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COMMENTARY

American Conference of Governmental Industrial Hygienists: Low Threshold of Credibility

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Key words: risk assessment, philosophic perspectives, occupational health, TLVs, conflict of interest, corporate influence

> "F.T. Bodurtha reviewed with subcommittee members the importance of reporting TLV data which can be used by ACGIH as a basis for establishing threshold limit values. This is particularly important in those cases where Du Pont feels that the TLV presently is too low."
>
> Du Pont Memo, September 1, 1966

INTRODUCTION

A recent article [Rappaport, 1993] on the threshold limit values (TLVs) credits the American Conference of Governmental Industrial Hygienists with reforming its practices, saying: "ACGIH has developed formal procedures to guard against conflicts of interest." Unfortunately, ACGIH has done practically nothing to assure that conflicts of interest will be avoided by members of the TLV committee.

The TLV committee has been criticized for having corporate employees, retirees, and consultants take the primary role of drafting the documentary bases of TLVs for chemicals made by their corporate employers and clients. Yet committee members are not required to disclose even to ACGIH the sources of income they receive from consulting; public disclosure of such income sources, which is a requirement for members of scientific advisory committees to U.S. government agencies, has been discussed within ACGIH and was bitterly resisted.

The conflict of interest "policy" consists of a mere understanding that, if a member of the committee suspects that he or she may have a conflict of interest, that should be discussed with the TLV committee chair and resolved. This ensures that, to the extent that conflicts of interest are of concern on the committee, they will be handled in such a way that there is no public disclosure of the issues involved or the manner of their resolution. ACGIH declined to explicitly prohibit committee members from being involved in developing TLVs for substances produced by firms with which they have financial relationships.

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Why must so much reliance be placed on the judgment and consciences of TLV committee members who have opposed more substantial guarantees to safeguard against such conflicts of interest? If working on the TLV committee is an act of public service, and it clearly is for some committee members, why not demonstrate that by embracing modern practices of openness?

The newest edition of the *Documentation of TLVs and BEIs* [ACGIH, 1991–1993] reflects the most obvious and disappointing response by ACGIH to charges of corporate influence on the TLVs over the past 5 years. Removed are citations to unpublished corporate communications that were critical in setting TLVs for over 100 substances [Castleman and Ziem, 1988]. The new documentations for individual substances are revised and reference only published literature. The problem is, the TLVs that were based on the old "references" were not subjected to review in the course of this process. The new *Documentation* plainly indicates that, for 85% of the substances whose documentations were revised in 1991, TLVs had not been scrutinized for the preceding 5 years. In a rare case in which a committee member recommended that a TLV be reviewed based on the data found in revising a documentation, the recommendation was voted down (ethylene oxide). By revising the *Documentation* but not the TLVs, ACGIH concealed corporate influence instead of eliminating it.

TLV committee minutes and ACGIH Board of Directors minutes about TLVs are regarded as private records by ACGIH and will not be publicly disclosed by ACGIH. Minutes of the TLV committee and some subcommittee minutes have nonetheless been located, and offer an impressive record of corporate influence.

The minutes reveal that primary responsibility for drafting documentations to serve as the bases for new TLVs for specific substances was frequently assigned to corporate employees and consultants. Though this has been noted before [Castleman and Ziem, 1988; Ziem and Castleman, 1989], Table I is the most complete record of this kind to appear in print. Table I, which is in all likelihood a less-than-complete record of these assignments, shows that more than 40 products of Dow Chemical were assigned to Dow toxicologist Theodore Torkelson. Another 20 were DuPont products assigned to DuPont employees James Morgan and Gerald Kennedy. Similar contributions were made by representatives of Bayer and Exxon.

ACGIH claims that the full TLV committee approves of all TLVs and is collectively responsible for the result. But in practice, the process depends very much on the thoroughness and impartiality of individuals preparing the documentations. A typical TLV committee meeting can cover 20–30 substances. Each member has documentations to prepare in addition to vetting those presented by the other members. Even if all the documentations and all supporting references were made available to all committee members in advance of meetings, which has never been done, it would be an enormous job for a member to analyze everything and come prepared to critique it. How many people doing this work as unpaid volunteers can find the time and resources to locate important works *omitted* by others in their documentations?

The weakness of the process in depending so much on the work of individuals on the TLV committee is reflected in the inaccuracies in the 1986 *Documentation* catalogued by Roach and Rappaport [1990]. There was no checking of the reference citations by the TLV committee chairmen, ACGIH staff, or anybody else. And it does not appear that the ACGIH Board got involved in developing specific TLVs until the

TABLE I. TLV Chemical Assignments to Corporate Representatives*

Substance	Person assigned (company)
Acrylamide	T. Torkelson (Dow[a])
Acrylonitrile	T.T. (Dow), J. Morgan (DuPont[a])
Amitrole	T.T. (Dow), G. Kimmerle (Bayer[a])
Asbestos	P. Gross (asbestos companies[a])
Azodrin	M. Zavon (Ethyl)
Bis-chloroethyl ether	T.T. (Dow)
Bromacil ("Hyvar X")	J.M. (DuPont[a])
Bromochloromethane	T.T. (Dow[a])
Bromodiphenyls	T.T. (Dow)
Calcium hydroxide	T.T. (Dow)
Caprolactam	T.T. (Dow[a])
Carbon tetrabromide	T.T. (Dow)
Carbon tetrachloride	T.T. (Dow[a]) subcommittee
Chlorine	T.T. (Dow[a])
Chloroacetic acid	T.T. (Dow[a])
Chloroacetone	T.T. (Dow)
Chloroacetyl chloride	T.T. (Dow[a])
Chlorodifluoromethane	J.M. (DuPont[a])
Chloroform	T.T. (Dow[a])
Chloromethyl methyl ether	T.T. (Dow)
Chloropentafluoroethane	J.M. (DuPont[a])
Chloroprene	J.M. (DuPont[a])
2-Chloropropionic acid	T.T. (Dow[a]) subcommittee
o-Chlorostyrene	T.T. (Dow)
2 Chloro-6-trimethyl pyridine ("N-Serve")	T.T. (Dow[a])
Chlorpyrifos ("Dursban")	T.T. (Dow[a])
Chromates	J.M. (DuPont[a])
Clopidol ("Coyden")	T.T. (Dow[a])
Crufomate ("Ruelene")	T.T. (Dow[a])
Cyanamide	J.M. (DuPont)
Cyclopentadiene	T.T. (Dow)
Cyclopentane	J.M. (DuPont), J. Hammond (Exxon)
Dibromochloropropane	T.T. (Dow[a])
Dichloromonofluoromethane	J.M. (DuPont[a])
1,2 Dichloropropane (propylene dichloride)	T.T. (Dow[a])
1,3 Dichloropropane	T.T. (Dow)
1,3 Dichloropropene ("Telone")	T.T. (Dow[a])
Dicrotophos ("Bidrin")	M.Z. (Ethyl)
Dicyclopentadiene	T.T. (Dow[b])
Dimethylate	T.T. (Dow)
Dimethyl formamide	J.M. (DuPont[a])
Dimethyl hydrazine	J.M. (DuPont)
Dimethyl sulfate	J.M. (DuPont[a])
Dimethyl sulfoxide	J.M. (DuPont)
3,5 Dinitro-o-tolamide ("Zoalene")	T.T. (Dow[a])
Dioxane	T.T. (Dow[a])
Dioxin	T.T. (Dow[a])
Dipropylene glycol methyl ether ("Dowanol DPM")	T.T. (Dow[a])
Diuron ("Karmex")	J.M. (DuPont[a])
Divinylbenzene	T.T. (Dow[a])
Epichlorohydrin	T.T. (Dow[a]) subcommittee
Ethanolamine	T.T. (Dow[a])
2-Ethoxyethanol	T.T. (Dow)

(continued)

TABLE I. TLV Chemical Assignments to Corporate Representatives* (Continued)

Substance	Person assigned (company)
2-Ethoxyethyl acetate	T.T. (Dow)
Ethyl chloride	T.T. (Dow)
Ethylene chlorohydrin	T.T. (Dow)
Ethylene diamine	T.T. (Dow[a])
Ethylene dibromide (1,2 dibromoethane)	T.T. (Dow[a])
Ethylene dichloride (1,2 dichloroethane)	T.T. (Dow[a])
Ethylene glycol	T.T. (Dow[a])
Fenamiphos ("Nemacur")	G. Kimmerle (Bayer/Mobay[a])
Fenthion ("Baytex")	G.K. (Bayer/Mobay[a])
Fibrous glass	P.G. (insulation manufacturing association[a])
Formamide	J.M., G.L. Kennedy (DuPont[a])
Gasoline	J. Hammond (Exxon[a])
Hexabromodiphenyl	T.T. (Dow)
Hexachlorobutadiene	T.T. (Dow)
Hexachlorocyclopentadiene	T.T. (Dow)
Hexachloroethane	T.T. (Dow)
Hexafluoroacetone	J.M. (DuPont[a])
Hexamethyl phosphoramide	J.M. (DuPont[a])
n-Hexane	J.H. (Exxon[a])
Hydrazine	G.L.K. (DuPont)
Hydrogen cyanide	J.M. (DuPont[a])
2-Hydroxypropyl acrylate	J.M. (DuPont)
Iodoform	T.T. (Dow)
Isohexane	J.H. (Exxon)
Isoparaffin	J.H. (Exxon)
Isophthalonitrile	M.Z. (Ethyl)
Kerosene, deodorized	T.T. (Dow)
Ketene	M. Zavon (Hooker Chemical)
Liquefied petroleum gas (LPG)	J.H. (Exxon[a])
Malathion	M.Z. (Hooker)
Methomyl ("Lannate")	J.M. (DuPont[a])
2-Methoxymethanol	M.Z. (Hooker), T.T. (Dow)
2-Methoxyethylacetate	M.Z. (Hooker), T.T. (Dow)
Methyl bromide	T.T. (Dow[a])
Methyl chloride	T.T. (Dow[a])
4,4'-Methylene bis (2-chloroaniline) ("MOCA")	J.M. (DuPont[a])
Methylene bis(4-cyclohexyl isocyanate)	G.L.K. (DuPont)
Methylene chloride	T.T. (Dow[a])
4,4' Methylene dianiline	T.T. (Dow[a]) subcommittee
Methyl hydrazine	G.L.K. (DuPont)
N-methyl pyrrolidone	J.M. (DuPont)
Metribuzin ("Sencor")	G.K. (Bayer/Mobay[a])
Morpholine	G.L.K. (DuPont)
Naphtha, VM & P	J.H. (Exxon[a])
p-Nitrochlorobenzene	G.L.K. (DuPont[a])
Octabromodiphenyl	T.T. (Dow)
Perchloroethylene	T.T. (Dow[a])
Perchloromethyl mercaptan	G.K. (Bayer/Mobay[a])
Perfluoroalkanes	J.M. (DuPont)
Perfluorooctanoic acid	G.L.K. (DuPont)
Phenyl betanaphthylamine	J.M. (DuPont)
Phenylene diamine	G.K. (Bayer/Mobay[a])
Phenyl hydrazine	G.L.K. (DuPont)

(continued)

TABLE I. TLV Chemical Assignments to Corporate Representatives* (Continued)

Substance	Person assigned (company)
Phosgene	J.M. (DuPont[a])
m-Phthalodinitrile	M.Z. (Ethyl)
Picloram ("Tordon")	T.T. (Dow[a])
Propylene glycol methyl ether ("Dowanol PM")	T.T. (Dow[a])
Stoddard solvent	J.H. (Exxon[a])
Styrene	T.T. (Dow[a])
Sulprofos ("Bolstar")	G.K. (Bayer/Mobay[a])
2,4,5-T	V.K. Rowe (Dow[a])
Tetrachloronaphthalene	T.T. (Dow)
Tetramethyl thiourea	M.Z. (Occidental Chemical)
Thiram	G.K. (Bayer/Mobay[a])
Tin, organo	T.T. (Dow)
m-Toluene diamine	J.M. (DuPont[a])
o-Toluidine	G.K. (Bayer/Mobay[a])
1,2,3 Trichlorobenzene	T.T. (Dow)
1,2,4 Trichlorobenzene	T.T. (Dow[a])
1,1,1 Trichloroethane	T.T. (Dow[a])
1,1,2 Trichloroethane	T.T. (Dow[a])
Trichloroethylene	T.T. (Dow[a])
1,2,3, Trichloropropane	T.T. (Dow[a])
Trichlorotrifluoroethane	J.M. (DuPont[a])
Tricyclohexyltin hydroxide ("Plictran," cyhexatin)	T.T. (Dow[a])
Trifluorobromomethane	J.M. (DuPont[a])
Tris(2,3 dibromopropyl phosphate)	T.T. (Dow) and J.M. (DuPont)
Vinyl bromide	T.T. (Dow)
Vinyl chloride	T.T. (Dow[a])
Vinyl fluoride	T.T. (Dow)
Vinylidene chloride	T.T. (Dow[a])
Vinylidene fluoride	T.T. (Dow)
m-Xylene, α,α'-diamine	J.M. (DuPont)
Xylidine	G.K. (Bayer/Mobay[a])

*Sources: TLV committee minutes, fragmentary TLV subcommittee minutes, and TLV Committee spreadsheets, 1970–1988; *Directory of Chemical Producers*, 1986; *Chemical Week Buyers' Guide*, 1976 and other years; *Synthetic Organic Chemicals*, U.S. International Trade Commission, 1972–1986; and personal communications with present and former TLV committee members.
[a]Product of the company at or before time that the TLV documentation was assigned.
[b]Product of the company after the time that TLV documentation was assigned.

Formaldehyde Institute invoked a clause of the by-laws to contest the proposal to lower the TLV for formaldehyde in 1991.

TLVs for 98 substances were criticized as insufficiently protective by the National Institute for Occupational Safety and Health (NIOSH), in comments to the Occupational Safety and Health Administration (OSHA) on the "Air Contaminants" rule [Robinson et al., 1991]. By this regulation, OSHA adopted the 1987 TLVs for about 350 of the 376 substances included. The rule was adopted in the last week of the Reagan administration, in 1989, and was supported by the Chemical Manufacturers Association. OSHA's regulation was then challenged by other industrial parties and overturned in court in 1992 [Begley and Kirschner, 1993]. TLVs and TLV assignments of 229 substances have been criticized in recent years (see Table II).

Rappaport [1993] also suggested that ACGIH consider revising its definition of

TABLE II. TLV Assignments and TLVs That Have Been Criticized, 1988–1991*

Substance	A	B	C	D	E
Acetaldehyde					x
Acetone				x	x
Acetonitrile			x		x
Acetylene tetrabromide					x
Acrylamide	x				
Acrylic acid		x			x
Acrylonitrile	x	x			x
Allyl alcohol			x		
Amitrole	x				
Arsine					x
Asbestos	x				
Asphalt fumes		x			
Benomyl		x			
Benzene		x		x	
Beryllium				x	x
Bis-chloroethyl ether	x				
Bromacil ("Hyvar X")	x				
n-Butyl acrylate		x			
sec-Butyl alcohol		x			
t-Butyl chromate					x
n-Butyl glycidyl ether		x			x
n-Butyl lactate		x			
o-sec-Butyl phenol		x			
Cadmium				x	
Camphor, synthetic					x
Caprolactam		x			x
Carbon black					x
Carbon disulfide		x	x		x
Carbon tetrachloride	x				x
Catechol		x			
Chlorinated camphene (60%)		x			x
Chorinated diphenyl oxide		x			
Chlorine	x				x
Chlorine dioxide			x		
Chloroacetaldehyde		x			
Chloroacetyl chloride		x			
Chlorobenzene					x
Chlorodifluoromethane	x	x			
Chlorodiphenyl			x		x
Chloroform	x				
o-Chlorostyrene		x			
o-Chlorotoluene		x			
2 Chloro-6-trichloromethyl pyridine	x				
Chlorpyrifos ("Dursban")	x	x			
Chromates	x				x
Chromium (II, III and VI) compounds					x
Clopidol ("Coyden")	x	x			
Coal dust (> and < 5% quartz)					x
Coal tar pitch volatiles (benzene soluble)					x
Copper		x			

(continued)

TABLE II. TLV Assignments and TLVs That Have Been Criticized, 1988–1991* (Continued)

Substance	A	B	C	D	E
Crufomate ("Ruelene")	x				
Cyclopentadiene		x			
Cyhexatin ("Plictran")		x			
Dibromochloropropane	x				
Dibutyl phthalate		x			
p-Dichlorobenzene					x
Dichlorodifluoromethane		x			
Dichlorodiphenyltrichloroethane (DDT)					x
Dichloroethylene		x			
Dichloromonofluoromethane	x	x			
1,2 Dichloropropane (propylene dichloride)	x				x
1,3 Dichloropropene	x				
2,2 Dichloropropionic acid		x			
Dichlorotetrafluoroethane		x			
Dicrotophos		x			
Dicyclopentadiene	x				
Dicyclopentadienyl iron		x			
Diethyl phthalate		x			
Diglycidyl ether		x			
Dimethyl acetamide		x			
Dimethyl amine		x			
Dimethyl formamide	x	x			
1,1 Dimethyl hydrazine					x
Dimethyl sulfate	x	x			
Dinitolmide	x	x			
Di-sec-octyl phthalate		x			
Dioxane	x				
Dioxin	x				
Diphenylamine		x			
Dipropylene glycol methyl ether	x				
Disulfoton					x
Diuron ("Karmex")	x				
Divinylbenzene	x	x			
Endrin		x			
Epichlorohydrin	x				x
Ethanol			x		
Ethanolamine	x				
Ethion		x			
2-Ethoxyethanol				x	
Ethyl acetate			x		
Ethyl acrylate					x
Ethyl amyl ketone		x			
Ethyl bromide					x
Ethyl chloride					x
Ethylene diamine	x			x	
Ethylene dibromide	x				
Ethylene dichloride	x	x			
Ethylene glycol	x				x
Ethylene oxide				x	

(continued)

TABLE II. TLV Assignments and TLVs That Have Been Criticized, 1988–1991* (Continued)

Substance	A	B	C	D	E
Ethylenimine		x			
Ethyl ether			x		x
n-Ethyl morpholine		x			
Fenamiphos ("Nemacur")	x	x			
Fenthion ("Baytex")	x				x
Fluoride			x		
Fluorine					x
Fonophos		x			
Formaldehyde				x	
Formamide	x				x
Furfural					x
Glutaraldehyde				x	
Grain dust					x
Heptane					x
Hexafluoroacetone	x				
Hexamethyl phosphoramide	x				
Hexane isomers					x
Hydrazine					x
Hydrogen cyanide	x				
Hydroquinone		x			
2-Hydroxypropyl acrylate		x			
Isooctyl alcohol		x			
Isophorone		x			
Isophorone diisocyanate		x			
Isopropoxyethanol		x			x
Isopropyl acetate					x
Isopropylamine					x
n-Isopropyl aniline		x			
Lead			x	x	
Lead chromate		x			
Magnesium oxide fume			x		
Manganese dust and compounds		x		x	x
Manganese tetroxide		x			x
Mercury			x	x	
Mesityl oxide					x
Methacrylic acid		x			
Methomyl ("Lannate")	x	x			
2-Methoxyethanol				x	
4-Methoxyphenol		x			
Methyl acetylene-propadiene mixture		x			
Methyl bromide	x				
Methyl n-butyl ketone		x			x
Methyl chloride	x	x			
Methyl chloroform				x	
Methyl 2-cyanoacrylate		x			
Methylene chloride	x	x			
4,4'-Methylene bis (2-chloroaniline)	x				x
Methylene bis(4-cyclohexyl isocyanate)		x			
Methylene bisphenyl isocyanate		x			
4,4' Methylene dianiline		x			
Methyl hydrazine					x
Methyl isocyanate		x			

(continued)

TABLE II. TLV Assignments and TLVs That Have Been Criticized, 1988–1991* (Continued)

Substance	A	B	C	D	E
Metribuzin ("Sencor")	x	x			
Mineral oil mist				x	
Molybdenum (soluble)					x
Monocrotophos		x			
Nickel, soluble or inorganic compounds					x
Nitrapyrin		x			
p-Nitrochlorobenzene	x				x
Nitroglycerin			x		
Nitromethane					x
2-Nitropropane					x
Octane					x
Ozone					x
Paraquat		x			
Parathion					x
Pentane					x
2-Pentanone (methyl propyl ketone)					x
Perchloroethylene	x				x
Perchloromethyl mercaptan	x				
Phenylene diamine	x				
Phenyl glycidyl ether					x
Phenyl hydrazine					x
Phenyl phosphine		x			
Phosgene	x				
Picloram ("Tordon")	x				
Piperazine dihydrochloride		x			
Propionic acid		x			
Propylene glycol methyl ether	x				
Propylene glycol monoethyl ether			x		
Propylene oxide					x
Quartz			x		
Quinone		x			
Resorcinol		x			
Rosin core solder pyrol. products		x			x
Selenium			x		
Silica, amorphous					x
Silica, crystalline				x	x
Silicon tetrahydride		x			
Silver and compounds		x			
Styrene	x			x	
Sulfur dioxide				x	
Sulfuric acid mist				x	
Sulfuryl fluoride		x			
Sulprofos ("Bolstar")	x				
2,4,5-T	x				
Tetraethyl lead		x			
Tetrahydrofuran		x			
Tetramethyl lead		x			
Tetrasodium pyrophosphate		x			
Thioglycolic acid		x			
Thiram	x				
Toluene			x	x	
m-Toluene diamine	x				

(continued)

TABLE II. TLV Assignments and TLVs That Have Been Criticized, 1988–1991* (Continued)

Substance	A	B	C	D	E
Toluene diisocyanate				x	
m- and p-Toluidine					x
1,2,4 Trichlorobenzene	x	x			
Trichloroethylene	x				x
Trichlorofluoromethane		x			
Trichlorotrifluoroethane	x	x			
Tricyclohexyltin hydroxide	x				
Triethylamine				x	x
Trimethyl phosphite		x			
Triphenyl amine		x			
Tris (2,3) dibromopropyl phosphate	x				
Tungsten compounds		x			
Vinyl acetate					x
Vinyl bromide					x
Vinyl chloride	x				
Vinyl cyclohexene dioxide		x			
Vinylidene chloride	x				x
Welding fumes					x
Wood dust, softwood					x
m-Xylene, α,α′-diamine		x			
Xylidine	x	x			
Zinc chromate					x
Zinc oxide fume				x	
Zinc stearate		x			
Zirconium compounds					x

*A: TLV documentation assigned to representative of manufacturer on TLV committee, 1970–1988 [Castleman and Ziem, 1988; Ziem and Castleman, 1989]; B: TLV (1986) placed important reliance on unpublished corporate communication(s) [Castleman and Ziem, 1988]; C: TLV (1986) reference articles show health effects at and below the TLVs (1986) [Roach and Rappaport, 1990]; D: Health effects at and below the TLV (1988) reported in occupational medicine journals, 1987–1989 [Ziem and Castleman, 1989]; E: TLV (1987) criticized by NIOSH as too permissive for OSHA to adopt as permissible exposure limits [Robinson et al., 1991].

TLVs to temper the assertion that the TLVs protect "nearly all workers." This language in TLV booklets has been misconstrued for 40 years as a guarantee of safety by some of the people the booklets were intended to serve. Its only present value is to attorneys defending companies in damage suits by reading selected sentences from the preface to the TLVs, to raise a "TLV defense" for failure to warn workers that products or practices were harmful. ACGIH leadership has resisted repeated urgings to revise the booklets' preface, to make it more realistic and internally consistent.

The concept of the TLV defense is older than the TLVs, even older than ACGIH, and was arguably one of the factors that contributed to the establishment of industrial hygiene as a profession in the 1930s. In 1935, a consortium of industrialists met to devise a comprehensive response to the "industrial dust problem," including claims demanding hundreds of millions of dollars in compensation for occupational lung disease. This led to the formation of the Air Hygiene Foundation in 1936, with 200 corporations and trade associations as members. One objective of the program of action devised was to set up "authoritative and approved standards for the control of

industrial dusts which, if complied with by industries, or by industrial companies, will act as a defense against personal injury suits" [Weidlein, 1935]. Today's TLV defense asserts that: exposures in this case were thought to be below the TLVs, the TLVs were thought to be safe for workers ("based on the best available information"—TLV preface), and thus what happened was not the fault of the defendant manufacturer or company hiring contract labor.

ACGIH has had 5 years to deal responsibly with criticisms of impropriety in the process for setting TLVs and has chosen to do little if anything that would inspire public trust. The organization yielded to the most recalcitrant elements on the TLV committee and on the Board of Directors in refusing to repudiate discredited procedures and by changing as little as possible. Through the combination of intransigence and lack of resolve, ACGIH leadership has failed its members and the public once again on the TLVs. The winners in this sad affair are the business interests and lawyers that continue to use the TLVs and ACGIH's tattered credibility as a shield from liability in personal injury lawsuits.

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