to a source of ignition and the pressure and vibration it creates may be sufficient to dislodge large accumulations of dust on horizontal ledges or surfaces of the building and equipment, thereby creating a secondary explosion of great force. Thus the air conditioning engineer is involved for two reasons: (1) to obtain a movement of dust-laden air into exhaust hoods or openings and through ventilating or pneumatic conveying ducts in a manner that will prevent accumulation of highly flammable dust at points where it could ignite inside the equipment; and (2) to so design *process ventilation* as to prevent the escape of dust which might settle on horizontal surfaces and become a potential source of disaster at some distance from the dusty operations. (See Chapter 46).

The intensity of a dust explosion depends upon: the chemical and thermal properties of the dust; the particle size and shape; the concentration in air; the proportion of inert dust in the air; the moisture content and composition of the air; the size and temperature of the ignition source; and the degree of dispersion of the dust cloud. Investigations on the explosibility of dusts require a determination of the maximum pressure developed during an explosion of a known air concentration, as well as determination of the rate of pressure rise. Investigators frequently experience difficulty in obtaining dust suspensions of uniform dispersion, and this fact must be weighed when comparing results from several sources [14].

The minimum explosive concentrations of airborne dusts already tested range from 0.01 to 0.5 oz per cubic foot, or 10 to 500 grams per cubic