and eliminate small amounts without harm. When intake rates exceed the normal excretion level, build-up occurs in the body. There is a safe level of absorption, and if the concentration of lead dust in the air of work areas is kept below the threshold limit, there should be no difficulty.

89. The importance of maintaining the concentration of air-borne lead at a very low value stems from lead's high toxicity and its tendency, in small amounts, to accumulate in the human system. When lead absorption in the body reaches a sufficient degree, symptoms of poisoning or intoxication appear.

Beryllium intoxication

90. Beryllium intoxication is a severe systemic disease that can result from the inhalation of massive doses of dust of metallic beryllium, beryllium oxide, and some soluble beryllium compounds. There are two forms of the disease. One is an acute form of chemical pneumonitis with cough, pain, difficulty in breathing, cyanosis, and loss of weight. In the chronic type, known as berylliosis, there may be loss of appetite and weight, weakness, cough, extreme difficulty in breathing, cyanosis, and cardiac failure. Mortality is high in chronic beryllium intoxication, and many who survive suffer from pulmonary distress.

91. Individual susceptibility apparently is an important factor in the development of the disease. In many instances, one employee has developed the severe symptoms while other employees doing the same work have shown no signs of disability.

92. Beryllium intoxication has never been demonstrated in individuals mining or handling ore only. There is no evidence of intoxication from the ingestion of beryllium oxide, beryllium metal, or any of the beryllium alloys. Only the inhalation of beryllium dust produces systemic disease.

93. Because of the severe nature of the disease and because there is no way of predicting who will develop it, extreme care must be taken to control the dust and fume that arise in the handling of beryllium, its alloys, and its compounds. Beryllium is toxic in such small quantity as to be considered the most toxic of all elements yet investigated.

TABLE III. SELECTED TOXIC DUSTS AND FUMES

Substance	Description and Effects	Threshold Limit in Milligrams per Cubic Meter of Air*
Antimony	Gray metal often associated with lead and arsenic. Hazardous from inhalation and ingestion. Soluble salts may cause dermatitis.	0.5
Arsenic	Silvery brittle crystalline metal. Hazardous from inhalation and ingestion. Usually encountered as arsenic trioxide.	0.5
Barium (soluble compounds)	Soluble barium chloride and sulfide are toxic when taken by mouth.	0.5
Beryllium	Light weight, gray metal. The metal, low-fired oxides, soluble salts, and some alloys are toxic by inhalation.	0.002
Chromic acid and Chromates	Red, brown, or black crystals. Caustic action on mucous membranes or skin.	0.1
Cyanide (as CN)	Nonvolatile cyanides are ingestion hazards. Cyanides inhibit tissue oxidation upon inhalation and cause death.	5.0 (skin**)
Dinitrobenzene	Yellowish crystal. Hazardous from skin absorption, inhalation, and ingestion.	1.0 (skin**)
Fluorides	Inorganic fluorides are highly irritant and toxic.	2.5
Hydroquinone	Colorless hexagonal crystals. Contact with the skin may cause sensitization and irritation. Excessive exposure to dust may cause corneal injury.	2.0
Iron oxide fume	Major sources are cutting and welding.	15.0
Lead	Lead fumes and lead compounds cause poisoning after prolonged exposure. Most important means of entry into body is inhalation. Skin absorption is of significance only from such organic compounds as lead tetraethyl.	0.2
Lead arsenate	White crystals—highly toxic.	0.15
Magnesium oxide fume	White powder. Inhalation of freshly generated fume may cause metal fume fever.	15.0

*These threshold limit values were adopted by the American Conference of Governmental Industrial Hygienists in 1962.

94. When the soluble salts of beryllium, especially beryllium fluoride, come in contact with cuts or abrasions on the skin, deep ulcers may be formed that heal very slowly. Complete surgical excision of the ulcer is sometimes required in order to effect healing.

Metal fume fever

95. Metal fume fever is an acute condition of short duration caused by a brief high exposure to the freshly generated fumes of metals such as zinc or magnesium or their oxides. Symptoms appear from four to twelve hours after exposure and consist of fever and shaking chills. There is complete recovery usually within one day, and ordinarily the employee can return to the same job without recurrence. However, after a period in which there has been no contact with the fume, for example,

TABLE III. SELECTED TOXIC DUSTS AND FUMES (Continued)

Substance	Description and Effects	Threshold Limit in Milligrams per Cubic Meter of Air*
Manganese	Silvery gray metal. Hazardous from inhalation of fumes or dust.	5.0
Pentachlorophenol	Dark-colored flakes. Harmful dust. Emits toxic fumes when heated.	0.5 (skin**)
Phosphorus (yellow)	Poisonous mainly by inhalation. Severe burn hazard from skin contact.	0.1
Picric acid	Yellow crystals or liquid. Explosive—particularly metallic salts. Emits toxic fumes on decomposition.	0.1 (skin**)
Selenium compounds	Toxicity varies somewhat according to the solubility of the specific compound. Often causes contact dermatitis.	0.1
Sodium hydroxide	White, deliquescent pieces or lumps. Has severe action upon all body tissue.	2.0
Tellurium	Similar to selenium chemically and in physiological effects.	0.1
Titanium dioxide	White to black powder. Considered in the nuisance category.	15.0
Trinitrotoluene	Colorless to yellow monoclinic crystals. Emits toxic fumes of oxides of nitrogen when heated to decomposition. Highly poisonous explosive.	1.5 (skin**)
Uranium	Highly toxic and a radiation hazard that requires special consideration.	0.05 (soluble compounds) 0.25 (insoluble compounds)
Vanadium pentoxide	Yellow to red crystals. Acts chiefly as an irritant to the conjunctiva and respiratory tract.	0.5 (dust) 0.1 (fume)
Zinc oxide fume	Amorphous white or yellow powder. The powder is essentially nontoxic, but freshly generated fume may cause metal fume fever.	5.0
Zirconium compounds	Most compounds are insoluble and have low toxicity.	5.0

*These threshold limit values were adopted by the American Conference of Governmental Industrial Hygienists in 1962.

**The word "skin" in this table indicates that the substance can penetrate the skin to contribute to the exposure.

after a layoff, resumption of exposure is likely to bring on an attack.

96. To cause metal fume fever, heavy concentrations of fumes are required. Zinc oxide fume is the most common source, but cases caused by the inhalation of fumes from magnesium oxide, copper oxide, and other metallic oxides have also been reported. The condition does not occur from the handling of these oxides in powder form. Apparently, it results only from the inhalation of extremely fine particles freshly formed as fume (nascent fume).

97. Nickel, mercury, and other metals may also produce a fever followed by the toxic effects of the element.

Allergic Reactions

98. When in the form of dust, a large number of materials may cause various allergic reactions in susceptible individuals. Examples of such agents are certain animal products, foods, drugs, and chemicals. The bodily systems usually involved in allergic reactions, which may be quite severe, are the skin, respiratory system, and gastrointestinal system. Occasionally, two or more systems are involved. Some of the allergic reactions are dermatitis, hay fever, asthma, and hives.

99. Usually, the victim is subjected to a series of exposures without any reactions during which sensitization is built up. These exposures may occur continuously for years. Then, at the end of the "incubation period," which varies according to the individual, a reaction is produced.

100. For a true allergic reaction two factors are required:

a. A history of prior exposure to the material involved (sometimes not known by affected employees).
b. A "challenge dose" of the material, which provokes the allergic reaction.

101. Continuous exposures may act as "desensitizing doses," and under these conditions an allergic individual may work without incident for long periods of time only to find that re-exposure after removal from the sensitizing material (such as after a vacation) causes an allergic response to recur.

102. Medical and engineering recommendations to prevent allergic reactions are based on prevention of exposure by means of personal protective equipment, ventilation methods, or removal of sensitized individuals from the exposure.

Infections

Infection and pneumoconiosis

103. The presence of pulmonary disease that significantly interferes with the natural defenses against foreign particles may increase susceptibility to pneumoconiosis. Conversely, a pneumoconiotic lung is more prone to infection. For example, tuberculosis occurs more frequently among silicotics than among normal persons. Severe disability or death of a silicotic, when caused by pulmonary conditions, usually results from complicating tuberculosis either alone or combined with other infections.

Bacteria and fungi

104. The possibility of lung in-