

Occupational Safety and Health Standards

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The Occupational Safety and Health Act¹ is the product of years of human experience with industrial environments. Unfortunately, the American work force had to endure a series of particularly shocking tragedies that eventually led Congress to take steps to "assure so far as possible every working man and woman in the nation safe and healthful working conditions."

What has been the history of standards development in the United States? In 1877, Massachusetts passed the first occupational safety law, and in 1893 legislation was passed by the U.S. Congress regulating railroad safety.² Between 1920 and 1948 all of the States had passed worker compensation laws; Mississippi was the last.³ According to Gersuny,³ most of these laws emphasized safety-related problems and had the support of conservative economic groups. The purpose of these workers' compensation laws was to undercut unionists and other advocates of adversary posture in labor-management relations.

The first air-quality standards or guidelines were published in 1912 by Rudolph Kobert⁴ titled, "The Smallest Amounts of Noxious Industrial Gases Which Are Toxic and the Amounts Which May Perhaps Be Endured." This list included 20 compounds such as HCl, chlorine, bromine, and ammonia. Other lists followed, and most were based on least-detectable odor or least amount required to cause irritation. In 1921 the Bureau of Mines published the first federal technical paper with limits for 33 compounds.⁵ The first list to consider not only acute effects, but also effects from prolonged exposure was that of Henderson and Haggard⁶ in 1927. The U.S. Public Health Service issued a manual listing recommended values based on its collective experience in 1943. In 1946 the American Conference of Governmental Industrial Hygienists (ACGIH) published its list for 140 substances.⁷ Others, such as Cook⁸ in 1945 and Smyth⁹ in 1956, also published suggested limits on expanded lists. Smyth's list contained 240 substances. This trend of publishing exposure limits continues to the present time.

There are several federal laws that have affected the standards-setting process. The first was the limited legislation concerning coal mine and railroad safety enacted in the 1880s.² The next significant law addressing workplace safety in the United States was the National Labor Relations Act, commonly known as the Wagner Act of 1935,¹⁰ legitimizing unionization and collective bargaining. The Walsh-Healy Public Contracts Act of 1936¹¹ provided federal jurisdiction in areas of regulation of working hours and also standards concerning safety and health, but it was limited to only those with government contracts of \$10,000 or more. The Labor Management Relations Act of 1947 provided that the employee might quit work in good faith because of "abnormally dangerous conditions," without it being considered a strike.¹²

The Metal and Nonmetallic Mine Safety Act of 1966¹³ followed by the federal Coal Mine Health and Safety Act of 1969¹⁴ marked the beginning of the federal

government's effort to provide a safe workplace through specific and detailed regulations.

As recently as 20 years ago, the American workforce still faced the risk of job-related death and injury. At hearings before the Senate Subcommittee on Labor of the Committee on Labor and Public Welfare in 1966, Secretary of Labor Willard Wirtz provided the following testimony:

Mr. Chairman, and members of the Committee, while we sit here talking, from now until noon, seventeen American men and women will be killed on their jobs.

Every minute we talk, 18 to 20 people will be hurt severely enough to have to leave their jobs—some of them never to work again.

In the time these two sentences have taken, another 20 people—one every second—have been injured on the job—less seriously, but in most cases needlessly.

Today's industrial casualty list—like yesterday's—and tomorrow's—and every working day's week after month after year— will be 55 dead, 8,500 disabled, over 27,200 hurt.

The figures for the year will be 14,000 to 15,000 dead, over 2 million disabled, over 7 million hurt.

The testimony given by Secretary Wirtz and others clearly described the magnitude of the problem.

Data published by the Office of Technology Assessment (OTA) of the U.S. Congress in 1985¹⁵ concluded that between 1979 and 1983 at least 4,650 and as many as 12,200 workers died as a result of occupational injuries each year. The total number of occupational deaths each year will obviously be greater than this, if one includes delayed deaths due to exposure to chemicals and physical agents such as asbestos, coal dust, and benzene. The point is obvious. In 1966, Secretary Wirtz estimated the annual occupational death toll to be about 14,000. In 1985 the U.S. Congress estimated the annual occupational death toll to be about 12,000. The similarity between these two figures tells you how far we have progressed, at least in absolute numbers.

When Congress passed the Occupational Safety and Health Act in 1970,¹⁶ its members realized that until the Occupational Safety and Health Administration (OSHA) could implement the rule-making procedures established in the Act, there must be a set of workplace health standards that OSHA could implement. The solution that Congress arrived at was to allow OSHA to adopt existing guidelines for workplace exposure limits as OSHA standards for airborne contaminants. At the time the largest collection of such guidelines was the list of Threshold Limit Values (TLVs) published by the ACGIH. Additional standards were adopted from consensus standards produced by the American Standards Association, now called The American National Standards Institute, and the National Fire Protection Association. Thus, OSHA began its existence with exposure standards for about 400 substances of industrial importance. They are contained in the Z-Tables of the current Code of Federal Regulations.¹⁷ In Section 6(b) of the Occupational Safety and Health Act¹ it is made clear that Congress intended that OSHA should promulgate new standards to update those on the Z-Tables using information supplied to them by the National Institute for Occupational Safety and Health (NIOSH) or other interested parties. The process established by Congress required that new OSHA standards be established following public scrutiny and discussion of the most current data. Congress also directed NIOSH to provide OSHA with data necessary to promulgate new standards.

Since passage of the Occupational Safety and Health Act of 1970, NIOSH has supplied OSHA with recommended standards for about 125 individual chemical

substances. And since passage of the Act, OSHA has promulgated new standards for about 26 chemical substances.

At the current rate of promulgation (about 1.5 standards a year), about 270 years will be needed to establish new standards for the 400 substances in the OSHA Z-Tables. On the basis of the history of the first 15 years of NIOSH, it will take about 50 years to produce recommended standards for the remainder of the substances in the Z-Tables.

OSHA is currently considering a proposal to update and expand the Z-Table containing those old start-up standards. This is a laudable idea, because the old table contains standards based on 1968 or earlier data; however, it can entail a number of problems. One major problem lies with the depth and reliability of documentation in the various data sources OSHA has to draw upon. If, for example, OSHA were to again use the ACGIH TLVs as their basic resource instead of NIOSH recommended standards, they would not be following the mandates of the OSHA Act. NIOSH recommended exposure limits¹ are intended to present: ". . . criteria dealing with toxic materials and harmful physical agents and substances which will describe exposure levels that are safe for various periods of employment, including but not limited to the exposure levels at which no employee will suffer impaired health or functional capacities or diminished life expectancy as a result of his work experience." The ACGIH TLVs, however, are intended as guidelines for health professionals to use in establishing protective procedures and are threshold limit values which: ". . . refer to airborne concentrations of substances and represent conditions under which it is believed that *nearly all workers* may be repeatedly exposed day after day without adverse effect."¹⁸ ACGIH TLVs are not intended to be used as exposure limits according to ACGIH's testimony at the October 1987 OSHA hearings on the proposed rule for hazardous waste site workers.

In one analysis of 12 chemicals found on the top 100 National Priority List for hazardous waste cleanup sites, three—lead, benzene, and arsenic—already have permissible exposure limits (PELs) established by OSHA through the public rule-making process. For these three chemicals, the current ACGIH TLVs are 3–20 times higher than the OSHA PELs. Analysis of six of the other nine chemicals revealed some interesting findings.

The TLV documentation for trichloroethylene stated that "A TLV of 50 ppm, as a time weighted average, is recommended to control subjective complaints such as headache, fatigue and irritability. A STEL of 200 ppm is recommended to protect against incoordination and other beginning anesthetic effects from trichloroethylene. These levels provide a wide margin of safety in preventing liver injury."¹⁸

In this same documentation, the ACGIH cited three studies in which neurotoxic effects were reported at concentrations that ranged from 1–335 ppm and became particularly noticeable at concentrations of about 40 ppm. This same recommendation also cited a National Cancer Institute bioassay¹⁹ that demonstrated hepatocellular carcinoma in mice.

In a NIOSH evaluation of these same data,²⁰ it was concluded that the reports of neurotoxicity and carcinogenicity were sufficient to warrant a reduction of the PEL to 25 ppm as an 8-hour time-weighted average (TWA). NIOSH also noted that this is a concentration that can be attained through the use of existing engineering controls.

The 1986 TLV for chloroform¹⁸ states: "In view of recent reports on carcinogenicity and embryotoxicity of chloroform, the Committee recommendation for a TLV is 10 ppm, as a TWA, and classification as an Industrial Substance Suspect of Carcinogenic Potential for Man (A2). A concentration of 10 ppm is one-fifth the

concentration at which organ injury was observed and one-half the concentration which would be derived comparing the toxicity of other organic solvents." NIOSH in 1976 lowered their recommended exposure limits to 2 ppm because of the suspected carcinogenic potential of chloroform.²¹

The ACGIH have two TLVs for polychlorinated biphenyls (PCBs) based on their chlorine content.¹⁸ For those compounds containing 42% chlorine, the TLV is 1 mg/cm as an 8-hour TWA with a STEL of 2 mg/cm. Those PCBs having 54% chlorine have a TLV of 0.5 mg/cm as an 8-hour TWA with a short-term exposure limit (STEL) of 1 mg/cm. The most recent study cited in this 1986 documentation was published in 1977. The documentation carries no mention of carcinogenicity but does carry a statement of intent to delete the STEL.

In response to data on the carcinogenicity of the PCBs, NIOSH in 1977 recommended an exposure limit of 0.001 mg/cm of air²² (the minimum reliably quantifiable concentration using the recommended sampling and analytic methods). These recommendations should be considered in the context of the EPA ban on the use of PCBs as a dielectric in transformers and capacitors, and the fact that PCBs are the only substances specifically mentioned in the Toxic Substances Control Act.²³

The most recent data cited by the ACGIH in support of its TLV for 1,1,2,2-tetrachloroethane were published in 1972. The ACGIH¹⁸ states that there are no data on carcinogenicity, mutagenicity, or teratogenicity in either animals or humans.

In 1978 NIOSH²⁴ recommended that tetrachloroethane be controlled to the lowest feasible concentration because of its carcinogenicity and its effects on the liver, gastrointestinal tract, and nervous system. The International Agency for Research on Cancer (IARC) listed it as a suspect animal carcinogen in 1979.²⁵

The ACGIH also cites¹⁸ data from Schmidt, indicating pathologic changes in rats at 2 ppm, and data from Navrotsky, indicating hematologic changes in rabbits at 1.5 ppm, before concluding that 1 ppm is safe for human exposure.

The most current information cited by the ACGIH in their 1986 documentation for cadmium was published in 1977.¹⁸ Although they cited the 1976 NIOSH criteria document on cadmium in which NIOSH concluded that the available information was insufficient evidence of cadmium's carcinogenicity, the ACGIH did not acknowledge information published in 1979, 1980, 1982, and 1983 or the revised NIOSH policy in 1984 that described cadmium's carcinogenicity, and recommended that exposures be reduced to the lowest feasible level.²⁶ It should also be noted that IARC²⁷ recognizes cadmium as a carcinogen. All of these reports noted associations between cadmium exposure and carcinogenicity in both animals and humans.

The literature on chromium and its compounds is not clear, particularly that on chromium VI compounds, some of which are water soluble and some of which are not.

NIOSH recommends 0.001 mg/m³ for carcinogenic Cr VI and 0.025 mg/m³ for other chromium VI compounds.²⁸ The latter includes a 15-minute ceiling of 0.05 mg/m³. NIOSH has a separate recommendation for chromic acid of 0.025 mg/m³ as a TWA and 0.05 mg/m³ as a 15-minute ceiling. It is important to note that the ACGIH recommendation for Cr VI compounds, 0.05 mg/m³, cites data from Mancuso and Hueper estimating that workers who developed lung cancer were exposed to Cr VI concentrations as low as 0.01 mg/m³, a concentration one fifth of the recommended TLV.¹⁸

For toluene,²⁹ phenol,³⁰ and xylene,³¹ both NIOSH and the ACGIH¹⁸ essentially agree on similar exposure limits.

SUMMARY AND CONCLUSION

If we are to approach developing a safe and healthful workplace in a more timely fashion, a more generic approach must be considered and applied instead of developing recommendations and standards simply on a substance-by-substance basis, an approach that has been the most prominent. Some examples in which developing generic standards may be appropriate are: cholinesterase-inhibiting substances, neurotoxic agents, reproductive hazards, cold environments, and vibration syndrome, to name but a few.

It is important to recognize that developing standards based on individual substances often does not allow for the role of synergism, a reaction that has had little study, but it is important in controlling occupational disease and injury.

These concerns can be addressed in several ways. One is to look at processes or conditions found in the workplace; for example, coke oven emissions that OSHA has promulgated into a standard³² and, as NIOSH has done in their recommendations to OSHA for foundries,³³ coal tar products,³⁴ the manufacture of paint and allied coatings,³⁵ field sanitation,³⁶ hazardous waste management,³⁷ hot environments,³⁸ and confined spaces.³⁹ Another is to address groups of similar substances such as NIOSH has done with alkanes,⁴⁰ benzidine-based dyes,⁴¹ diisocyanates,⁴² dinitrotoluenes,⁴³ and glycol ethers.⁴⁴ A third comprehensive approach is to look at general categories of hazards, such as the generic carcinogen policy,⁴⁵ and the hazard communication rule.⁴⁶

Finally, risk must be considered in the development of any standard. Nelson Rockefeller once said in relation to an incidence involving a radiation hazard that, "you can't have a riskless society." I would amend this to say that you cannot have a reckless society either. Safety and health regulations are essential and must be designed, promulgated, and then enforced so that a reckless society is avoided or controlled, with a riskless society being the ultimate aim.

[Note added in proof: OSHA published a time rule on air contaminants on January 19, 1989 in the Federal Register (54(12): 2329-2984) updating the OSHA PELs.]

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