



CHEMICAL MANUFACTURERS ASSOCIATION

August 4, 1988

To: Vinylidene Chloride Panel

Re: NIOSH Comments on Adding VDC to OSHA "Z-Table" as a Carcinogen

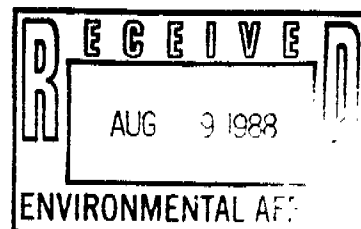
Enclosed are copies of the written and oral testimony given by NIOSH at the OSHA hearings on the "Z-Table" rulemaking.

On pages 7 - 9 and pages 13 - 16 of the written testimony, NIOSH suggests the addition of 53 chemicals, including VDC, as carcinogens and that PELs be established. The chemicals are covered by NIOSH Criteria Documents on Current Intelligence Bulletins. Mr. Dickson will be reviewing these documents and will advise the Panel on the appropriateness of commenting.

A handwritten signature in dark ink, appearing to read "B. Moran", is written over a light background.

Elizabeth J. Moran
Manager, Vinylidene Chloride Panel

cc: B. Dickson



SL 061910

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I am Richard A. Lemen, Director of the Division of Standards Development and Technology Transfer (DSDTT) of the National Institute for Occupational Safety and Health (NIOSH). With me today are senior staff from NIOSH research divisions, each of whom has expertise in various aspects of this rulemaking. Our purpose for appearing at this hearing is to support the Occupational Safety and Health Administration's (OSHA's) efforts to promulgate a new standard. NIOSH may make comments or recommendations in addition to those contained in this testimony, based upon other information presented during this hearing.

I want to take this opportunity to commend OSHA for embarking upon this rulemaking effort. This comprehensive updating of the Z-Tables will directly influence the health of all American workers. NIOSH strongly supports OSHA in its desire to make the air contaminant standards consistent with the most current information. We agree that there is an urgent need to update the current air contaminant standards because they represent exposure limits based on data available prior to 1968. Current information on health effects indicates that more protective limits are required for many substances. Even though NIOSH will question some of the specific Permissible Exposure Limits (PELs) that have been proposed, NIOSH does not question the wisdom of this rulemaking. Although NIOSH will suggest that some proposed PELs are not optimal, NIOSH nevertheless advocates adoption of more protective PELs. Even if some PELs are less protective than NIOSH might prefer, the overall impact of this Z-Table update represents a significant advance for worker safety and health. On the other hand, it should be clearly understood by all that this rulemaking is an exceptional event made necessary by the passage of 20 years without significant reevaluation of the standards contained in the Z-Tables. This should in no way impede vigorous action in the future to promulgate comprehensive standards as specified under Section 6(b) of the Occupational Safety and Health Act. Instead this should serve as an impetus to proceed more swiftly and efficiently with comprehensive standards.

NIOSH has transmitted to the Department of Labor 129 Criteria Documents and 50 Current Intelligence Bulletins (CIBs) (of these, one Criteria Document and one CIB were transmitted after this rulemaking was initiated). NIOSH Criteria Documents and CIBs are unparalleled in terms of the amount of information considered, the detail to which that information is examined, the extent to which evaluations are subjected to external peer review prior to publication, and the care with which those evaluations are explained in the published recommendation. It is important that the record is clear on what a NIOSH Criteria Document represents in this regard.

Criteria Documents are based on comprehensive reviews of the world's scientific literature. They routinely cite over 100 references and many cite several hundred. NIOSH does not rely upon information that

cannot be made public. Critical evaluations of cited references with detailed discussions of their implications are included in Criteria Documents to provide the reader with an appreciation of their strengths, their weaknesses, and a clear description of how NIOSH interprets these publications. By this method, the reader has enough information to reach independent conclusions regarding these cited reports. Each draft Criteria Document is reviewed by experts representing affected industries, organized labor, and trade or professional organizations, and by scientists, physicians, and other health professionals with related experience in academia, government, or industry. The number of these external peer reviewers normally is greater than 10 and often exceeds twice that number. In addition to the invaluable contribution their comments make to the completed Criteria Document, OSHA receives, along with the completed Criteria Document, the full text of each reviewer's written comments accompanied by itemized annotations indicating how the draft was modified in response, or providing the rationale if the comment or recommendation was not adopted. Each Criteria Document contains an extensive summary in which the basis for the Recommended Exposure Limit (REL) is carefully developed with clear and explicit citation of the data relied upon at all steps of the logical development. No other source of exposure limits approximates the comprehensiveness of these documents.

NIOSH recommends that the chemical universe defined for the present rulemaking include all chemicals covered by NIOSH RELs. We recognize the practical necessity for OSHA to limit the universe of chemicals subject to this rulemaking, but as noted by OSHA in its preamble, there are relatively "few instances" of substances with a NIOSH REL but no threshold limit value (TLV®). Including these substances would not significantly affect the "boundary on the number of substances to be evaluated," a concern expressed by OSHA in the notice for proposed rulemaking. NIOSH Table N5 (Appendix A) lists these 42 chemicals excluded up to now from the Z-Table update. If these are not added to the current update, they should be targeted for priority rulemaking to begin immediately upon completion of the present effort.

For a large number of the chemicals covered by this rulemaking (277 to be exact), NIOSH concurs with the PEL being proposed by OSHA. These chemicals are listed in NIOSH Table N1 (Appendix A). For them, the available documentation appears to support the proposed exposure limits as adequate to protect workers from recognized health hazards.

NIOSH questions the proposed PELs for the 31 chemicals listed in Table N2. They are:

- 1) Acrylic acid (HS 1009)
- 2) n-Butyl glycidyl ether (BGE) (HS 1052)
- 3) Camphor, synthetic (HS 1063)
- 4) Caprolactam vapor (HS 1065)

- 5) Coal dust (<5% quartz) (HS 1096)
- 6) Coal dust (>5% quartz) (HS 1097)
- 7) Disulfoton - skin (HS 1152)
- 8) Ethyl bromide (HS 1163)
- 9) Ethyl ether (HS 1164)
- 10) Ethylene glycol vapor (HS 1169)
- 11) Fenthion - skin (HS 1175)
- 12) Fluorine (HS 1179)
- 13) Formamide (NIC - skin) (HS 1182)
- 14) Furfural - skin (HS 1183)
- 15) Heptane (n-Heptane) (HS 1194)
- 16) Hexane isomers (HS 1201)
- 17) 2-Hexanone (Methyl n-butyl ketone) (HS 1202)
- 18) Isopropoxyethanol (HS 1223)
- 19) Isopropyl acetate (HS 1224)
- 20) Isopropylamine (HS 1228)
- 21) Manganese tetroxide (HS 1238)
- 22) Mesityl oxide (HS 1243)
- 23) Octane (HS 1296)
- 24) Ozone (HS 1301)
- 25) Pentane (HS 1306)
- 26) 2-Pentanone (methyl propyl ketone) (HS 1307)
- 27) Silica--Amorphous (diatomaceous earth) (HS 1352)
- 28) m-Toluidine - skin (HS 1401)
- 29) Triethylamine (HS 1408)
- 30) Vinyl acetate (HS 1424)
- 31) Zirconium compounds, as Zr (HS 1439)

Examples of reasons for NIOSH's concern for the chemicals from NIOSH Table N2 are given for the following 2 substances.

1. Ethylene Glycol (EG)

OSHA currently does not have a PEL and proposes a 50 ppm ceiling as the new PEL as recommended by the American Conference of Governmental Industrial Hygienists (ACGIH). In the NIOSH review of EG, we have found that positive rat and mouse teratogenicity for oral administration of EG has been reported by Lamb et al. [1985], Price et al. [1985], and Hardin et al. [1987]. The summary statement by C. Price is germane to OSHA's consideration of PELs:

"The lack of apparently serious maternal effects at the lowest dose which produced malformation in both species, as well as the severity and frequency of fetal defects at higher doses, suggest that EG may carry a selective risk to the embryo and should be considered a potential development hazard in situations where major EG exposure is likely to occur."

The interpretation of the human (volunteers) inhalation exposure study by Wills et al. [1974], as indicating a 50 ppm ceiling (125 mg/m^3) TLV, is questioned. Review of the reported study indicates the most common complaint was irritation of the upper respiratory tract during the 30-day, 20-22 hours per day exposures at mean daily concentrations ranging from 3 to 67 mg/m^3 (1.4-27 ppm) and the irritative phenomena became common when the concentration was raised to about 140 mg/m^3 (56 ppm). Despite the significantly erratic exposure concentrations during the 30 days of "continuous" exposure, the reported irritation would indicate that a 50 ppm limit does not offer sufficient protection from respiratory irritation. The potential teratogenicity and the known respiratory irritation at the proposed level suggests that OSHA should reconsider their proposed PEL.

In addition, the OSHA Summary of Toxicology should be corrected to read for the Wills et al. study [page 21035 of the Federal Register notice, 2nd column, 19 lines from the top]: "In a human inhalation study, Wills and colleagues [1974] reported that volunteers exposed to the aerosol from 20 to 22 hours per day for 4 weeks, at mean daily concentrations between 3 and 67 mg/m^3 (1.4-27 ppm) complained of throat irritation, and on occasion mild headache and lower back pain."

2. Ethyl Ether

OSHA proposes to add a short-term exposure limit (STEL) to their current PEL of 400 ppm for Ethyl Ether. The current PEL is the same as the ACGIH TLV and the STEL of 500 ppm is also recommended by ACGIH. ACGIH set a TLV of 400 ppm time-weighted average (TWA) and a 500 ppm STEL based upon workers developing a tolerance to irritation at that level [ACGIH 1986]. Nelson et al. [1943] tested human subjects for a period of 3 to 5 minutes for sensory responses to ethyl ether and reported, "Complaints of nasal irritation began at 200 ppm. Three hundred was objectionable as a working atmosphere." It was further suggested that 100 ppm was the highest concentration which the majority of subjects estimated satisfactory for 8-hour exposure and 200 ppm was a level which produced nasal irritation in a majority of subjects. Nelson stated that the study reported is "not sufficient" to act as a basis for new limits. However, it would appear that a 400 ppm TWA may protect workers from systemic effects, but would not prevent irritation to some individuals.

The concerns for the remaining 29 substances on NIOSH Table N2 have been submitted to the docket with NIOSH's written testimony.

Some of the chemicals in the universe defined by the 1986 ACGIH TLV list have been excluded from this rulemaking by OSHA for a variety of reasons. NIOSH concurs with OSHA's determination on 127 substances

listed in NIOSH Table N3A (Appendix A) as not needing further revisions based on available data, but believes that those listed in NIOSH Table N3B (Appendix A) should be included in this rulemaking. NIOSH has identified 9 chemicals in NIOSH Table N3B which are of concern. They are:

- 1) Acetylene tetrabromide (HS None)
- 2) Chlorobenzene (HS None)
- 3) Chromium (II) compounds, as Cr (insoluble) (HS None)
- 4) Chromium (III) compounds, as Cr (insoluble) (HS None)
- 5) Cresol, all isomers - skin (HS None)
- 6) Manganese dust & compounds (HS None)
- 7) Molybdenum, as Mo (soluble compounds) (HS None)
- 8) Nitromethane (HS None)
- 9) Parathion - skin (HS None)

Cresol will serve as an example of NIOSH's concern. The OSHA PEL and the ACGIH TLV [ACGIH 1986] for cresol both have identical exposure limits of 5 ppm (22 mg/m³), TWA, with a skin notation; therefore, this chemical is not being considered for revision. However, NIOSH has established an REL of 2.3 ppm (10 mg/m³), TWA, which should be considered in the revision of the OSHA standards. In 1952, ACGIH established a 5 ppm TWA based on an analogy with phenol [ACGIH 1986]. The toxicity of cresol compared to phenol was considered in two studies [Fairhall 1957; Hamilton et al. 1949]. It was believed the 5 ppm level would protect against irritation, and kidney and liver damage.

NIOSH [1978] established an REL of 2.3 ppm (TWA). NIOSH reported that although the data indicates similarities in toxicity between cresol and phenol when they are given by several routes of exposure, other evidence suggests that cresol is more toxic by inhalation [Uzhdavini et al. 1972]. The findings of Deichmann et al. [1963] agreed with Uzhdavini concerning the adverse effects of cresol below 20 mg/m³. The NIOSH REL is more protective than the current OSHA PEL or TLV.

NIOSH's concerns for the other 8 substances are attached to our written comments and are in the OSHA docket.

In NIOSH Table N4 (Appendix A), NIOSH has identified 48 substances which OSHA is proposing to regulate as nuisance dusts. OSHA is proposing PELs for 47 substances (Table C10-1) that are currently regulated by OSHA's PEL for nuisance dust (15 mg/m³ for total dust and 5 mg/m³ for respirable dust). The proposed PELs are 5 mg/m³ for fibrous glass dust and 10 mg/m³ for the remaining 46 substances. The 10-mg/m³ PELs are based on the TLVs established for these substances by ACGIH. Exposure to these substances is considered to cause adverse "nuisance" effects, including interference with vision, irritation of the upper respiratory tract and skin, and deposits of these substances in the eyes, ears, and nasal passages. Reactions of lung tissue to these substances are considered to be reversible when exposure ceases.

NIOSH has conducted a limited evaluation of the literature on the 48 substances in Table N4, and has concluded that the documentation cited by OSHA is inadequate to support the proposed PEL of 10 mg/m³ for many of the substances. Recent toxicologic and exposure data indicate that exposure to some of these substances may cause cancer or other serious adverse health effects. Adherence to the proposed PEL of 10 mg/m³ (total dust) would not prevent the toxicologic effects associated with many of these substances. NIOSH is therefore concerned that it is misleading to apply the term "nuisance dust" to such substances.

NIOSH is also concerned that total dust exposure may be an inappropriate criterion for assessing the relationship between exposure and effect. The 48 substances considered here are present in many occupational environments within a respirable size range, and the respiratory system is therefore the most likely route of exposure. However, differences in particle morphology and size affect pulmonary defense mechanisms differently. Furthermore, solubility and pH must be determined to assess the effects of some substances on the mucous membranes. All of the characteristics of a substance need to be assessed when determining its potential toxicity. For substances that typically become airborne in the workplace as respirable particulates, a PEL based on the respirable fraction of the substance would be warranted. Substances that exhibit a toxic effect upon contact with mucous membranes may more appropriately require exposure limits for both total and respirable particulates.

NIOSH is further concerned that exposure to several of the substances listed in Table C10-1 may involve concomitant exposure to free silica, which may cause silicosis or lung cancer. OSHA has proposed that the PEL for these substances be applied only when the quartz content is less than 1 percent. This criterion may understate the risk of airborne exposure to quartz, since the percentage of quartz is typically determined by analysis of the raw material or of the settled dust and not by analysis of airborne samples. Airborne samples should be collected and analyzed for free silica whenever workers are exposed to quartz or to any of the substances associated with free silica. Exposure to free silica should be limited to concentrations below the NIOSH REL of 50 ug/m³.

NIOSH is particularly concerned that toxicologic evidence demonstrates a relationship between exposure to certain substances listed in Table C10-1 and chronic respiratory disease, including cancer. Clear evidence of chronic respiratory disease has been observed in workers exposed to various types of mineral fibers [Walton 1987]. Enterline et al. [1987] reported a statistically significant risk of lung cancer in workers exposed to glass and mineral-wool fibers. This risk of cancer was also observed in animals [Stanton et al. 1980] when fibers with various physical and chemical characteristics were implanted in the pleurae of rats. The ability of these fibers to induce cancer was

discovered to be related to the length and diameter of the fibers and not to their chemical compositions. Rats dosed with fibrous glass, aluminum oxide, and silicon carbide exhibited a carcinogenic response similar to that of rats dosed with asbestos.

The NIOSH evaluation of data on titanium dioxide indicates a risk of cancer from exposure. The incidence of tumors observed in animals exposed to titanium dioxide meets the OSHA criterion for potential occupational carcinogens (29 CFR 1990.103). Other data evaluated by NIOSH indicate that benomyl exposure may cause adverse reproductive effects and that magnesium oxide exposure may cause chronic respiratory disease. NIOSH has included pertinent literature on these substances as part of its submission, and OSHA should consider it in this rulemaking.

Having selected the TLV list as the universe to be considered, OSHA frequently limits its consideration of health effects to those that the ACGIH considered when establishing the TLV. The full range of available toxicologic, epidemiologic, and exposure information should be considered for all chemicals in the universe selected. The need to do so is most evident for chemicals that NIOSH and others consider to be carcinogenic. For a large number of these chemicals, OSHA proposes to establish a PEL without identifying the chemical as a potential occupational carcinogen. In some cases, OSHA acknowledges without comment the conclusion by NIOSH or others that these chemicals are potential occupational carcinogens, but still does not so designate those chemicals. In some cases the limits proposed for adoption were based on carcinogenicity; in other cases they were based on other acute or chronic health effects. Even if OSHA chooses not to accept NIOSH recommendations that occupational exposure to carcinogens should be restricted to the lowest feasible level, OSHA should designate these chemicals as potential occupational carcinogens because these chemicals meet the criteria for carcinogenicity as established by OSHA [29 CFR 1990.103]. Chemicals that should be designated as potential occupational carcinogens are listed in NIOSH Tables N6A and N6B (Appendix A) and have been submitted to the OSHA docket with our written testimony. On Table N6A, NIOSH has identified 39 substances which have proposed PELs that NIOSH can agree with, but for which a carcinogen designation should be added to the PEL. The chemicals are:

- 1) Acrylamide - skin (HS 1008)
- 2) Aldrin - skin (HS None)
- 3) Amitrole (HS 1020)
- 4) Aniline & homologues - skin (HS 1025)
- 5) Anisidine (o-, p-isomers) - skin (HS None)
- 6) Captafol - skin (HS 1066)
- 7) Captan (HS 1067)
- 8) Carbon tetrachloride - skin (HS 1073)
- 9) Chlordane - skin (HS None)
- 10) Chloroform (HS 1086)

- 11) Dichloroacetylene (HS 1123)
- 12) Dichloroethyl ether - skin (HS 1127)
- 13) Dichloropropene - skin (HS 1129)
- 14) Dieldrin - skin (HS None)
- 15) Diglycidyl ether (DGE) (HS 1139)
- 16) Dimethyl sulfate - skin (HS 1142)
- 17) Dinitrotoluene - skin (HS None)
- 18) Dioxane - skin (HS 1145)
- 19) Di-sec-octyl phthalate (HS 1116) ✓
- 20) Ethylene dichloride (HS 1168)
- 21) Heptachlor - skin (HS None)
- 22) Hexachlorobutadiene - skin (HS 1195)
- 23) Hexachloroethane - skin (HS 1197)
- 24) Hexamethyl phosphoramide (HS None)
- 25) Methyl iodide - skin (HS 1259)
- 26) Nickel carbonyl (as Ni) (HS 1284)
- 27) Propylene imine - skin (HS None)
- 28) Silica - crystalline (cristobalite) (HS 1354)
- 29) Silica - crystalline (tridymite) (HS 1356)
- 30) 1,1,2,2-Tetrachloroethane - skin (HS 1385)
- 31) Toluene-2,4-diisocyanate (TDI) (HS 1398)
- 32) o-Toluidine - skin (HS 1399)
- 33) 1,1,2-Trichloroethane (HS None)
- 34) Trichloroethylene (HS 1406)
- 35) 1,2,3-Trichloropropane - skin (HS 1407)
- 36) Uranium (insoluble compounds, as U) (HS 1418)
- 37) Uranium (soluble compounds, as U) (HS 1419)
- 38) Vinyl cyclohexene dioxide (HS 1426)
- 39) Wood dust (hard wood) (HS 1430A)

There are 53 chemicals on NIOSH Table N6B that not only should be designated as carcinogens, but for which there remains a substantial level of risk at the proposed PEL. The substances are:

- 1) Acetaldehyde (HS 1001)
- 2) Arsine (HS None)
- 3) Asphalt (petroleum) fumes (HS 1028)
- 4) Benzo(a)pyrene (HS None)
- 5) Beryllium & compounds, as Be (HS 1033)
- 6) tert-Butyl chromate, as CrO₃ - skin (HS None)
- 7) Carbon black (HS None)
- 8) Chlorinated camphene - skin (HS 1078)
- 9) Chlorodiphenyl (42% chlorine) - skin (HS None)
- 10) Chlorodiphenyl (54% chlorine) - skin (HS None)
- 11) Chromic acid and chromates (HS 1092)
- 12) Chromite ore processing (chromates), as Cr (HS None)
- 13) Chromium (VI) compounds, Cr (water soluble) (HS None)
- 14) Chromium (VI) compounds, Cr (certain water insoluble) (HS None)
- 15) Chromyl chloride (HS 1094)
- 16) Chrysene (HS None)

- 17) Coal tar pitch volatiles, as benzene solubles (HS None)
- 18) DDT (Dichlorodiphenyl-trichloroethane) (HS 1113)
- 19) p-Dichlorobenzene (HS 1125) ✓
- 20) Dimethyl carbamoyl chloride (HS None)
- 21) 1,1-Dimethylhydrazine - skin (HS None)
- 22) Epichlorohydrin - skin (HS 1158)
- 23) Ethyl acrylate - skin (HS 1161) ✓
- 24) Ethyl chloride (HS None)
- 25) Gasoline (HS 1185)
- 26) Hydrazine - skin (HS 1205)
- 27) Lead chromate (as Cr) (HS None)
- 28) Methyl bromide - skin (HS 1253)
- 29) Methyl chloride (HS 1254)
- 30) Methyl hydrazine - skin (HS None)
- 31) 4,4'-Methylene bis(2-chloroaniline) - skin (HS 1273)
- 32) Nickel (soluble [or inorganic] compounds as Ni) (HS 1283)
- 33) Nickel sulfide roasting, fume & dust (as Ni) (HS None)
- 34) p-Nitrochlorobenzene (HS 1288)
- 35) 2-Nitropropane (HS 1291)
- 36) Perchloroethylene (HS 1308)
- 37) N-Phenyl-beta-naphthylamine (HS None)
- 38) Phenyl glycidyl ether (PGE) (HS 1315)
- 39) Phenylhydrazine - skin (HS 1317)
- 40) Propane sultone (HS None)
- 41) Propylene dichloride (HS 1341)
- 42) Propylene oxide (HS 1344)
- 43) Rosin core solder pyrolysis products, as formaldehyde (HS 1350)
- 44) Silica--Crystalline (quartz) (HS 1355)
- 45) Silica--Crystalline (tripoli) (HS 1357)
- 46) Silica--Crystalline (fused) (HS 1358)
- 47) o-Tolidine - skin (HS None)
- 48) p-Toluidine - skin (HS 1400)
- 49) Vinyl bromide (HS 1425)
- 50) Vinylidene chloride (HS 1428) ✓
- 51) Welding fumes (HS 1430)
- 52) Wood Dust (soft wood) (HS 1430b)
- 53) Zinc chromate, as Cr (HS 1436)

Some chemicals on NIOSH Tables N6A and N6B have been excluded from this rulemaking by OSHA as is evident from their lack of a HS number. However, NIOSH concludes that OSHA should include these chemicals in this rulemaking.

On NIOSH Table N7, NIOSH has identified 15 substances for which OSHA intends to adopt a TWA instead of the recommended NIOSH Ceiling Value. NIOSH recommends that OSHA adopt the NIOSH Ceiling Values to provide the most appropriate degree of health protection. These substances are:

- 1) Butyl mercaptan (HS 1054)
- 2) Benzyl chloride (HS None)
- 3) Cyanides (as CN) - skin (potassium cyanide) (HS None)
- 4) Cyanides (as CN) - skin (sodium cyanide) (HS None)
- 5) Hydrogen sulfide (HS 1209)
- 6) Hydroquinone (HS None)
- 7) Isopropyl glycidyl ether (IGE) (HS 1227)
- 8) Methyl chloroform (HS 1255)
- 9) Methyl mercaptan (HS 1263)
- 10) Petroleum distillates (naphtha; rubber solvent) (HS 1312)
- 11) Phenol - skin (HS None)
- 12) Phenyl mercaptan (HS 1316)
- 13) Phosgene (HS None)
- 14) Vanadium (as V2O5) - respirable dust fume (HS 1421)
- 15) Vanadium (as V2O5) - fume (HS 1422)

Turning now to the specific questions posed in the NPRM:

1. Are substances included which should be excluded on this rulemaking?

No. On the contrary, substances were excluded which should have been included. Immediately upon completion of this rulemaking, OSHA should take action to establish PELs for all substances that are excluded from this rulemaking despite the existence of a formal NIOSH recommendation to OSHA. As a first step, OSHA should initiate consolidated rulemaking similar to the present Z-Table update to adopt all NIOSH RELs pending chemical-specific Section 6(b) rulemaking to establish comprehensive standards.

2. Is additional health and feasibility documentation available relative to the proposed PELs beyond that described in the preamble?

Yes. OSHA has frequently limited itself to the documentation used by the ACGIH in support of TLVs. Whenever available, NIOSH Criteria Documents, Current Intelligence Bulletins, and Alerts should be considered by OSHA in its final rulemaking. For many of the chemicals, substantial databases are available from other governments (e.g., Germany, the United Kingdom, Sweden), as well as from organizations such as the International Labor Organization, the American Industrial Hygiene Association, the Nordic Expert Group for Documentation of Occupational Exposure Limits, and the National Library of Medicine. A large number of National Cancer Institute (NCI), National Toxicology Program (NTP), and International Research on Cancer (IARC) monographs on chronic bioassay reports are available that provide extensive information on acute and chronic systemic toxicity in addition to data on potential carcinogenicity.

As part of this response, NIOSH is providing a chemical-by-chemical discussion with citations of the most pertinent supporting data that could be identified within the time limitations. For chemicals included in the PEL update, copies have been submitted to the docket of all pertinent NIOSH Health Hazard Evaluations (HHEs), as well as all citations for toxicity contained in the NIOSH Registry of Toxic Effects of Chemical Substances (RTECS). These data are collected as mandated by Section 20(a)(6) of the Occupational Safety and Health Act of 1970 (PL 91-596). These data are publicly available and will assist OSHA in fulfilling its obligation under the Occupational Safety and Health Act to consider "the latest available scientific data in the field." NIOSH has not attempted to provide OSHA with the other elements the Act requires OSHA to consider, namely, "...the feasibility of the standards, and experience gained under this and other health and safety laws." The HHE reports will provide some idea of the exposures found during requested NIOSH evaluations in industry. NIOSH is continuing to develop information and will provide to OSHA other relevant data on exposure concentrations found in industry in our post-hearing comments. These data should assist OSHA in determining feasibility.

In addition to these publicly available sources of information, OSHA should ask major employers throughout the country to provide listings of all of their own internal exposure limits along with their documentation of those limits. In many industries these may be more restrictive than existing OSHA PELs, and this should be an excellent source of information on feasibility of various limits.

Because many of the proposed PELs are derived from TLVs, OSHA should obtain from the ACGIH all unpublished data that contributed to the establishment of those TLVs. OSHA should follow up on these unpublished data to make the record as complete as possible.

Dimethyl Formamide (DMF), a compound from NIOSH Table N3A, is of particular interest to both NIOSH and OSHA because of recent published information concerning testicular cancer and liver disease. NIOSH will provide to OSHA a summary of these data presently in preparation.

3. Are substances included in this rulemaking used in industries other than those described in the preamble?

and

4. Are substances included in this rulemaking used for purposes other than those described in the preamble?

NIOSH has previously supplied to OSHA, at their request, a printout of the complete NIOSHTIC data base file on approximately 260 chemicals to aid in the identification of additional industries using the chemicals in this rulemaking. NIOSH is continuing to search its data base files (National Occupational Hazard Survey [NOHS]) for additional information which will be provided during this rulemaking process.

5. Do alternative unpublished exposure guidelines exist, such as those used in private workplaces, which may be suitable for general usage?

NIOSH is aware of the existence of internal exposure guidelines in a number of private workplaces. NIOSH surveyors, in assessing ethylene oxide exposure, often found internal workplace controls in the 1 to 2 ppm range when the OSHA PEL was 10 ppm. Some of the proposals for change by ACGIH incorporate workplace exposure limits being used in industry at the time of the change. Nickel carbonyl is an example. This documentation relates that a nickel refinery in Sudbury, Canada, begins treating their workers for nickel carbonyl poisoning when their blood level of nickel reaches 150 micrograms/liter. It is further noted that the factory sounds an alarm when air concentrations read 10 ppb and an evacuation alarm sounds at 80 ppb. In this case the TLV is 5 times the level thought to be safe.

There are existing guidelines on exposure to radioactive materials published by the International Commission on Radiation Protection (ICRP) and by the National Commission on Radiation Protection, which are applicable to radioactive substances, specifically, soluble and insoluble uranium in this rulemaking.

Before considering unpublished data, OSHA should update the published information on which it is relying for this proposed rule. A cursory review indicates that 72% of the references cited by OSHA were published prior to 1980 and 35% prior to 1969. The latter is the publication date for the current Z-1 table. NIOSH has submitted a complete set of references for each of the substances under consideration from its RTECS data base.

6. Is there information regarding laboratory analytical procedures which may be used in lieu of those suggested by OSHA (see Appendix A) to determine exposure to air contaminants?

NIOSH has transmitted to OSHA all of its applicable analytical procedures. NIOSH would caution OSHA that, in the "Sampling and Analytical Methods" table, several existing NIOSH analytical methods have been extended to compounds for which the suggested method has not been verified. Some of these compounds have

markedly different chemical properties than the compound(s) for which the method was developed. These methods will require validation before use:

<u>Method</u>	<u>Validated for</u>	<u>Extension proposed by OSHA</u>	<u>HS #</u>
NIOSH 1003	halogenated H/C	1,3-dichloropropene	1129
NIOSH S43	methyl methacrylate	2-hydroxypropyl acrylate	1211
NIOSH 1400	isopropanol	propargyl alcohol	1335
NIOSH 1400	isopropanol	isooctyl alcohol	1220
NIOSH 1603	acetic acid	trichloroacetic acid	1404
NIOSH 1003	halogenated H/C	dichloroacetylene	1123
NIOSH 1020	1,1,2-trichloro- 1,2,2-trifluoroethane	chlorodifluoromethane	1085
NIOSH 1020	1,1,2-trichloro- 1,2,2-trifluoroethane	chloropentafluoroethane	1087
NIOSH 1003	halogenated hydrocarbons	o-chlorostyrene	1089
NIOSH 1003	halogenated hydrocarbons	o-chlorotoluene	1090
NIOSH 1500	hydrocarbons	cyclopentane	1111
NIOSH 1500	hydrocarbons	hexane isomers	1201
NIOSH 5021	terphenyls	hydrogenated terphenyls	1210
NIOSH 2002	aromatic amines	N-isopropylaniline	1229
NIOSH S264	ethyl silicate	methyl silicate	1266
NIOSH 1500	hydrocarbons	nonane	1293
NIOSH 2002	aromatic amines	p-toluidine	1400
NIOSH 2002	aromatic amines	m-toluidine	1401

The following are corrections to the NIOSH Analytical Methods for PEL Update Table (pp. 21308-21312 of the Federal Register).

<u>No.</u>	<u>Analyte</u>	<u>Correct NIOSH Validated Method</u>
4	acetone	NIOSH 1300
17	ammonia	Add NIOSH S347
20	ammonium sulfamate	NIOSH S348
63	carbon Dioxide	NIOSH S249
190	hexachlorocyclopentadiene	NIOSH 2518
304	petroleum distillates (naphtha)	NIOSH 1550
302	1,2,3-trichloropropane	NIOSH 1003

7. Are the proposed exposure limits for each substance appropriate?

NIOSH has addressed comments on each exposure limit it believes to be inappropriate, and has submitted these comments with supporting data to the docket as specified by OSHA in part VIII of the proposed rule.

8. Is additional information available for those substances for which ACGIH proposed a higher TLV which might affect OSHA's decision that such a change was not justified?

This rulemaking is not an appropriate proceeding for raising any permissible exposure limit. The decision to raise an occupational exposure limit should only be made through a full 6(b) rulemaking procedure with adequate time for all concerned parties to respond.

NIOSH has examined all of the available additional scientific information on substances for which the ACGIH TLV is higher and has commented where appropriate. The only substance included on Table C16-1 (Federal Register, p. 21211) that OSHA proposes to raise is Fluorine (HS 1179), and NIOSH has submitted detailed comments on this chemical which demonstrate that OSHA was not justified in raising the proposed PEL.

Additionally, OSHA inadvertently stated (on p. 21029 of the Federal Register) that the current OSHA PEL for Synthetic Camphor (HS 1063) is 2 ppm rather than $2 \mu\text{g}/\text{m}^3$ (0.3 ppm). Because of this error, OSHA proposed to adopt the ACGIH TLV and STEL, i.e. 2 and 3 ppm, respectively, which is approximately 7 times higher than the current PEL.

9. Should the implementation dates for some substances be delayed because of sampling/analytical limitations or short-term feasibility impact considerations?

Delaying the implementation date would not be technology forcing with regard to reducing occupational exposures. However, it is extremely important to note that for many substances listed in the update, there are no sampling and analytical methods available or the method given has not been validated by either NIOSH or OSHA. Also, many of the proposed methods are in-house OSHA methods which are not available to NIOSH or the general public for evaluation. Finally, there are methods whose Limit of Quantitation cannot support the proposed PEL or STEL. These problems are critical and must be corrected for proper enforcement of the regulation.

Therefore, it is important that NIOSH and OSHA work together on a method development scheme that will allow the appropriate validated methods to be developed in a prioritized fashion within the implementation of the regulation. Also, it is imperative that OSHA set a high priority for promulgating followup regulations that deal with these sampling and analytical issues.

10. Is there additional information relative to the OSHA plans to adopt some recommended 10-hour TWA REL's as an 8-hour PEL?

A NIOSH REL "... determined as a time-weighted average (TWA) exposure for up to a 10-hour work day, 40-hour work week" first appeared in the 1973 Inorganic Arsenic Criteria Document. That document was developed during the energy crisis of the early 1970's, when many employers began using 10-hour work days as an energy conservation measure. Consideration was given to recommending a mathematical adjustment of TWA RELs based on a constant limitation of the Concentration x Time for 8-hour and longer work days. For example, an 8-hour TWA of 100 ppm ($100 \text{ ppm} \times 8 \text{ hr} = 800 \text{ ppm hr}$) would convert to 80 ppm for a 10-hour day ($800 \text{ ppm hr} / 10 \text{ hr} = 80 \text{ ppm hr}$). The conclusion at the time was that, so long as the work schedule did not exceed 10 hours per day or 40 hours per week, there was not sufficient precision in the selection of exposure limits to justify the precision implied by that mathematical adjustment. Therefore, the same TWA REL was intended to be applied to 8-hour and 10-hour work days in a 40-hour work week. The action proposed by OSHA in this rulemaking relative to these RELs is consistent with that original intent. A mathematical conversion in the opposite direction, i.e., converting a 10-hour TWA of 100 ppm (1000 ppm hr) to an 8-hour TWA of 125 ppm (1000 ppm hr), would be contrary to the original intent and would be opposed by NIOSH.

11. Does the most current scientific information generally support acceptance of the hypothesis that all C-5-8-Alkanes are not equally toxic because a metabolite of n-Hexane exhibits unique neurotoxic properties?

It is generally accepted that the metabolite that is responsible for the neurotoxic effects of n-hexane is 2,5-hexanedione (2,5-HD), a gamma diketone. This compound is also a metabolite of methyl-n-butyl ketone (MnBK), but is not known to be a metabolite of other alkanes in the C-5 to C-8 group. 2,5-HD produces axonal degeneration (so-called "central peripheral distal axonopathy") characterized by a breakdown of neurofilaments and their accumulation distal to Ranvier nodes in the neuron. The observable symptomatology is, in sequence, limb weakness, severe paralysis, and muscle degeneration. The observation of similar neuropathies after exposures to MnBK or n-hexane and the discovery of their common metabolite, 2,5-HD, suggested the specific hypothesis that it is the gamma spacing of the diketone in the molecule that is the necessary and sufficient characteristic for producing this type of neuropathy. It would be correct to state that 2,5-HD is the principal neurotoxic metabolite of n-hexane and MnBK. It should also be recognized that any gamma diketone or any compound that may be metabolized to a gamma diketone (e.g., 5-nonanone metabolized to

2,5-nonanedione) may be neurotoxic. It would be incorrect to conclude that the neurotoxic properties ascribed to n-hexane are unique to this compound. Other alkanes or related chemicals that are ultimately metabolized to a gamma diketone may have similar toxicity.

12. OSHA has proposed to use exposure limits from two well-established sets of guidelines as a source of values to update the PELs. Is information available about alternative sources which OSHA might consider for this purpose?

In its preamble to this proposed rulemaking, OSHA referred to 9 alternative sources:

- International Labor Organization
- World Health Organization
- European Economic Community
- United Kingdom Occupational Exposure Limits
- West German Maximum Allowable Concentrations
- Swedish Allowable Workplace Air Concentrations
- Japanese Permissible Exposure Limits
- American National Standards Institute
- American Industrial Hygiene Association

Another possibility is the Nordic Expert Group for Documentation of Occupational Exposure Limits.

NIOSH believes all of these should be considered as equal or superior to the ACGIH TLV list in terms of the criteria listed by OSHA.

No single source should be expected to stand alone as a comprehensive list of candidates for regulation. OSHA should construct its own comprehensive list by drawing information from all available sources.

No single list is current in its entirety. Although the ACGIH TLV list is republished annually, it is a mistake to assume that every TLV is reconsidered annually. The annual republishing is only a mechanism whereby those TLVs that have been revised can be disseminated. The ACGIH does not claim to reevaluate every TLV on a regular schedule.

Economic and technical feasibility may be considered by the ACGIH in developing TLVs, but those considerations, if any, are not defined in the documentation of TLVs. Feasibility information for PELs derived from agencies listed above would be comparable, in most cases, to that provided by the ACGIH in support of TLVs.

OSHA should consider the availability and quality of documentation on a substance-by-substance basis and use all available documentation, rather than select an exclusive list of substances simply because that list consistently has some documentation.

The fact that the alternative sources listed above do not originate in the U.S. should not disqualify them from consideration of applicability. They should be judged against what is required to protect workers from the known toxicity of each substance regulated. Only after determining the level of control necessary to ensure a safe and healthy workplace should other factors be considered. Because they are limits that other officials have judged necessary to protect worker safety and health, NIOSH believes that OSHA should at least consider limits from all of the sources listed above.

13. OSHA has outlined its criteria for identifying special situations. Are alternative criteria available which might be used in lieu of these, or in addition to them?

OSHA has identified five circumstances that it considers special situations:

Situations one and two involve a comparison of the ACGIH TLVs to four alternate data bases--the United Kingdom 1987 Occupational Exposure Limits, the West German 1985 Maximum Allowable Concentrations, the Japanese 1983 Permissible Exposure Limits, and the Swedish 1984 Allowable Workplace Air Concentrations. OSHA Tables 1-F-C and 1-F-D, that are based on these comparisons, are not accurate. NIOSH has reviewed the pertinent data on selected substances on Tables 1-F-C and 1-F-D and has submitted comments on the appropriateness of the limits proposed.

Situation three involves the substances where the current TLV exceeds the existing PEL. NIOSH has addressed this issue in the response to question 8.

Situation four involves the circumstances where the available analytical methods are not adequate to measure the substance at the air concentration proposed. NIOSH has addressed this situation in the answer to question 9.

In the fifth situation where recent information suggests that neither the TLV nor the REL is appropriate, NIOSH finds it difficult to identify the exact substances to which OSHA is referring. NIOSH has commented on those substances which, based on the best available scientific information, meet OSHA's occupational carcinogen definition. On other substances where recent information indicates that neither the TLV nor the REL is

low enough to be adequately protective, OSHA should adopt the lower of the available limits and immediately schedule the substance for expedited rulemaking.

14. OSHA has outlined three alternative procedures for dealing with substances requiring special attention. Are additional approaches available which might be used in lieu of these, or in addition to them?

NIOSH would support OSHA in its decision to adopt either the level proposed or such other level as the evidence presented to the record indicates as proper for these substances, and identify them as possibly requiring followup rulemaking. NIOSH has endeavored to provide OSHA with the required data for selecting a proper limit for selected substances on Tables I-F-C and I-F-D. NIOSH concurs with OSHA that it is in the best interest of the worker to promptly provide such increased health protection as is indicated by the evidence in the record.

15. OSHA has performed feasibility analyses for the following substances, based on limited available information: Acetonitrile, Carbon disulfide, Carbon monoxide, Carbon tetrachloride, Chloroform, Ethylene dichloride, Ethylene glycol dinitrate, Fibrous glass dust, Hydrogen cyanide, Isophorone diisocyanate, Nitrogen dioxide, Nitroglycerin, Trichloroethylene.

Is further information available which might be used to supplement the present findings regarding the feasibility of achieving these levels in the workplaces?

From NIOSH research data, we are including a detailed engineering feasibility study (Appendix B) for those listed in the question, as well as for the following chemicals: Acetone, Chlorine, Styrene, and Sulfur dioxide.

16. OSHA has made a preliminary assessment of the proposed rulemakings' impact on large and small establishments. The Act requires OSHA to determine whether a regulation will have a significant impact on a substantial number of small entities, pursuant to the Regulatory Flexibility Act of 1980, 5 U.S.C. 601 et seq. Is there additional information regarding implementation of this rule for small businesses and entities which OSHA should consider?

NIOSH has no comment.

17. OSHA has proposed PEL's for some substances where the basis of this proposal also includes a carcinogenicity designation (e.g., TLV with an A1 or A2 designation; REL with a Ca designation). Should OSHA include a similar carcinogen designation in the Z-4 Table in this rulemaking?

Yes. For both the TLVs and the RELs, the carcinogen designation is an inseparable part of the recommendation. OSHA should include carcinogen designations for all chemicals that meet the OSHA definition of "potential occupational carcinogen" (29 CFR 1990.103).

18. OSHA has preliminarily decided that for substances where the ACGIH TLV is a TWA and the NIOSH REL is a Ceiling Value which is the same or one half of the TWA, OSHA will propose that the TWA be adopted as the PEL. Should this approach be modified in the final rulemaking? What approach should be used when the converse of this situation (TLV, Ceiling REL, TWA) exists?

NIOSH would suggest that this question fails to recognize the essential differences between a time weighted average (TWA) and a Ceiling Value. A TWA is appropriate as a limit when the toxic effect of the substance is directly related to the total dose received in a daily exposure. Ceiling values are intended to minimize toxic effects related to the peak exposure.

Ceiling values are necessary when there are immediate acute responses to an air contaminant independent of the total daily dose or when chronic effects are dose-rate response related. In conjunction with a TWA, ceiling values are also used to minimize the total daily dose when there is intermittent occupational exposure, e.g., ethylene oxide.

The simple numerical relationship that OSHA has proposed is not a scientifically sound basis for selecting between a TWA and a ceiling value. An analysis of the data supporting the proposed limit must be conducted on a case-by-case basis to discern which limit is appropriate.

NIOSH has submitted specific comments on a substance-by-substance basis in this category to assist OSHA in selecting the appropriate limit. These substances are listed in the NIOSH Table N7 of the NIOSH comments.

19. OSHA preliminarily plans to adopt a phased start-up schedule. This would include an initial start-up requirement permitting the use of alternate control methods for revised PEL's, followed at a later date by the required use of control methods fully consistent with the methods of compliance priorities in effect at that time. OSHA will shortly be requesting comments on the hierarchy of controls. An alternate approach is to set a compliance date for engineering controls based on final determinations of that rulemaking. OSHA solicits comments on those approaches and suggestions regarding appropriate times for the two proposed start-up dates.

NIOSH believes that work practices and engineering controls such as substitution, isolation, and ventilation should be used to control occupational exposures to the fullest extent feasible. NIOSH believes that personal protective equipment should be worn only when engineering controls are not feasible, such as during maintenance procedures.

NIOSH recommends that OSHA allow industry 6 months to come into compliance by any combination of control methods, and 2 years for compliance by the NIOSH recommended hierarchy of control methods [NIOSH 1983]. OSHA currently is recommending that industry be allowed 4 years to come into compliance by OSHA's hierarchy of control methods. Furthermore, NIOSH recommends that OSHA require staged implementation over the 2-year period of conversion to the hierarchy. This latter requirement would be technology forcing and it would minimize the occurrence of last minute requests to OSHA for variances to meet the conversion requirement.

20. OSHA requests comment on whether the establishment of margins of safety below lowest observed or no effect levels is consistent with the concept of "significant risk," and on whether the specific margins of safety proposed for specific chemicals are appropriate.

Margins of safety and safety factors are attempts to adjust for uncertainty in available data and knowledge. The use of a margin of safety or a safety factor approach to identify exposure limits does not estimate the human risk associated with those proposed exposure limits. Therefore, such an approach cannot be considered to provide protection against or to reduce "significant risk" (either in a general conceptual sense or in the sense of any specific judicial precedent). Nonetheless, NIOSH recognizes that a thorough case-by-case evaluation for all major industrial agents may not be possible for a variety of reasons, and the use of a margin of safety or a safety factor approach to identify exposure limits for those chemicals provide a pragmatic method to develop standards. The exception to this statement is that NIOSH does not believe such an approach should be used to identify an exposure limit for an adverse health effect that results from non-threshold processes (e.g., cancer).

In developing its recommendations to OSHA, NIOSH conducts thorough evaluations of all research data, estimated human risks associated with specific exposures, the sensitivity of measurement and analytic methods, alternative technologies, technological feasibility of various exposure levels, background or ambient exposure levels, methods of worker protection, and many other factors pertinent to specific exposure agents or environments. NIOSH knows of no other method to develop reliable exposure limit standards that is consistent with NIOSH's

2. Are there episodes of identifiable respiratory illness?
3. Does the effect result in an incapacitating illness?
4. Is there permanent respiratory injury?
5. Is there progressive respiratory dysfunction?

Particularly on the job, sensory irritation is clearly relevant to point 1. Mucous membrane irritation is associated with respiratory illnesses, depending on the composition of specific exposure and on the dose, duration, and frequency of exposure. No universally applicable conclusion can be drawn at this time regarding the association between irritative symptoms and permanent injury of dysfunction. Where certain individuals show no measurable impairment after an exposure, even when experiencing irritative symptoms, others may develop identifiable dysfunction.

Aside from the effects of irritation, mucous membrane exposure may result in absorption of a substance, with resultant systemic toxicity. An inflamed mucous membrane may be an even more effective route of absorption, either for the irritant or for other substances. Furthermore, injury to bronchopulmonary membranes can impair removal of particulates from the respiratory system.

22. The question also arises of whether odorants present material impairment of health. That issue also might arise in the context of other substances. Based on the evidence in the final record concerning this issue, OSHA will determine if the criteria detailed in section IV-C-16 have been met, and take appropriate action. OSHA requests comment on this issue.

Odors emitted by industrial chemicals often play an important role in occupational safety and health. When odors can be detected before health effects occur, they may provide early warning of exposure. A number of chemicals have strong odors at concentrations which are otherwise minimally toxic. These odors may cause undue health concerns among exposed workers or may create safety hazards by distracting workers from their tasks. Strong odors in the workplace may also mask the presence of other, more toxic substances. Strong odors can produce irritation and/or nausea at high concentrations, although these effects may be reversible following cessation of exposure. Olfactory fatigue often occurs and should be considered a functional impairment that can result in increased worker exposure. Olfactory fatigue can reduce the wearer's ability to sense inadequate respirator performance of air-purifying respirators.

responsibility from the OSHA to assure as far as possible, every working man and woman in the Nation, safe and healthful working conditions. Since the use of a margin of safety or a safety factor approach does not address essential issues required to develop a reliable exposure limit, including evaluation of "significant risk," NIOSH recommends that any standards developed by the use of a margin of safety or a safety factor approach be considered interim standards. NIOSH recommends that standards based on a margin of safety or a safety factor approach, as well as standards derived from a case-by-case evaluation, be periodically reviewed to determine what new information is available.

NIOSH is not recommending specific margins of safety or safety factors on any chemical.

21. OSHA has identified sensory irritation, which causes rhinitis, cough, sputum production, chest pain, wheezing and dyspnea as material impairment of health. OSHA invites comments on this understanding.

The recognition of sensory irritation as potentially being "material impairment of health" is consistent with the current scientific consensus related to health effects of environmental agents.

Mucous membrane irritants can cause increased blink frequency and tearing; nasal discharge, congestion, and sneezing; and cough, sputum production, chest discomfort, wheezing, chest tightness, and dyspnea. Work environments often require levels of physical and mental performance considerably greater than those encountered in daily living. Even in the absence of any permanent impairment, the symptoms listed can interfere with job performance and safety.

Mucous membrane irritation can result in inflammation, which may lead to increased susceptibility to nonspecific irritants and infectious agents. For example, experimental ozone exposure in humans results in increased airway reactivity. Also, studies of exposure to environmental tobacco smoke have shown irritative symptoms and evidence of increased frequency of respiratory tract illnesses in young children and decreased pulmonary function in adults.

The American Thoracic Society has identified several points relevant to the issue of respiratory tract irritation.

1. Does the effect interfere with normal activity of the individual?

23. Is there exposure information available which can be supplied which will refine OSHA's estimates of employee exposures and over exposures to the substances being regulated?

NIOSH is submitting for the current rulemaking all relevant Health Hazard Evaluation Reports (HHEs) to the docket. Appendix C is a comprehensive listing of HHEs being submitted. We also have previously submitted to OSHA a copy of data tapes from the National Occupational Health Survey (NOHS). NIOSH anticipates submitting to OSHA a comprehensive listing of pertinent NIOSH exposure information in our post-hearing comments.

24. Is there information available which can be supplied to improve or supplement the engineering controls identified as necessary in order to reduce exposure levels? Is there additional cost data which can be supplied to refine the annual costs associated with these controls?

In addition to the material on engineering feasibility provided to OSHA relating to question 15, NIOSH is continuing to evaluate general engineering feasibility data for these substances in this rulemaking that meet OSHA's definition of a potential occupational carcinogen (29 CFR 1990).

25. Under what conditions, involving which industrial processes, will respirators be needed during the start up period, for maintenance operations, or where other controls are infeasible in order to protect employees at the proposed exposure levels? Are respirators currently being used under the conditions identified, or would they need to be purchased? Please describe the type of respirator currently in use or needed.

NIOSH concurs with OSHA's assessment in the Non-Regulatory Alternative Section that personal protective equipment should only be used "where it is impractical to apply engineering or work practice controls, or where these applications will not consistently reduce employee exposures below the proposed PEL's." In these instances, NIOSH recommends that the NIOSH Respirator Decision Logic (Appendix D) be used to select the appropriate respirator.

NIOSH has little quantitative information on which respirators are currently being used under the conditions specified by OSHA. A NIOSH contractor's report ("Preliminary Survey of Existing Data and Economic Overview of Respirator Industry," Granville Corporation, March 10, 1982) is submitted to the docket as Appendix E and provides limited data on the numbers and types of respirators sold in the United States. This report used respirator manufacturers' data on respirator sales in 1980 and published data on workers [i.e., Economic Report of the

President, (U.S.G.P.O., Washington, 1981)] to make some estimates on the number of certified respirators being worn by workers in the U.S. The Granville report estimates that 19.1% of mining, manufacturing, and construction workers wore or had access to certified respirators in 1980. In addition, it was estimated that over 20 million manufacturing workers and almost 4.5 million construction workers, and more than 1 million miners used certified respirators. The Granville report also indicated that SCBAs, "disposables," and particulate and chemical cartridge respirators have "large and roughly equal market shares (ranging from 25 to 30%) in terms of total dollar sales" (Granville Report, p. 40).

26. As a result of simultaneously regulating many substances, what cost savings will be realized in purchasing new engineering controls? Are alternate engineering controls available to achieve the lower permissible exposure limits being proposed?

NIOSH has no comment with regard to the costs of purchasing new engineering controls. Alternate engineering control methods are discussed in our responses to questions 15 and 19.

27. What is the current state of technology control and financing in firms which would need to comply with reduced exposure limits to wood dust?

In addition to the information provided on the individual chemical comments for Wood Dust (H.S. 1430A and 1430B), several innovative designs and devices have been developed to control wood dust in sawing, cutting, sanding and shaping. These published NIOSH references (Huebener DJ [1987]. Dust controls for a wood shaper. Appl Ind Hyg 2(4):164-169; and Hampl V and Johnston DE [1985]. Control of wood dust from horizontal belt sanding. Am Ind Hyg Assoc J 46(10):567-577) have been submitted to the docket as Appendix F.

REFERENCES

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Stanton MF, Layard M, Tegeris A, Miller E, May M, Morgan E, Smith A [1981]. Relation of particle dimension to carcinogenicity in amphibole asbestoses and other fibrous minerals. *JNCI* 67(5):965-975.

Walton WH (ed) [1987]. Man-made mineral fibres in the working environment. *In*: The Annals of Occupational Hygiene. Oxford, UK: Pergamon Press.



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July 25, 1988

Mr. Thomas Hall
OSHA Division of Consumer Affairs
Docket No. H-020
U.S. Department of Labor
Room N-3647
200 Constitution Avenue, N.W.
Washington, D.C. 20210

Dear Mr. Hall:

Enclosed is the National Institute for Occupational Safety and Health's (NIOSH's) testimony to the OSHA Docket Office in support of the proposed rule on Air Contaminants [53 FR 20960]. The following items are also enclosed with this letter:

1. Seven tables consisting of the following (4 copies):

Table N1	Proposed PELs (NIOSH concurrence)
Table N2	Proposed PELs (NIOSH non-concurrence)
Table N3A	Established PELs Not Addressed in Current Rulemaking (NIOSH Concurrence)
Table N3B	Established PELs Not Addressed in Current Rulemaking (NIOSH non-concurrence)
Table N4	Nuisance Dusts
Table N5	NIOSH RELs Not Included in OSHA Rulemaking
Table N6A	Proposed PELs That Meet the OSHA Definition of "Potential Occupational Carcinogen" (NIOSH concurrence)
Table N6B	Proposed PELs That Meet the OSHA Definition of "Potential Occupational Carcinogen"
Table N7	Proposed PELs as TWAs for which NIOSH Recommends a Ceiling

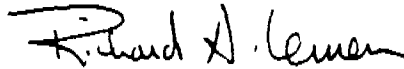
2. Individual folders on substances with which NIOSH has specific comments and supporting references (4 copies each)
3. Health Hazard Evaluations (HHEs) on all chemicals within the scope of this rulemaking (1 paper copy and 3 microfiche copies)

Page 2 - Mr. Thomas Hall

.. In a separate delivery, NIOSH is submitting paper copies of all toxicity references contained with the Registry of Toxic Effects for Chemical Substances (RTECS)

If you have any questions, please call me at FTS 684-8302 or 513/533-8302.

Sincerely yours,

A handwritten signature in dark ink, appearing to read "Richard A. Lemen". The signature is fluid and cursive, with a large initial "R" and a stylized "L".

Richard A. Lemen
Director
Division of Standards Development
and Technology Transfer

SL 061939

TESTIMONY OF THE
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH
ON THE
OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION'S
PROPOSED RULE ON AIR CONTAMINANTS

29 CFR Part 1910
Docket No. H-020

Presented at the OSHA Informal Public Hearing
August 2, 1988
Washington, D.C.

J. Donald Millar, M.D.
Assistant Surgeon General
Director
National Institute for Occupational Safety and Health

SL 061940

NIOSH staff presenting for Dr. Millar:

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Nancy J. Bollinger Chief	Chief, Certification Branch, Division of Safety Research
Thomas Hodous Medical Officer	Medical Section, Clinical Investigations Branch, Division of Respiratory Disease Studies

I am Richard A. Lemen, Director of the Division of Standards Development and Technology Transfer (DSDTT) of the National Institute for Occupational Safety and Health (NIOSH). With me today are senior staff from NIOSH research divisions, each of whom has expertise in various aspects of this rulemaking. Our purpose for appearing at this hearing is to support the Occupational Safety and Health Administration's (OSHA's) efforts to promulgate a new standard. NIOSH may make comments or recommendations in addition to those contained in this testimony, based upon other information presented during this hearing.

I want to take this opportunity to commend OSHA for embarking upon this rulemaking effort. This comprehensive updating of the Z-Tables will directly influence the health of all American workers. NIOSH strongly supports OSHA in its desire to make the air contaminant standards consistent with the most current information. We agree that there is an urgent need to update the current air contaminant standards because they represent exposure limits based on data available prior to 1968. Current information on health effects indicates that more protective limits are required for many substances. Even though NIOSH will question some of the specific Permissible Exposure Limits (PELs) that have been proposed, NIOSH does not question the wisdom of this rulemaking. Although NIOSH will suggest that some proposed PELs are not optimal, NIOSH nevertheless advocates adoption of more protective PELs. Even if some PELs are

less protective than NIOSH might prefer, the overall impact of this Z-Table update represents a significant advance for worker safety and health. On the other hand, it should be clearly understood by all that this rulemaking is an exceptional event made necessary by the passage of 20 years without significant reevaluation of the standards contained in the Z-Tables. This should in no way impede vigorous action in the future to promulgate comprehensive standards as specified under Section 6(b) of the Occupational Safety and Health Act. Instead this should serve as an impetus to proceed more swiftly and efficiently with comprehensive standards.

NIOSH has transmitted to the Department of Labor 129 Criteria Documents and 50 Current Intelligence Bulletins (CIBs) (of these, one Criteria Document and one CIB were transmitted after this rulemaking was initiated). NIOSH Criteria Documents and CIBs are unparalleled in terms of the amount of information considered, the detail to which that information is examined, the extent to which evaluations are subjected to external peer review prior to publication, and the care with which those evaluations are explained in the published recommendation. It is important that the record is clear on what a NIOSH Criteria Document represents in this regard.

Criteria Documents are based on comprehensive reviews of the world's scientific literature. They routinely cite over 100 references and

many cite several hundred. NIOSH does not rely upon information that cannot be made public. Critical evaluations of cited references with detailed discussions of their implications are included in Criteria Documents to provide the reader with an appreciation of their strengths, their weaknesses, and a clear description of how NIOSH interprets these publications. By this method, the reader has enough information to reach independent conclusions regarding these cited reports. Each draft Criteria Document is reviewed by experts representing affected industries, organized labor, and trade or professional organizations, and by scientists, physicians, and other health professionals with related experience in academia, government, or industry. The number of these external peer reviewers normally is greater than 10 and often exceeds twice that number. In addition to the invaluable contribution their comments make to the completed Criteria Document, OSHA receives, along with the completed Criteria Document, the full text of each reviewer's written comments accompanied by itemized annotations indicating how the draft was modified in response, or providing the rationale if the comment or recommendation was not adopted. Each Criteria Document contains an extensive summary in which the basis for the Recommended Exposure Limit (REL) is carefully developed with clear and explicit citation of the data relied upon at all steps of the logical development. No other source of exposure limits approximates the comprehensiveness of these documents.

NIOSH recommends that the chemical universe defined for the present rulemaking should include all chemicals covered by NIOSH RELs. We recognize the practical necessity for OSHA to limit the universe of chemicals subject to this rulemaking, but as noted by OSHA in its preamble, there are relatively "few instances" of substances with a NIOSH REL but no TLV*. Including these substances would not significantly affect the "boundary on the number of substances to be evaluated," a concern expressed by OSHA in the notice for proposed rulemaking. NIOSH Table N5 (Appendix A) lists these 42 chemicals excluded up to now from the Z-Table update. If these are not added to the current update, they should be targeted for priority rulemaking to begin immediately upon completion of the present effort.

For a large number of the chemicals covered by this rulemaking (277 to be exact), NIOSH concurs with the PEL being proposed by OSHA. These chemicals are listed in NIOSH Table N1 (Appendix A). For them, the available documentation appears to support the proposed exposure limits as adequate to protect workers from recognized health hazards.

NIOSH questions the proposed PELs for the 31 chemicals listed in Table N2. They are:

- 1) Acrylic acid (HS 1009)
- 2) n-Butyl glycidyl ether (BGE) (HS 1052)

- 3) Camphor, synthetic (HS 1063)
- 4) Caprolactam vapor (HS 1065)
- 5) Coal dust (<5% quartz) (HS 1096)
- 6) Coal dust (>5% quartz) (HS 1097)
- 7) Disulfoton - skin (HS 1152)
- 8) Ethyl bromide (HS 1163)
- 9) Ethyl ether (HS 1164)
- 10) Ethylene glycol vapor (HS 1169)
- 11) Fenthion - skin (HS 1175)
- 12) Fluorine (HS 1179)
- 13) Formamide (NIC - skin) (HS 1182)
- 14) Furfural - skin (HS 1183)
- 15) Heptane (n-Heptane) (HS 1194)
- 16) Hexane isomers (HS 1201)
- 17) 2-Hexanone (Methyl n-butyl ketone) (HS 1202)
- 18) Isopropoxyethanol (HS 1223)
- 19) Isopropyl acetate (HS 1224)
- 20) Isopropylamine (HS 1228)
- 21) Manganese tetroxide (HS 1238)
- 22) Mesityl oxide (HS 1243)
- 23) Octane (HS 1296)
- 24) Ozone (HS 1301)
- 25) Pentane (HS 1306)
- 26) 2-Pentanone (Methyl propyl ketone) (HS 1307)
- 27) Silica--Amorphous
diatomaceous earth (HS 1352)
- 28) m-Toluidine - skin (HS 1401)
- 29) Triethylamine (HS 1408)
- 30) Vinyl acetate (HS 1424)
- 31) Zirconium compounds, as Zr (HS 1439)

Examples of reasons for NIOSH's concern for the chemicals from NIOSH Table N2 are given for the following 2 substances.

1. Ethylene Glycol (EG)

OSHA currently does not have a PEL and proposes a 50 ppm ceiling as the new PEL as recommended by the ACGIH. In the NIOSH review of EG we have found that positive rat and mouse teratogenicity for

oral administration of EG has been reported by Lamb et al. [1985], Price et al. [1985], and Hardin et al. [1987]. The summary statement by C. Price is germane to OSHA's consideration of PELs:

"The lack of apparently serious maternal effects at the lowest dose which produced malformation in both species, as well as the severity and frequency of fetal defects at higher doses, suggest that EG may carry a selective risk to the embryo and should be considered a potential development hazard in situations where major EG exposure is likely to occur."

The interpretation of the human (volunteers) inhalation exposure study by Wills et al. [1974], as establishing a 50 ppm ceiling (125 mg/m³) TLV, is questioned. Review of the reported study indicates the most common complaint was irritation of the upper respiratory tract during the 30-day, 20-22 hours per day exposures at mean daily concentrations ranging from 3 to 67 mg/m³ (1.4-27 ppm) and the irritative phenomena became common when the concentration was raised to about 140 mg/m³ (56 ppm). Despite the significantly erratic exposure concentrations during the 30 days of "continuous" exposure, the reported irritation would indicate that a 50 ppm limit does not offer sufficient protection from respiratory irritation. The potential teratogenicity and the known respiratory irritation at the proposed level suggests that OSHA reconsider their proposed PEL.

In addition, the OSHA Summary of Toxicology should be corrected to read for the Wills et al. study [page 21035 of the Federal Register notice, 2nd column, 19 lines from the top]: "In a human inhalation study, Wills and colleagues [1974] reported that volunteers exposed to the aerosol from 20 to 22 hours per day for 4 weeks, at mean daily concentrations between 3 and 67 mg/m³ (1.4-27 ppm) complained of throat irritation, and on occasion mild headache and lower back pain."

2. Ethyl Ether

OSHA proposes to add a STEL to their current PEL of 400 ppm for Ethyl Ether. The current PEL is the same as the ACGIH TLV and the STEL of 500 ppm is also recommended by ACGIH. ACGIH set a TLV of 400 ppm TWA and a 500 ppm STEL based upon workers developing a tolerance to irritation at that level [ACGIH 1986]. Nelson et al. [1943] tested human subjects for a period of 3 to 5 minutes for sensory responses to ethyl ether and reported, "Complaints of nasal irritation began at 200 ppm. Three hundred was objectionable as a working atmosphere." It was further suggested that 100 ppm was the highest concentration which the majority of subjects estimated satisfactory for 8-hour exposure and 200 ppm was a level which produced nasal irritation in a majority of subjects. Nelson stated that the study reported is "not sufficient" to act as a basis for new limits. However, it would

appear that a 400 ppm TWA may protect workers from systemic effects, but would not prevent irritation to some individuals.

The concerns for the remaining 29 substances on NIOSH Table N2 have been submitted to the docket with NIOSH's written testimony.

Some of the chemicals in the universe defined by the 1986 ACGIH TLV list have been excluded from this rulemaking by OSHA for a variety of reasons. NIOSH concurs with OSHA's determination on 127 substances listed in NIOSH Table N3A (Appendix A) as not needing further revisions based on available data, but believes that those listed in NIOSH Table N3B (Appendix A) should be included in this rulemaking. NIOSH has identified 9 chemicals in NIOSH Table N3B which are of concern. They are:

- 1) Acetylene tetrabromide (HS None)
- 2) Chlorobenzene (HS None)
- 3) Chromium (II) compounds, as Cr (insoluble) (HS None)
- 4) Chromium (III) compounds, as Cr (insoluble) (HS None)
- 5) Cresol, all isomers - skin (HS None)
- 6) Manganese dust & compounds (HS None)
- 7) Molybdenum as Mo (soluble compounds) (HS None)
- 8) Nitromethane (HS None)
- 9) Parathion - skin (HS None)

Cresol will serve as an example of NIOSH's concern. The OSHA PEL and the ACGIH TLV [ACGIH 1986] for cresol both have identical exposure limits of 5 ppm (22 mg/m³), TWA, with a skin notation; therefore, this chemical is not being considered for revision. However, NIOSH

has established an REL of 2.3 ppm (10 mg/m³), TWA, which should be considered in the revision of the OSHA standards. In 1952, ACGIH established a 5 ppm TWA based on an analogy with phenol [ACGIH 1986]. The toxicity of cresol compared to phenol was considered in two studies [Fairhall 1957; Hamilton et al. 1949]. It was believed the 5 ppm level would protect against irritation, and kidney and liver damage.

NIOSH [1978] established an REL of 2.3 ppm (TWA). NIOSH reported that although the data indicates similarities in toxicity between cresol and phenol when they are given by several routes of exposure, other evidence suggests that cresol is more toxic by inhalation [Uzhdavini et al. 1972]. The findings of Deichmann et al. [1963] agreed with Uzhdavini concerning the adverse effects of cresol below 20 mg/m³. The NIOSH REL is more protective than the current OSHA PEL or TLV.

NIOSH's concerns for the other 8 substances are attached to our written comments and are in the OSHA docket.

In NIOSH Table N4 (Appendix A), NIOSH has identified 48 substances which OSHA is proposing to regulate as nuisance dusts. OSHA is proposing permissible exposure limits (PELs) for 47 substances (Table C10-1) that are currently regulated by OSHA's PEL for nuisance dust (15 mg/m³ for total dust and 5 mg/m³ for respirable dust). The

proposed PELs are 5 mg/m³ for fibrous glass dust and 10 mg/m³ for the remaining 46 substances. The 10-mg/m³ PELs are based on the TLVs established for these substances by ACGIH. Exposure to these substances is considered to cause adverse "nuisance" effects, including interference with vision, irritation of the upper respiratory tract and skin, and deposits of these substances in the eyes, ears, and nasal passages. Reactions of lung tissue to these substances are considered to be reversible when exposure ceases.

NIOSH has conducted a limited evaluation of the literature on the 48 substances in Table N4 and has concluded that the documentation cited by OSHA is inadequate to support the proposed PEL of 10 mg/m³ for many of the substances. Recent toxicologic and exposure data indicate that exposure to some of these substances may cause cancer or other serious adverse health effects. Adherence to the proposed PEL of 10 mg/m³ (total dust) would not prevent the toxicologic effects associated with many of these substances. NIOSH is therefore concerned that it is misleading to apply term "nuisance dust" to such substances.

NIOSH is also concerned that total dust exposure may be an inappropriate criterion for assessing the relationship between exposure and effect. The 48 substances considered here are present in many occupational environments within a respirable size range, and the respiratory system is therefore the most likely route of exposure.

However, differences in particle morphology and size affect pulmonary defense mechanisms differently. Furthermore, solubility and pH must be determined to assess the effects of some substances on the mucous membranes. All the characteristics of a substance need to be assessed when determining its potential toxicity. For substances that typically become airborne in the workplace as respirable particulates, a PEL based on the respirable fraction of the substance would be warranted. Substances that exhibit a toxic effect upon contact with mucous membranes may more appropriately require exposure limits for both total and respirable particulates.

NIOSH is further concerned that exposure to several of the substances listed in Table C10-1 may involve concomitant exposure to free silica, which may cause silicosis or lung cancer. OSHA has proposed that the PEL for these substances be applied only when the quartz content is less than 1 percent. This criterion may understate the risk of airborne exposure to quartz, since the percentage of quartz is typically determined by analysis of the raw material or of the settled dust and not by analysis of airborne samples. Airborne samples should be collected and analyzed for free silica whenever workers are exposed to quartz or to any of the substances associated with free silica. Exposure to free silica should be limited to concentrations below the NIOSH REL of 50 $\mu\text{g}/\text{m}^3$.

NIOSH is particularly concerned that toxicologic evidence demonstrates a relationship between exposure to certain substances listed in Table C10-1 and chronic respiratory disease, including cancer. Clear evidence of chronic respiratory disease has been observed in workers exposed to various types of mineral fibers [Walton 1987]. Enterline et al. [1987] reported a statistically significant risk of lung cancer in workers exposed to glass and mineral-wool fibers. This risk of cancer was also observed in animals [Stanton et al. 1980] when fibers with various physical and chemical characteristics were implanted in the pleurae of rats. The ability of these fibers to induce cancer was discovered to be related to the length and diameter of the fibers and not to their chemical compositions. Rats dosed with fibrous glass, aluminum oxide, and silicon carbide exhibited a carcinogenic response similar to that of rats dosed with asbestos.

The NIOSH evaluation of data on titanium dioxide indicates a risk of cancer from exposure. The incidence of tumors observed in animals exposed to titanium dioxide meets the OSHA criterion for potential occupational carcinogens (29 CFR 1910.103). Other data evaluated by NIOSH indicate that benomyl exposure may cause adverse reproductive effects and that magnesium oxide exposure may cause chronic respiratory disease. NIOSH has included pertinent literature on these substances as part of its submission, and OSHA should consider it in this rulemaking.

Having selected the TLV list as the universe to be considered, OSHA frequently limits its consideration of health effects to those that the ACGIH considered when establishing the TLV. The full range of available toxicologic, epidemiologic, and exposure information should be considered for all chemicals in the universe selected. The need to do so is most evident for chemicals that NIOSH and others consider to be carcinogenic. For a large number of these chemicals, OSHA proposes to establish a PEL without identifying the chemical as a potential occupational carcinogen. In some cases OSHA acknowledges without comment the conclusion by NIOSH or others that these chemicals are potential occupational carcinogens, but still does not so designate those chemicals. In some cases the limits proposed for adoption were based on carcinogenicity, in other cases they were based on other acute or chronic health effects. Even if OSHA chooses not to accept NIOSH recommendations that occupational exposure to carcinogens should be restricted to the lowest feasible level, OSHA should designate these chemicals as potential occupational carcinogens because these chemicals meet the criteria for carcinogenicity as established by OSHA [29 CFR 1990.103]. Chemicals that should be designated as potential occupational carcinogens are listed in NIOSH Tables N6A and N6B (Appendix A) and have been submitted to the OSHA docket with our written testimony. On Table N6A, NIOSH has identified 39 substances which have proposed PELs that NIOSH can agree with, but for which a carcinogen designation should be added to the PEL. The chemicals are:

- 1) Acrylamide - skin (HS 1008)
- 2) Aldrin - skin (HS None)
- 3) Amitrole (HS 1020)
- 4) Aniline & homologues - skin (HS 1025)
- 5) Anisidine (o-, p-isomers) - skin (HS None)
- 6) Captafol - skin (HS 1066)
- 7) Captan (HS 1067)
- 8) Carbon tetrachloride - skin (HS 1073)
- 9) Chlordane - skin (HS None)
- 10) Chloroform (HS 1086)
- 11) Dichloroacetylene (HS 1123)
- 12) Dichloroethyl ether - skin (HS 1127)
- 13) Dichloropropene - skin (HS 1129)
- 14) Dieldrin - skin (HS None)
- 15) Diglycidyl ether (DGE) (HS 1139)
- 16) Dimethyl sulfate - skin (HS 1142)
- 17) Dinitrotoluene - skin (HS None)
- 18) Dioxane - skin (HS 1145)
- 19) Di-sec-octyl phthalate (HS 1116)
- 20) Ethylene dichloride (HS 1168)
- 21) Heptachlor - skin (HS None)
- 22) Hexachlorobutadiene - skin (HS 1195)
- 23) Hexachloroethane - skin (HS 1197)
- 24) Hexamethyl phosphoramide (HS None)
- 25) Methyl iodide - skin (HS 1259)
- 26) Nickel carbonyl (as Ni) (HS 1284)
- 27) Propylene imine - skin (HS None)
- 28) Silica - crystalline (cristobalite) (HS 1354)
- 29) Silica - crystalline (tridymite) (HS 1356)
- 30) 1,1,2,2-Tetrachloroethane - skin (HS 1385)
- 31) Toluene-2,4-diisocyanate (TDI) (HS 1398)
- 32) o-Toluidine - skin (HS 1399)
- 33) 1,1,2-Trichloroethane (HS None)
- 34) Trichloroethylene (HS 1406)
- 35) 1,2,3-Trichloropropane - skin (HS 1407)
- 36) Uranium (insoluble compounds, as U) (HS 1418)
- 37) Uranium (soluble compounds, as U) (HS 1419)
- 38) Vinyl cyclohexene dioxide (HS 1426)
- 39) Wood dust, hardwood (HS 1430A)

There are 53 chemicals on NIOSH Table N6B that not only should be designated as carcinogens, but for which there remains a substantial level of risk at the proposed PEL. The substances are:

- 1) Acetaldehyde (HS 1001)
- 2) Arsine (HS None)
- 3) Asphalt (petroleum) fumes (HS 1028)
- 4) Benzo(a)pyrene (HS None)
- 5) Beryllium & compounds, as Be (HS 1033)
- 6) tert-Butyl chromate, as CrO₃ - skin (HS None)
- 7) Carbon black (HS None)
- 8) Chlorinated camphene - skin (HS 1078)
- 9) Chlorodiphenyl (42% chlorine) - skin (HS None)
- 10) Chlorodiphenyl (54% chlorine) - skin (HS None)
- 11) Chromic acid and chromates (HS 1092)
- 12) Chromite ore processing (chromates), as Cr (HS None)
- 13) Chromium (VI) compounds, Cr (water soluble) (HS None)
- 14) Chromium (VI) compounds, Cr (certain water insoluble) (HS None)
- 15) Chromyl chloride (HS 1094)
- 16) Chrysene (HS None)
- 17) Coal tar pitch volatiles, as benzene solubles (HS None)
- 18) DDT (Dichlorodiphenyl-trichloroethane) (HS 1113)
- 19) p-Dichlorobenzene (HS 1125)
- 20) Dimethyl carbamoyl chloride (HS None)
- 21) 1,1-Dimethylhydrazine - skin (HS None)
- 22) Epichlorohydrin - Skin (HS 1158)
- 23) Ethyl acrylate - Skin (HS 1161)
- 24) Ethyl chloride (HS None)
- 25) Gasoline (HS 1185)
- 26) Hydrazine - Skin (HS 1205)
- 27) Lead chromate (as Cr) (HS None)
- 28) Methyl bromide - Skin (HS 1253)
- 29) Methyl chloride (HS 1254)
- 30) Methyl hydrazine - skin (HS None)
- 31) 4,4'-Methylene bis(2-chloroaniline) - Skin (HS 1273)
- 32) Nickel
 - Soluble or (inorganic) compounds, a Ni (HS 1283)
- 33) Nickel sulfide roasting, fume & dust (as Ni) (HS None)
- 34) p-Nitrochlorobenzene (HS 1288)
- 35) 2-Nitropropane (HS 1291)
- 36) Perchloroethylene (HS 1308)
- 37) N-Phenyl-beta-naphthylamine (HS None)
- 38) Phenyl glycidyl ether (PGE) (HS 1315)
- 39) Phenylhydrazine - Skin (HS 1317)
- 40) Propane sulfone (HS None)
- 41) Propylene dichloride (HS 1341)
- 42) Propylene oxide (HS 1344)
- 43) Rosin core solder pyrolysis products, as formaldehyde (HS 1350)
- 44) Silica--Crystalline
 - Quartz (HS 1355)
 - Tripoli (HS 1357)
 - Silica, fused (HS 1358)
- 47) o-Tolidine - skin (HS None)
- 48) p-Toluidine - Skin (HS 1400)

- 49) Vinyl bromide (HS 1425)
- 50) Vinylidene chloride (HS 1428)
- 51) Welding fumes (HS 1430)
- 52) Wood Dust, softwood (HS 1430b)
- 53) Zinc chromate, s Cr (HS 1436)

Some chemicals on NIOSH Table N6A and N6B have been excluded from this rulemaking by OSHA as is evident from their lack of a HS number.

However, NIOSH concludes that OSHA should include these chemicals in this rulemaking.

On NIOSH Table N7, NIOSH has identified 15 substances for which OSHA intends to adopt a TWA instead of the recommended NIOSH Ceiling Value. NIOSH recommends that OSHA adopt the NIOSH Ceiling Values to provide the most appropriate degree of health protection. These substances are:

- 1) Butyl mercaptan (HS 1054)
- 2) Benzyl chloride (HS None)
- 3) Cyanides (as CN) - skin (potassium cyanide) (HS None)
- 4) Cyanides (as CN) - skin (sodium cyanide) (HS None)
- 5) Hydrogen sulfide (HS 1209)
- 6) Hydroquinone (HS None)
- 7) Isopropyl glycidyl ether (IGE) (HS 1227)
- 8) Methyl chloroform (HS 1255)
- 9) Methyl mercaptan (HS 1263)
- 10) Petroleum distillates (naphtha; rubber solvent) (HS 1312)
- 11) Phenol - skin (HS None)
- 12) Phenyl mercaptan (HS 1316)
- 13) Phosgene (HS None)
- 14) Vanadium (as V2O5) - respirable dust fume (HS 1421)
- 15) Vanadium (as V2O5) - fume (HS 1422)

Turning now to the specific questions posed in the NPRM:

1. Are substances included which should be excluded from this rulemaking?

No. On the contrary, substances were excluded which should have been included. Immediately upon completion of this rulemaking, OSHA should take action to establish PELs for all substances that are excluded from this rulemaking despite the existence of a formal NIOSH recommendation to OSHA. As a first step, OSHA should initiate consolidated rulemaking similar to the present Z-Table update to adopt all NIOSH RELs pending chemical-specific Section 6(b) rulemaking to establish comprehensive standards.

2. Is additional health and feasibility documentation available relative to the proposed PELs beyond that described in the preamble?

Yes. OSHA has frequently limited itself to the documentation used by the ACGIH in support of TLVs. Whenever available, NIOSH Criteria Documents, Current Intelligence Bulletins, and Alerts should be considered by OSHA in its final rulemaking. For many of the chemicals, substantial databases are available from other governments (e.g., Germany, the United Kingdom, Sweden), as well as from organizations such as the International Labor

Organization, the American Industrial Hygiene Association, the Nordic Expert Group for Documentation of Occupational Exposure Limits, and the National Library of Medicine. A large number of National Cancer Institute (NCI), National Toxicology Program (NTP), and International Research on Cancer (IARC) monographs on chronic bioassay reports are available that provide extensive information on acute and chronic systemic toxicity in addition to data on potential carcinogenicity.

As part of this response, NIOSH is providing a chemical-by-chemical discussion with citations of the most pertinent supporting data that could be identified within the time limitations. For chemicals included in the PEL update, copies have been submitted to the docket of all pertinent NIOSH Health Hazard Evaluations (HHEs) as well as all citations for toxicity contained in the NIOSH Registry of Toxic Effects of Chemical Substances (RTECS). These data are collected as mandated by Section 20(a)(6) of the Occupational Safety and Health Act of 1970 (PL 91-596). These data are publicly available and will assist OSHA in fulfilling its obligation under the Occupational Safety and Health Act to consider "the latest available scientific data in the field." NIOSH has not attempted to provide OSHA with the other elements the Act requires OSHA to consider, namely, "... the feasibility of the standards, and experience gained under this and other health and safety laws."

The HHE reports will provide some idea of exposures found during requested NIOSH evaluations in industry. NIOSH is continuing to develop information and will provide to OSHA other relevant data on exposure concentrations found in industry in our post-hearing comments. These data should assist OSHA in determining feasibility.

In addition to these publicly available sources of information, OSHA should ask major employers throughout the country to provide listings of all of their own internal exposure limits along with their documentation of those limits. In many industries these may be more restrictive than existing OSHA PELs, and this should be an excellent source of information on feasibility of various limits.

Because many of the proposed PELs are derived from TLVs, OSHA should obtain from the ACGIH all unpublished data that contributed to the establishment of those TLVs. OSHA should follow up on these unpublished data to make the record as complete as possible.

Dimethyl Formamide (DMF), a compound from NIOSH Table N3A, is of particular interest to both NIOSH and OSHA because of recent published information concerning testicular cancer and liver

disease. NIOSH will provide to OSHA a summary of these data presently in preparation.

3. Are substances included in this rulemaking used in industries other than those described in the preamble?

and

4. Are substances included in this rulemaking used for purposes other than those described in the preamble?

NIOSH has previously supplied to OSHA at their request a printout of the complete NIOSHTIC data base file on approximately 260 chemicals to aid in the identification of additional industries using the chemicals in this rulemaking. NIOSH is continuing to search its data base files (National Occupational Hazard Survey [NOHS]) for additional information which will be provided during this rulemaking process.

5. Do alternative unpublished exposure guidelines exist, such as those used in private workplaces, which may be suitable for general usage?

NIOSH is aware of the existence of internal exposure guidelines in a number of private workplaces. NIOSH surveyors in assessing

ethylene oxide exposure often found internal workplace controls in the 1 to 2 ppm range when the OSHA PEL was 10 ppm. Some of the proposals for change by ACGIH incorporate workplace exposure limits being used in industry at the time of the change. Nickel carbonyl is an example. This documentation relates that a nickel refinery in Sudbury, Canada, begins treating their workers for nickel carbonyl poisoning when their blood level of nickel reaches 150 micrograms/liter. It is further noted that the factory sounds an alarm when air concentrations read 10 ppb and an evacuation alarm sounds at 80 ppb. In this case the TLV is 5 times the level thought to be safe.

There are existing guidelines on exposure to radioactive materials published by the International Commission on Radiation Protection (ICRP) and by the National Commission on Radiation Protection, which are applicable to radioactive substances, specifically soluble and insoluble uranium in this rulemaking.

Before considering unpublished data, OSHA should update the published information on which it is relying for this proposed rule. A cursory review indicates that 72% of the references cited by OSHA were published prior to 1980 and 35% prior to 1969. The latter is the publication date for the current Z-1 table. NIOSH has submitted a complete set of references for each of the substances under consideration from its RTECS data base.

- 6) Is there information regarding laboratory analytical procedures which may be used in lieu of those suggested by OSHA (see appendix A) to determine exposure to air contaminants?

NIOSH has transmitted to OSHA all of its applicable analytical procedures. NIOSH would caution OSHA that in the "Sampling and Analytical Methods" table several existing NIOSH analytical methods have been extended to compounds for which the suggested method has not been verified. Some of these compounds have markedly different chemical properties than the compound(s) for which the method was developed. These methods will require validation before use:

<u>Method</u>	<u>Validated for</u>	<u>Extension proposed by OSHA</u>	<u>HS #</u>
NIOSH 1003	halogenated H/C	1,3-dichloropropene	1129
NIOSH S43	methyl methacrylate	2-hydroxypropyl acrylate	1211
NIOSH 1400	isopropanol	propargyl alcohol	1335
NIOSH 1400	isopropanol	isooctyl alcohol	1220
NIOSH 1603	acetic acid	trichloroacetic acid	1404
NIOSH 1003	halogenated H/C	dichloroacetylene	1123
NIOSH 1020	1,1,2-trichloro- 1,2,2-trifluoroethane	perdifluoromethane	1085
NIOSH 1020	1,1,2-trichloro- 1,2,2-trifluoroethane	perpentafluoroethane	1087
NIOSH 1003	halogenated hydrocarbons	o-chlorostyrene	1089
NIOSH 1003	halogenated hydrocarbons	o-chlorotoluene	1090
NIOSH 1500	hydrocarbons	cyclopentane	1111
NIOSH 1500	hydrocarbons	hexane isomers	1201
NIOSH 5021	terphenyls	hydrogenated terphenyls	1210
NIOSH 2002	aromatic amines	N-isopropylaniline	1229
NIOSH S264	ethyl silicate	methyl silicate	1266
NIOSH 1500	hydrocarbons	nonane	1293
NIOSH 2002	aromatic amines	p-toluidine	1400
NIOSH 2002	aromatic amines	m-toluidine	1401

The following are corrections to the NIOSH Analytical Methods for PEL Update Table (pp. 21308-21312 of the Federal Register).

<u>No.</u>	<u>Analyte</u>	<u>Correct NIOSH Validated Method</u>
4	acetone	NIOSH 1300
17	ammonia	Add NIOSH S347
20	ammonium sulfamate	NIOSH S348
63	carbon Dioxide	NIOSH S249
190	hexachlorocyclopentadiene	NIOSH 2518
304	petroleum distillates (naphtha)	NIOSH 1550
392	1,2,3-trichloropropane	NIOSH 1003

7) Are the proposed exposure limits for each substance appropriate?

NIOSH has addressed comments on each exposure limit it believes to be inappropriate and submitted these comments with supporting data to the docket as specified by OSHA in part VIII of the proposed rule.

8. Is additional information available for those substances for which ACGIH proposed a higher TLV which might affect OSHA's decision that such a change was not justified?

This rulemaking is not an appropriate proceeding for raising any permissible exposure limit. The decision to raise an occupational exposure limit should only be made through a full 6(b) rulemaking procedure with adequate time for all concerned parties to respond.

NIOSH has examined all of the available additional scientific information on substances for which the ACGIH TLV is higher and has commented where appropriate. The only substance included on Table C16-1 (Federal Register, p. 21211) that OSHA proposes to raise is Fluorine (HS 1179), and NIOSH has submitted detailed comments on this chemical which demonstrate that OSHA was not justified in raising the proposed PEL.

Additionally, OSHA inadvertently stated (on p. 21029 of the Federal Register) that the current OSHA PEL for Synthetic Camphor (HS 1063) is 2 ppm rather than 2 mg/m^3 (0.3 ppm). Because of this error, OSHA proposed to adopt the ACGIH TLV and STEL, i.e. 2 and 3 ppm, respectively, which is approximately 7 times higher than the current PEL.

9. **Should the implementation dates for some substances be delayed because of sampling/analytical limitations or short-term feasibility impact considerations?**

Delaying the implementation date would not be technology forcing with regard to reducing occupational exposures. However, it is extremely important to note that for many substances listed in the update there are no sampling and analytical methods available or the method given has not been validated by either NIOSH or OSHA. Also, many of the proposed methods are in-house

OSHA methods which are not available to NIOSH or the general public for evaluation. Finally, there are methods whose Limit of Quantitation cannot support the proposed PEL or STEL. These problems are critical and must be corrected for proper enforcement of the regulation.

Therefore, it is important that NIOSH and OSHA work together on a method development scheme that will allow the appropriate validated methods to be developed in a prioritized fashion within the implementation of the regulation. Also, it is imperative that OSHA set a high priority for promulgating followup regulations that deal with these sampling and analytical issues.

10. Is there additional information relative to the OSHA plans to adopt some recommended 10-hour TWA REL's as an 8-hour PEL?

A NIOSH REL "... determined as a time-weighted average (TWA) exposure for up to a 10-hour work day, 40-hour work week" first appeared in the 1973 Inorganic Arsenic Criteria Document. That document was developed during the energy crisis of the early 1970's, when many employers began using 10-hour work days as an energy conservation measure. Consideration was given to recommending a mathematical adjustment of TWA RELs based on a constant limitation of the Concentration x Time for 8-hour and

longer work days. For example, an 8-hour TWA of 100 ppm ($100 \text{ ppm} \times 8 \text{ hr} = 800 \text{ ppm hr}$) would convert to 80 ppm for a 10-hour day ($800 \text{ ppm hr} / 10 \text{ hr} = 80 \text{ ppm hr}$). The conclusion at the time was that, so long as the work schedule did not exceed 10 hours per day or 40 hours per week, there was not sufficient precision in the selection of exposure limits to justify the precision implied by that mathematical adjustment. Therefore, the same TWA REL was intended to be applied to 8-hour and 10-hour work days in a 40-hour work week. The action proposed by OSHA in this rulemaking relative to these RELs is consistent with that original intent. A mathematical conversion in the opposite direction, i.e., converting a 10-hour TWA of 100 ppm (1000 ppm hr) to an 8-hour TWA of 125 ppm (1000 ppm hr), would be contrary to the original intent and would be opposed by NIOSH.

11. Does the most current scientific information generally support acceptance of the hypothesis that all C-5-8-Alkanes are not equally toxic because a metabolite of n-Hexane exhibits unique neurotoxic properties?

It is generally accepted that the metabolite that is responsible for the neurotoxic effects of n-hexane is 2,5-hexanedione (2,5-HD), a gamma diketone. This compound is also a metabolite of methyl-n-butyl ketone (MnBK), but is not known to be a metabolite of other alkanes in the C-5 to C-8 group. 2,5-HD

produces axonal degeneration (so-called "central peripheral distal axonopathy") characterized by a breakdown of neurofilaments and their accumulation distal to Ranvier nodes in the neuron. The observable symptomatology is, in sequence, limb weakness, severe paralysis, and muscle degeneration. The observation of similar neuropathies after exposures to MnBK or n-hexane and the discovery of their common metabolite, 2,5-HD, suggested the specific hypothesis that it is the gamma spacing of the diketone in the molecule that is the necessary and sufficient characteristic for producing this type of neuropathy. It would be correct to state that 2,5-HD is the principal neurotoxic metabolite of n-hexane and MnBK. It should also be recognized that any gamma diketone or any compound that may be metabolized to a gamma diketone (e.g., 5-nonanone metabolized to 2,5-nonanedione) may be neurotoxic. It would be incorrect to conclude that the neurotoxic properties ascribed to n-hexane are unique to this compound. Other alkanes or related chemicals that are ultimately metabolized to a gamma diketone may have similar toxicity.

- 12) OSHA has proposed to use exposure limits from two well-established sets of guidelines as a source of values to update the PELs. Is information available about alternative sources which OSHA might consider for this purpose?

In its preamble to this proposed rulemaking, OSHA referred to 9 alternative sources:

- International Labor Organization
- World Health Organization
- European Economic Community
- United Kingdom Occupational Exposure Limits
- West German Maximum Allowable Concentrations
- Swedish Allowable Workplace Air Concentrations
- Japanese Permissible Exposure Limits
- American National Standards Institute
- American Industrial Hygiene Association

Another possibility is the Nordic Expert Group for Documentation of Occupational Exposure Limits.

NIOSH believes all of these should be considered as equal or superior to the ACGIH TLV list in terms of the criteria listed by OSHA.

No single source should be expected to stand alone as a comprehensive list of candidates for regulation. OSHA should construct its own comprehensive list by drawing information from all available sources.

No single list is current in its entirety. Although the ACGIH TLV list is republished annually, it is a mistake to assume that every TLV is reconsidered annually. The annual republishing is only a mechanism whereby those TLVs that have been revised can be disseminated. The ACGIH does not claim to reevaluate every TLV on a regular schedule.

Economic and technical feasibility may be considered by the ACGIH in developing TLVs, but those considerations, if any, are not defined in the documentation of TLVs. Feasibility information for PELs derived from agencies listed above would be comparable, in most cases, to that provided by the ACGIH in support of TLVs.

OSHA should consider the availability and quality of documentation on a substance-by-substance basis and use all available documentation, rather than select an exclusive list of substances simply because that list consistently has some documentation.

The fact that the alternative sources listed above do not originate in the U.S. should not disqualify them from consideration of applicability. They should be judged against what is required to protect workers from the known toxicity of each substance regulated. Only after determining the level of

control necessary to ensure a safe and healthy workplace should other factors be considered. Because they are limits that other officials have judged necessary to protect worker safety and health, NIOSH believes that OSHA should at least consider limits from all of the sources listed above.

13. OSHA has outlined its criteria for identifying special situations. Are alternative criteria available which might be used in lieu of these, or in addition to them?

OSHA has identified five circumstances that it considers special situations:

Situations one and two involve a comparison of the ACGIH TLVs to four alternate data bases--the United Kingdom 1987 Occupational Exposure Limits, the West German 1985 Maximum Allowable Concentrations, the Japanese 1983 Permissible Exposure Limits, and the Swedish 1984 Allowable Workplace Air Concentrations. OSHA Tables 1-F-C and 1-F-D, that are based on these comparisons, are not accurate. NIOSH has reviewed the pertinent data on selected substances on Tables 1-F-C and 1-F-D and have submitted comments on the appropriateness of the limits proposed.

Situation three involves the substances where the current TLV exceeds the existing PEL. NIOSH has addressed this issue in the response to question 8.

Situation four involves the circumstances where the available analytical methods are not adequate to measure the substance at the air concentration proposed. NIOSH has addressed this situation in the answer to question 9.

In the fifth situation where recent information suggests that neither the TLV nor the REL is appropriate, NIOSH finds it difficult to identify the exact substances to which OSHA is referring. NIOSH has commented on those substances which, based on the best available scientific information, meet OSHA's occupational carcinogen definition. On other substances where recent information indicates that neither the TLV nor the REL is low enough to be adequately protective, OSHA should adopt the lower of the available limits and immediately schedule the substance for expedited rulemaking.

14. OSHA has outlined three alternative procedures for dealing with substances requiring special attention. Are additional approaches available which might be used in lieu of these, or in addition to them?

NIOSH would support OSHA in its decision to adopt either the level proposed or such other level as the evidence presented to the record indicates as proper for these substances, and identify them as requiring possible followup rulemaking. NIOSH has endeavored to provide OSHA with the required data for selecting a proper limit for selected substances on Tables I-F-C and I-F-D. NIOSH concurs with OSHA that it is in the best interest of the worker to promptly provide such increased health protection as is indicated by the evidence in the record.

15. OSHA has performed feasibility analysis for the following substances, based on limited available information:
Acetonitrile, Carbon disulfide, Carbon monoxide, Carbon tetrachloride, Chloroform, Ethylene dichloride, Ethylene glycol dinitrate, Fibrous glass dust, Hydrogen cyanide, Isophorone diisocyanate, Nitrogen dioxide, Nitroglycerin, Trichloroethylene.

Is further information available which might be used to supplement the present findings regarding the feasibility of achieving these levels in the workplaces?

From NIOSH research data, we are including a detailed engineering feasibility study (Appendix B) for those listed in the question, as well as for the following chemicals: Acetone, Chlorine, Styrene, and Sulfur dioxide.

16. OSHA has made a preliminary assessment of the proposed rulemakings' impact on large and small establishments. The Act requires OSHA to determine whether a regulation will have a significant impact on a substantial number of small entities, pursuant to the Regulatory Flexibility Act of 1980, 5 U.S.C. 601 et seq. Is there additional information regarding implementation of this rule for small businesses and entities which OSHA should consider?

NIOSH has no comment.

17. OSHA has proposed PEL's for some substances where the basis of this proposal also includes a carcinogenicity designation (e.g., TLV with an A1 or A2 designation; REL with a Ca designation). Should OSHA include a similar carcinogen designation in the 2-4 Table in this rulemaking?

Yes. For both the TLVs and the RELs, the carcinogen designation is an inseparable part of the recommendation. OSHA should include carcinogen designations for all chemicals that meet the OSHA definition of "potential occupational carcinogen" (29 CFR 1990.103).

18. OSHA has preliminarily decided that for substances where the ACGIH TLV is a TWA and the NIOSH REL is a Ceiling Value which is

the same or one half of the TWA, OSHA will propose that the TWA be adopted as the PEL. Should this approach be modified in the final rulemaking? What approach should be used when the converse of this situation (TLV, Ceiling REL, TWA) exists?

NIOSH would suggest that this question fails to recognize the essential differences between a time weighted average (TWA) and a Ceiling Value. A TWA is appropriate as a limit when the toxic effect of the substance is directly related to the total dose received in a daily exposure. Ceiling values are intended to minimize toxic effects related to the peak exposure.

Ceiling values are necessary when there are immediate acute responses to an air contaminant independent of the total daily dose or when chronic effects are dose-rate response related. In conjunction with a TWA, ceiling values are also used to minimize the total daily dose when there is intermittent occupational exposure, e.g., ethylene oxide.

The simple numerical relationship that OSHA has proposed is not a scientifically sound basis for selecting between a TWA and a ceiling value. An analysis of the data supporting the proposed limit must be conducted on a case-by-case basis to discern which limit is appropriate.

NIOSH has submitted specific comments on a substance-by-substance basis in this category to assist OSHA in selecting the appropriate limit. These substances are listed in the NIOSH Table N7 of the NIOSH comments.

19. OSHA preliminarily plans to adopt a phased start-up schedule. This would include an initial start-up requirement permitting the use of alternate control methods for revised PEL's, followed at a later date by the required use of control methods fully consistent with the methods of compliance priorities in effect at that time. OSHA will shortly be requesting comments on the hierarchy of controls. An alternate approach is to set compliance date for engineering controls based on final determinations of that rulemaking. OSHA solicits comments on those approaches and suggestions regarding appropriate times for the two proposed start-up dates.

NIOSH believes that work practices and engineering controls such as substitution, isolation, and ventilation should be used to control occupational exposures to the fullest extent feasible. NIOSH believes that personal protective equipment should be worn only when engineering controls are not feasible such as during maintenance procedures.

NIOSH recommends that OSHA allow industry 6 months to come into compliance by any combination of control methods, and 2 years for compliance by the NIOSH recommended hierarchy of control methods [NIOSH 1983]. OSHA currently is recommending that industry be allowed 4 years to come into compliance by OSHA's hierarchy of control methods. Furthermore, NIOSH recommends that OSHA require staged implementation over the 2-year period of conversion to the hierarchy. This latter requirement would be technology forcing and it would minimize the occurrence of last minute requests to OSHA for variances to meet the conversion requirement.

20. OSHA requests comment on whether the establishment of margins of safety below lowest observed or no effect levels is consistent with the concept of "significant risk," and on whether the specific margins of safety proposed for specific chemicals are appropriate.

Margins of safety and safety factors are attempts to adjust for uncertainty in available data and knowledge. The use of a margin of safety or a safety factor approach to identify exposure limits does not estimate the human risk associated with those proposed exposure limits. Therefore, such an approach cannot be considered to provide protection against or to reduce "significant risk" (either in a general conceptual sense or in

the sense of any specific judicial precedent). Nonetheless, NIOSH recognizes that a thorough case-by-case evaluation for all major industrial agents may not be possible for a variety of reasons and the use of a margin of safety or a safety factor approach to identify exposure limits for those chemicals provide a pragmatic method to develop standards. The exception to this statement is that NIOSH does not believe such an approach should be used to identify an exposure limit for an adverse health effect that result from non-threshold processes (e.g., cancer).

In developing its recommendations to OSHA, NIOSH conducts thorough evaluations of all research data, estimated human risks associated with specific exposures, the sensitivity of measurement and analytic methods, alternative technologies, technological feasibility of various exposure levels, background or ambient exposure levels, methods of worker protection and many other factors pertinent to specific exposure agents or environments. NIOSH knows of no other method to develop reliable exposure limit standards that is consistent with NIOSH's responsibility from the OSHA Act to assure as far as possible, every working man and woman in the Nation, safe and healthful working conditions. Since the use of a margin of safety or a safety factor approach does not address essential issues required to develop a reliable exposure limit, including evaluation of "significant risk," NIOSH recommends that any

standards developed by the use of a margin of safety or a safety factor approach be considered interim standards. NIOSH recommends that standards based on a margin of safety or a safety factor approach, as well as standards derived from a case-by-case evaluation, be periodically reviewed to determine what new information is available.

NIOSH is not recommending specific margins of safety or safety factors on any chemical.

21. OSHA has identified sensory irritation, which causes rhinitis, cough, sputum production, chest pain, wheezing and dyspnea as material impairment of health. OSHA invites comments on this understanding.

The recognition of sensory irritation as potentially being "material impairment of health" is consistent with the current scientific consensus related to health effects of environmental agents.

Mucous membrane irritants can cause increased blink frequency and tearing; nasal discharge, congestion, and sneezing; and cough, sputum production, chest discomfort, wheezing, chest tightness, and dyspnea. Work environments often require levels of physical and mental performance considerably greater than

encountered in daily living. Even in the absence of any permanent impairment, the symptoms listed can interfere with job performance and safety.

Mucous membrane irritation can result in inflammation, which may lead to increased susceptibility to nonspecific irritants and infectious agents. For example, experimental ozone exposure in humans results in increased airway reactivity. Also, studies of exposure to environmental tobacco smoke have shown irritative symptoms and evidence of increased frequency of respiratory tract illnesses in young children and decreased pulmonary function in adults.

The American Thoracic Society has identified several points relevant to the issue of respiratory tract irritation.

1. Does the effect interfere with normal activity of the individual?
2. Are there episodes of identifiable respiratory illness?
3. Does the effect result in an incapacitating illness?
4. Is there permanent respiratory injury?
5. Is there progressive respiratory dysfunction?

Particularly on the job, sensory irritation is clearly relevant to point 1. Mucous membrane irritation is associated with respiratory illnesses, depending on the composition of specific exposure and on the dose, duration, and frequency of exposure. No universally applicable conclusion can be drawn at this time regarding the association between irritative symptoms and permanent injury or dysfunction. Where certain individuals show no measurable impairment after an exposure, even when experiencing irritative symptoms, others may develop identifiable dysfunction.

Aside from the effects of irritation, mucous membrane exposure may result in absorption of a substance, with resultant systemic toxicity. An inflamed mucous membrane may be an even more effective route of absorption, either for the irritant or for other substances. Furthermore, injury to bronchopulmonary membranes can impair removal of particulates from the respiratory system.

22. The question also arises of whether odorants present material impairment of health. That issue also might arise in the context of other substances. Based on the evidence in the final record concerning this issue, OSHA will determine if the criteria detailed in section IV-C-16 have been met, and take appropriate action. OSHA requests comment on this issue.

Odors emitted by industrial chemicals often play an important role in occupational safety and health. When odors can be detected before health effects occur, they may provide early warning of exposure. A number of chemicals have strong odors at concentrations which are otherwise minimally toxic. These odors may cause undue health concerns among exposed workers or may create safety hazards by distracting workers from their tasks. Strong odors in the workplace may also mask the presence of other, more toxic substances. Strong odors can produce irritation and/or nausea at high concentrations, although these effects may be reversible following cessation of exposure. Olfactory fatigue often occurs and should be considered a functional impairment that can result in increased worker exposure. Olfactory fatigue can reduce the wearer's ability to sense inadequate respirator performance of air-purifying respirators.

23. Is there exposure information available which can be supplied which will refine OSHA's estimates of employee exposures and over exposures to the substances being regulated?

NIOSH is submitting for the current rulemaking all relevant Health Hazard Evaluation Reports (HHEs) to the docket. Appendix C is a comprehensive listing of HHEs being submitted. We have also previously submitted to OSHA a copy of data tapes

from the National Occupational Health Survey (NOHS). NIOSH anticipates submitting to OSHA a comprehensive listing of pertinent NIOSH exposure information in our post-hearing comments.

24. Is there information available which can be supplied to improve or supplement the engineering controls identified as necessary in order to reduce exposure levels? Is there additional cost data which can be supplied to refine the annual costs associated with these controls?

In addition to the material on engineering feasibility provided to OSHA relating to question 15, NIOSH is continuing to evaluate general engineering feasibility data for these substances in this rulemaking that meet OSHA's definition of a potential occupational carcinogen (29 CFR 1990).

25. Under what conditions, involving which industrial processes, will respirators be needed during the start up period, for maintenance operations, or where other controls are infeasible in order to protect employees at the proposed exposure levels? Are respirators currently being used under the conditions identified, or would they need to be purchased? Please describe the type of respirator currently in use or needed.

NIOSH concurs with OSHA's assessment in the Non-Regulatory Alternative Section that personal protective equipment should only be used "where it is impractical to apply engineering or work practice controls, or where these applications will not consistently reduce employee exposures below the proposed PEL's." In these instances, NIOSH recommends that the NIOSH Respirator Decision Logic (Appendix D) be used to select the appropriate respirator.

NIOSH has little quantitative information on which respirators are currently being used under the conditions specified by OSHA. A NIOSH contractor's report ("Preliminary Survey of Existing Data and Economic Overview of Respirator Industry," Granville Corporation, March 10, 1982) is submitted to the docket as Appendix E and provides limited data on the numbers and types of respirators sold in the United States. This report used respirator manufacturers' data on respirator sales in 1980 and published data on workers [i.e., Economic Report of the President, (U.S.G.P.O., Washington, 1981)] to make some estimates on the number of certified respirators being worn by workers in the U.S. The Granville report estimates that 19.1% of mining, manufacturing, and construction workers wore or had access to certified respirators in 1980. In addition, it was estimated that over 20 million manufacturing workers and almost 4.5 million construction workers, and more than 1 million miners

used certified respirators. The Granville report also indicated that SCBAs, "disposables," and particulate and chemical cartridge respirators have "large and roughly equal market shares (ranging from 25 to 30%) in terms of total dollar sales" (Granville Report, p. 40).

26. As a result of simultaneously regulating many substances, what cost savings will be realized in purchasing new engineering controls? Are alternate engineering controls available to achieve the lower permissible exposure limits being proposed?

NIOSH has no comment with regard to the costs of purchasing new engineering controls. Alternate engineering control methods are discussed in our responses to questions 15 and 19.

27. What is the current state of technology control and financing in firms which would need to comply with reduced exposure limits to wood dust?

In addition to the information provided on the individual chemical comments for Wood Dust (H.S. 1430A and 1430B), several innovative designs and devices have been developed to control wood dust in sawing, cutting, sanding and shaping. These published NIOSH references (Huebener DJ [1987]. Dust controls for a wood shaper. Appl Ind Hyg 2(4):164-169; and Hampl V and

Johnston DE [1985]. Control of wood dust from horizontal belt
sanding. Am Ind Hyg Assoc J 46(10):567-577) have been submitted
to the docket as ~~Appendices E and F, respectively~~ **Appendix F**

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APPENDIX A

Tabulation of NIOSH Reviews of Proposed PELs
 NIOSH Table N1 - Proposed PELs
 (NIOSH concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Acetic acid	1002	64-19-7	10	25	15	37	10	25	
Acetic anhydride	1003	108-24-7	C 5	C 20			5	20	
Acetone	1004	67-64-1	750	1780	1000	2375	1,000	2,400	250 ppm (590 mg/m ³) TWA
Acetonitrile - Skin	1005	75-05-8	40	70	60	105	40	70	20 ppm (34 mg/m ³) TWA
Acetylsalicylic acid (Aspirin)	1006	50-78-2		5			None		
Acrolein	1007	107-02-8	0.25	0.3	0.8	0.1	0.25		
Allyl alcohol - Skin	1010	107-18-6	2	5	4	10	2	5	
Allyl chloride	1011	107-5-1	1	3	2	6	1	3	1 ppm (3.1 mg/m ³) TWA; 3 ppm (9.3 mg/m ³) ceiling (15 min)
Allyl glycidyl ether Skin	1012	106-92-3	5	22	10	44	C 10	C 45	9.6 ppm (45 mg/m ³) ceiling (15 min)
Allyl propyl disulfide	1013	2179-59-1	2	12	3	18	2	12	
Aluminum		7429-90-5							
Alkyls (NOC*)	1015			2			None		
Pyro powders	1017			5			None		
Soluble salts	1018			2			None		
Welding fumes	1019			5			None		

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CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Ammonia	1021	7664-41-7	25	18	35	27	50	35	50 ppm (34.8 mg/m ³) ceiling (5 min)
Ammonium chloride fume	1022	12125-02-9		10		20		15	
Atrazine	1029	1912-24-9		5			None		
Bismuth telluride (Se-doped)	1034	1304-82-1		5			None		
Borates, tetra, sodium salts		1303-96-4							
Anhydrous	1036			1			None		
Decahydrate	1037			5					
Pentahydrate	1038			1					
Boron tribromide	1040	10294-33-4	C 1	C 10			None		
Bromacil	1041	314-40-9	1	10			None		
Bromine	1042	7726-95-6	0.1	0.7	0.3	2	0.1	0.7	
Bromine pentafluoride	1043	7789-30-2	0.1	0.7			None		
Butane	1044	106-97-8	800	1,900			None		
2-Butanone (Methyl ethyl ketone;MEK)	1045	78-93-3	200	590	300	885	200	590	200 ppm (590 mg/m ³) TWA
2-Butoxyethanol - Skin	1046	111-76-2	25	120			50	240	
n-Butyl acetate	1047	123-86-4	150	710	200	950	150	710	

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CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Butyl acrylate	1048	141-32-2	10	55			None		
sec-Butyl alcohol	1049	78-92-2	100	305	150	455	150	450	
tert-Butyl alcohol	1050	75-65-0	100	300	150	450	100	300	
n-Butyl alcohol - Skin	1051	71-36-3	C 50	C 150			100	300	
n-Butyl lactate	1053	138-22-7	5	25			None		
o-sec-Butylphenol - Skin	1055	89-72-5	5	30			None		
p-tert-Butyltoluene	1056	98-51-1	10	60	20	120	10	60	
Calcium cyanamide	1058	156-62-7		0.5			None		
Calcium hydroxide	1059	1305-62-0		5			None		
Calcium oxide	1060	1305-78-8		2				5	
Caprolactam Dust	1064	105-60-2		1		3	None		
Carbofuran	1068	1563-66-2		0.1			None		
Carbon dioxide	1069	124-38-9	5,000	9,000	30,000	54,000	5,000	9,000	10,000 ppm (18,000 mg/m ³) TWA; 30,000 ppm (54,000 mg/m ³) ceiling (10 min)

Tabulation of NIOSH Reviews of Proposed PELs
 NIOSH Table N1 - Proposed PELs
 (NIOSH concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Carbon disulfide - Skin	1070	75-15-0	10	30			20 ppm TWA 30 ppm Ceiling, 100 ppm Max Ceiling, (30 min)		1 ppm (3 mg/m ³) TWA; 10 ppm (30 mg/m ³) ceiling (15 min)
Carbon monoxide	1071	630-08-0	50	55	400	440	50	55	35 ppm (40 mg/m ³), 8-hr TWA; 200 ppm (229 mg/m ³) ceiling (No defined time)
Carbon tetrabromide	1072	558-13-4	0.1	1.4	0.3	4	None		
Carbonyl fluoride	1074	353-50-4	2	5	5	15	None		
Catechol	1075	120-80-9	5	20			None		
Cesium hydroxide	1077	21351-79-1		2			None		
Chlorine	1079	7782-50-5 (NIC	1 0.5	3 1.5	3 1	9 3)	C 1 C 3	C 3	0.5 ppm (1.45 mg/m ³) ceiling (15 min)
Chlorine dioxide	1080	10049-04-4	0.1	0.3	0.3	0.9	0.1	0.3	
1-Chloro-1-nitropropane	1081	600-25-9	2	10			20	100	
Chloroacetyl chloride	1083	79-04-9	0.05	0.2			None		
o-Chlorobenzylidene malononitrile - Skin	1084	2698-41-1	C 0.05	C 0.4			0.05	0.4	

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Tabulation of NIOSH Reviews of Proposed PELs
NIOSH Table M1 - Proposed PELs
(NIOSH concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Chlorodifluoromethane	1085	75-45-6	1,000	3,500	1,250	4,375	None		
Chloropentafluoroethane	1087	76-15-3	1,000	6,320			None		
Chloroprene - Skin	1088	126-99-8	10	35			25	90	1 ppm (3.6 mg/m ³) ceiling (15 min)
o-Chlorostyrene	1089	2039-87-4	50	285	75	430	None		
o-Chlorotoluene - Skin	1090	95-49-8	50	250	75	375	None		
Chlorpyrifos - Skin	1091	2921-88-2		0.2		0.6	None		
Chromium Metal as Cr	1093	7440-47-3		0.5				1	
Cobalt carbonyl, as Co	1098	10210-68-1		0.1				0.1	NIOSH has concluded that there is insufficient evidence to warrant recom- mending a new exposure limit
Cobalt hydrocarbonyl, as Co	1099	16842-03-8		0.1				0.1	NIOSH has concluded that there is insufficient evidence to warrant recom- mending a new exposure limit
Cobalt, as Co Metal dust & fume	1100	7440-48-4		0.05				0.1	NIOSH has concluded that there is insufficient evidence to warrant recom- mending a new exposure limit

Tabulation of NIOSH Reviews of Proposed PELs
 NIOSH Table N1 - Proposed PELs
 (NIOSH concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV						REL
			TWA		STEL		PEL		
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Cu ₂ S Fume	1101	7440-50-8		0.2				0.1	
Crotonaldehyde	1103	299-86-5		5		20	None		
Cyanamide	1104	420-04-2		2			None		
Cyanogen	1105	460-19-5	10	20			None		
Cyanogen chloride	1106	506-77-4	C 0.3	C 0.6			None		
Cyclohexanol - Skin	1107	108-93-0	50	200			50	200	
Cyclohexanone -Skin	1108	108-94-1	25	100			50	200	25 ppm (100 mg/m ³) TWA
Cyclohexylamine	1109	108-91-8	10	40			None		
Cyclonite - Skin	1110	121-82-4		1.5		3	None		
Cyclopentane	1111	287-92	100	1,720			None		
Cyhexatin	1112	13121-70-5		5			None		
Decaborane - Skin	1114	17702-41-9	0.05	0.3	0.15	0.9	0.05	0.3	
2,6-di-tert-butyl-p-cresol	1117	128-37-0		10			None		
Diazinon - Skin	1118	333-41-5		0.1			None		
Dibutyl phosphate	1119	107-66-4	1	5	2	10	1	5	

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(NIOSH concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
2-N-Dibutylaminoethanol - Skin	1120	102-81-8	2	14			None		
1,1-Dichloro-1-nitroethane - Skin	1121	594-72-9	2	10			C 10	C 60	
1,3-Dichloro-5,5-dimethyl hydantoin	1122	118-52-5		0.2		0.4		0.2	
1,1-Dichloroethane	1126	75-34-3	200	810	250	1,010	100	400	
Dichloromonofluoromethane	1128	75-43-4	10	40			1,000	4,200	
2,2-Dichloropropionic acid	1130	75-99-0	1	6			None		
Dicrotophos (Bidtin) - Skin	1131	141-66-2		0.25			None		
Dicyclopentadiene	1132	77-73-6	5	30			None		
Diethanolamine	1134	111-42-2	3	15			None		
Diethyl ketone	1135	96-22-0	200	705			None		
Diethyl phthalate	1136	84-66-2		5			None		
Diethylamine	1137	109-89-7	10	30	25	75	25	75	
Diethylene triamine - Skin	1138	111-40-0	1	4			None		
Diisobutyl ketone	1140	108-83-8	25	150			50	290	25 ppm (140 mg/m ³) TWA

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(NIOSH concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV						REL
			TWA		STEL		PEL		
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Dimethyl 1,2-dibromo- 2,2-dichloroethyl phosphate (Naled Dibrom) - Skin	1141	300-76-5		3				3	
Dimethylaniline (N,N-Dimethylaniline)	1143	121-69-7	5	25	10	50	5	25	
Dinitolmide	1144	148-01-6		5			None		
Dioxathion - Skin	1146	78-34-2		0.2			None		
Diphenylamine	1147	122-39-4		10			None		
Dipropyl ketone	1148	123-19-3	50	235			None		
Dipropylene glycol methyl ether	1149	34590-94-8	100	600	150	900	100	600	
Diquat	1150	85-00-7		0.5			None		
Disulfiram	1151	97-77-8		2			None		
Diuron	1153	330-54-1		10			None		
Divinyl benzene	1154	1321-74-0	10	50			None		
Endosulfan - Skin	1156	115-29-7		0.1			None		
Ethanolamine	1159	141-43-5	3	8	6	15	3	6	

Tabulation of NIOSH Reviews of Proposed PELs
 NIOSH Table N1 - Proposed PELs
 (NIOSH concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Ethion (Nialate) - Skin	1160	563-12-2		0.4			None		
Ethyl benzene	1162	100-41-4	100	435	125	545	100	435	
Ethyl mercaptan (1-ethanethiol)	1165	75-08-1	0.5	1			C 10	C 25	0.5 ppm (1.3 mg/m ³) ceiling (15 min) Mixtures of thiols to be controlled by calculation of equivalent concentrations
Ethyl silicate	1166	78-10-4	10	85			100	850	
Ethylene chlorohydrin - Skin	1167	107-07-3	C 1	C 3			5	16	
Ethylene glycol dinitrate - Skin	1170	628-96-6	0.05	0.3			0.2	1	0.1 mg/m ³ ceiling (20 min) recommended limit for either substance alone or mixtures
Ethylidene norbornene	1171	16219-75-3	C 5	C 25			None		
N-Ethylmorpholine - Skin	1172	100-74-3	5	23			20	94	
Fenamiphos - Skin	1173	22224-92-6		0.1			None		
Fensulfothion (Dasanit)	1174	115-90-2		0.1			None		
ferrovanadium dust	1177	12604-58-9		1		3		1	

Tabulation of NIOSH Reviews of Proposed PELs
 NIOSH Table N1 - Proposed PELs
 (NIOSH concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Fluorotrichloromethane (Trichlorofluoromethane)	1180	75-69-4	C 1,000	C 5,600			None		
Fonofos - Skin	1181	944-22-9		0.1			None		
Furfuryl alcohol - Skin	1184	98-00-0	10	40	15	60	50	200	50 ppm (200 mg/m ³) TWA
Germanium tetrahydride	1186	7782-65-2	0.2	0.6			None		
Glutaraldehyde	1187	111-30-8	C 0.2	C 0.7			None		
Glycidol	1189	556-52-5	25	75			50	150	
Grain dust (oats, wheat, barley)	1190			4, Total particulate			None		
Graphite (natural)	1191	7782-42-5		2.5 Respirable dust (NIC 10 Total dust)			2.5 Respirable dust		
Hexachlorocyclopentadiene	1196	77-47-4	0.01	0.1			None		
Hexafluoroacetone - Skin	1198	684-16-2	0.1	0.7			None		
Hexane (n-Hexane)	1200	110-54-3	50	180			500	1,800	
Hexone (Methyl isobutyl ketone)	1203	108-10-1	50	205	75	300	100	410	50 ppm (200 mg/m ³) TWA
Hexylene glycol	1204	107-41-5	C 25	C 125			None		

Tabulation of NIOSH Reviews of Proposed PELs
 NIOSH Table N1 - Proposed PELs
 (NIOSH concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Hydrogen bromide	1206	10035-10-6	C 3	C 10			3	10	
Hydrogen cyanide - Skin	1207	74-90-8	C 10	C 10			10	11	4.7 ppm (5 mg /m ³) ceiling (10 min)
Hydrogen fluoride, as F	1208	7664-39-3	C 3	C 2.5			3		3 ppm (2.5 mg F/m ³) TWA; 6 ppm (5.0 mg F/m ³) ceiling (15 min)
Hydrogenated terphenyls	1210	61788-32-7	0.5	5			None		
2-Hydroxypropyl acrylate	1211	999-61-1	0.5	3			None		
Indene	1212	95-13-6	10	45			None		
Indium & compounds, as in	1213	7440-74-6		0.1			None		
Iodoform	1214	75-47-8	0.6	10			None		
Iron oxide fume as Fe (Fe2O3)	1215	1309-37-1		5				10	
Iron pentacarbonyl as Fe	1216	13463-40-6	0.1	0.8	0.2	1.6	None		
Iron salts, soluble, as Fe	1217			1			None		
Isoamyl alcohol	1218	123-51-3	100	360	125	450	100	360	
Isobutyl alcohol	1219	78-83-1	50	150			100	300	

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 NIOSH Table N1 - Proposed PELs
 (NIOSH concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Isooctyl alcohol - Skin	1220	26952-21-6	50	270			None		
Isophorone	1221	78-59-1	C 5	C 25			25	140	4 ppm (23 mg/m ³) TWA
Isophorone diisocyanate - Skin	1222	4098-71-9 (NIC	0.01 0.005	0.09 0.045)			None		45 µg/m ³ (5 ppb) TWA, 180 µg/m ³ (20 ppb) ceiling (10 min), Diisocyanates
Isopropyl alcohol	1225	67-63-0	400	980	500	1,225	400	980	400 ppm (984 mg/m ³) TWA; 800 ppm (1,968 mg/m ³) ceiling (15 min)
Isopropyl ether	1226	108-20-3	250	1,050	310	1,320	500	2,100	
N-Isopropylaniline - Skin	1229	768-52-5	2	10			None		
Ketene	1231	463-51-4	0.5	0.9	1.5	3	0.5	0.9	
Manganese, as Mn Fume	1236A	7439-96-5		1		3		15	
Manganese cyclopentadienyl tricarbonyl, as Mn - Skin	1237	12079-65-1		0.1			None		
Mercury, as Hg - Skin		7439-97-6							
Aryl & inorganic compounds	1240			0.1			C 0.1		0.05 mg Hg/m ³ , 8-hr TWA
Vapor	1241			0.05			C 0.1		0.05 mg Hg/m ³ , 8-hr TWA
Alkyl compounds	1242			0.01		0.03		0.01 (C 0.04)	

Tabulation of NIOSH Reviews of Proposed PELs
NIOSH Table M1 - Proposed PELs
(NIOSH concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Methacrylic acid	1244	79-41-4	20	70			None		
Methomyl (Lannate)	1245	16752-77-5		2.5			None		
4-Methoxyphenol	1247	150-76-5		5			None		
Methyl 2-cyanoacrylate	1248	137-05-3	2	8	4	16	None		
Methyl acetate	1249	79-20-9	200	610	250	760	200	610	
Methyl acetylene-propadiene mixture (MAPP)	1250		1,000	1,800	1,250	2,250	1,000	1,800	
Methylacrylonitrile - Skin	1251	126-98-7	1	3			None		
Methyl alcohol - Skin	1252	67-56-1	200	260	250	310	200	260	200 ppm (262 mg/m ³) TWA; 800 ppm (1,048 mg/m ³) ceiling (15 min)
Methyl demeton - Skin	1256	8022-00-2		0.5			None		
Methyl ethyl ketone peroxide	1257	1338-23-4	C 0.2	C 1.5			None		
Methyl formate	1258	107-31-3	100	250	150	375	100	250	
Methyl isoamyl ketone	1260	110-12-3	50	240			None		50 ppm (230 mg/m ³) TWA
Methyl isobutyl carbinol - Skin	1261	108-11-2	25	100	40	165	25	100	

Tabulation of NIOSH Reviews of Proposed PELs
 NIOSH Table N1 - Proposed PELs
 (NIOSH concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Methyl isopropyl ketone	1262	563-80-4	200	705			None		
Methyl n-amyl ketone	1264	110-43-0	50	235			100	465	100 ppm (465 mg/m ³) TWA
Methyl parathion - Skin	1265	298-00-0		0.2			None		0.2 mg/m ³ TWA
Methyl silicate	1266	681-84-5	1	6			None		
alpha-Methyl styrene	1267	98-83-9	50	240	100	485	C 100	C 480	
Methylcyclohexane	1268	108-87-2	400	1,600			500	2,000	
Methylcyclohexanol	1269	25639-42-3	50	235			100	470	
o-Methylcyclohexanone - Skin	1270	583-60-8	50	230	75	345	100	460	
2-Methylcyclopentadienyl manganese tricarbonyl, as Mn - Skin	1271	12108-13-3		0.2			None		
Methylene bis(4-cyclo- hexylisocyanate)	1272	5124-30-1	C 0.01 (NIC 0.005)	C 0.11 0.055)			None		55 µg/m ³ TWA 210 µg/m ³ Ceiling (10 min)
Metribuzin	1275	21087-64-9		5			None		
Mica	1276	12001-25-2		3, Respirable dust	3				
Monocrotophos	1279	6923-22-4		0.25			None		

Tabulation of NIOSH Reviews of Proposed PELs
 NIOSH Table N1 - Proposed PELs
 (NIOSH concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				REL		
			TWA		STEL		PEL		
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Monomethylaniline - Skin (N-Methyl aniline)	1280	100-61-8	0.5	2			2	9	
Morpholine - Skin	1281	110-91-8	20	70	30	105	20	70	
Naphthalene	1282	91-20-3	10	50	15	75	10	50	
Nitric acid	1286	7697-37-2	2	5	4	10	2	5	2 ppm (5 mg/m ³) TWA
p-Nitroaniline - Skin	1287	100-01-6	0.05	3			1	6	
Nitrogen dioxide	1289	10102-44-0	3	6	5	10	C 5	C 9	1 ppm (1.8 mg/m ³) ceiling (15 min)
Nitroglycerin (NG) - Skin	1290	55-63-0	0.05	0.5			C 0.2	C 2	0.1 mg/m ³ ceiling (20 min) recommended limit for either substance alone or mixtures
Nitrotoluene - Skin	1292	99-08-1	2	11			5	30	
Nonane	1293	111-84-2	200	1,050			None		
Octachloronaphthalene - Skin	1295	2234-13-1		0.1		0.3		0.1	
Osmium tetroxide, as Os	1298	20816-12-0	0.0002	0.002	0.0006	0.006		0.002	
Oxalic acid	1299	144-62-7		1		2		1	
Oxygen difluoride	1300	7783-41-7	C 0.05	C 0.1			0.05	0.1	

Tabulation of NIOSH Reviews of Proposed PELs
 NIOSH Table N1 - Proposed PELs
 (NIOSH concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Paraffin wax fume	1302	8002-74-2		2			None		
Paraquat, respirable sizes	1303	4685-14-7		0.1				0.5	
Pentaborane	1304	19624-22-7	0.005	0.01	0.015	0.03	0.005	0.01	
Perchloryl fluoride	1309	7616-94-6	3	14	6	28	3	13.5	
Phenothiazine - Skin	1313	92-84-2		5			None		
Phenyl ether (vapor)	1314	101-84-8	1	7	2	14	1	7	
Phenylphosphine	1318	638-21-1	C 0.05	C 0.25			None		
Phorate (Thimet) - Skin	1319	298-02-2		0.05		0.2	None		
Phosdrin - Skin (Mevinphos)	1320	7786-34-7	0.01	0.1	0.03	0.3		0.1	
Phosphine	1321	7803-51-2	0.3	0.4	1	1	0.3	0.4	
Phosphoric acid	1322	7664-38-2		1		3		1	
Phosphorus oxychloride	1323	10025-87-3	0.1	0.6	0.5	3	None		
Phosphorus pentasulfide	1324	1314-80-3		1		3		1	
Phosphorus trichloride	1325	7719-12-2	0.2	1.5	0.5	3	0.5	3	
Phthalic anhydride	1326	85-44-9	1	6			2	12	

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 (NIOSH concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
m-Phthalodinitrile	1327	626-17-5		5			None		
Picric acid - Skin	1329	88-89-1		0.1		0.3		0.1	
Piperazine dihydrochloride	1330	142-64-3		5			None		
Platinum Metal	1332	7440-06-4		1			None		
Potassium hydroxide	1334	1310-58-3		C 2			None		
Propargyl alcohol - Skin	1335	107-19-7	1	2			None		
Propionic acid	1336	79-09-4	10	30	15	45	None		
Propoxur (Baygon)	1337	114-26-1		0.5			None		
n-Propyl acetate	1338	109-60-4	200	840	250	1,050	200	840	
Propyl alcohol - Skin	1339	71-23-8	200	500	250	625	200	500	
n-Propyl nitrate	1340	627-13-4	25	105	40	170	25	105	
Propylene glycol dinitrate - Skin	1342	6423-43-4	0.05	0.3			None		
Propylene glycol monomethyl ether	1343	107-98-2	100	360	150	540	None		

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 (NIOSH concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				REL	
			TWA		STEL		PEL	
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³
Resorcinol	1346	108-46-3	10	45	20	90	None	
Rhodium		7440-16-6						
Metal and Insoluble compounds, as Rh	1347			1			0.1	
Soluble salts, as Rh	1348			0.01			0.001	
Ronnel	1349	299-84-3		10			15	
Silica -- Amorphous*								
Precipitated silica and silica gel	1353			10			6	
Silicon tetrahydride	1361	7803-62-5	5	7			None	
Silver								
Metal, dust and fume	1362	7440-22-4		0.1			0.01	
Soapstone								
Respirable dust	1363			3			None	
Total dust	1363A			6			6	
The value is for total dust containing no asbestos and <1% free silica.								
Sodium azide	1364	26628-22-8	C 0.1	C 0.3			None	
Sodium bisulfite	1365	7631-90-5		5			None	
Sodium fluoroacetate - Skin	1366	62-74-8		0.05		0.15	0.05	

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CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Sodium hydroxide	1367	1310-73-2		C 2			2		2mg/m ³ ceiling (15 min)
Sodium metabisulfite	1368	7681-57-4		5			None		
Stoddard solvent	1371	8052-41-3	100	525			500	2,900	350 mg/m ³ TWA; 1,800 mg/m ³ ceiling (15 min); Blood and urine monitoring required; action level: 350 mg/m ³ TWA
Styrene, monomer	1372	100-42-5	50	215	100	425	100 ppm TWA, 200 ppm Ceiling, 600 ppm Max Ceiling, (5 min in 3 hr)		50 ppm (213 mg/m ³) TWA; 100 ppm (426 mg/m ³) ceiling
Subtilisins (Proteolytic enzymes as 100% pure crystalline enzyme) (k) Based on "high volume" sampling.	1373	1395-21-7			C 0.00006 (k)		None		
Sulfur dioxide	1375	7446-09-5	2	5	5	10	5	13	0.5 ppm (1.3 mg/m ³) TWA
Sulfur monochloride	1376	10025-67-9	C 1	C 6			1	6	
Sulfur pentafluoride	1377	5714-22-7	C 0.01	C 0.1			0.025	0.25	
Sulfur tetrafluoride	1378	7783-60-0	C 0.1	C 0.4			None		
Sulfuryl fluoride	1379	2699-79-8	5	20	10	40	5	20	

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 (NIOSH concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Sulprofos	1380	35400-43-2		1			None		
Talc (containing no asbestos fibers)	1381	14807-96-6		2, Respirable dust			3		
Tantalum	1382	7440-25-7		5 (NIC 10 no asbestos and <1% crystalline silica)		10		5	
Terphenyls	1384	26140-60-3	C 0.5	C 5			C 1	C 9	
Tetraethyl lead, as Pb - Skin	1386	78-00-2		0.1				0.075	
Tetrahydrofuran	1387	109-99-9	200	590	250	735	200	590	
Tetramethyl lead, as Pb - Skin	1388	75-74-1		0.15				0.075	
Tetrasodium pyrophosphate	1389	7722-88-5		5			None		
Thioglycolic acid - Skin	1392	68-11-1	1	4			None		
Thionyl chloride	1393	7719-09-7	C 1	C 5			None		
Tin		7440-31-5							
Organic compounds, as Sn except SnH4, as Sn - Skin	1394			0.1				0.1	0.1 mg Sn/m ³ TWA
Metal, Oxide & inorganic compounds, as Sn	1395			2				2	

Tabulation of NIOSH Reviews of Proposed PELs
 NIOSH Table N1 - Proposed PELs
 (NIOSH concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Toluene (toluol)	1397	108-88-3	100	375	150	560	200 ppm TWA, 300 ppm Ceiling, 500 ppm Max Ceiling (10 min)		100 ppm (375 mg/m ³), 8-hr TWA; 200 ppm (750 mg/m ³) ceiling (10 min)
Tributyl phosphate	1402	126-73-8	0.2	2.5				5	
1,1,2-Trichloro-1,2,2- trifluoroethane	1403	76-13-1	1,000	7,600	1,250	9,500	1,000	7,600	
Trichloroacetic acid	1404	76-03-9	1	7			None		
1,2,4-Trichlorobenzene	1405	120-82-1	C 5	C 40			None		
Trimellitic anhydride	1409	552-30-7	0.005	0.04			None		Should be handled in the workplace as an extremely toxic substance
Trimethyl phosphite	1410	121-45-9	2	10			None		
Trimethylamine	1411	75-50-3	10	24	15	36	None		
Trimethyl benzene	1412	25551-13-7	25	125			None		
2,4,6-Trinitrotoluene (TNT) - Skin	1413	118-96-7		0.5				1.5	
Triorthocresyl phosphate - Skin	1414	78-30-8		0.1				0.1	
Triphenyl amine	1415	603-34-9		5			None		

Tabulation of NIOSH Reviews of Proposed PELs
 NIOSH Table M1 - Proposed PELs
 (NIOSH concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL		ppm	mg/m ³	
			ppm	mg/m ³	ppm	mg/m ³			
Tungsten, as W		7440-33-7							
Insoluble compounds	1416			5		10	None		5 mg W/m ³ TWA;
Soluble compounds	1417			1		3	None		1 mg W/m ³ TWA;
n-Valeraldehyde	1420	110-62-3	50	175			None		
Vinyl toluene	1427	25013-15-4	50	240	100	485	100	480	
VM & P Naphtha	1429	8030-30-6	300	1,350			None		350 mg/m ³ TWA 1,800 mg/m ³ ceiling (15 min) Blood and urine monitoring required; action level: 200 mg/m ³ TWA
Xylene (o-, m-, p-isomers)	1431	1330-20-7	100	435	150	655	100	435	100 ppm (434 mg/m ³) TWA; 200 ppm (868 mg/m ³) ceiling (10 min)
m-Xylene alpha, alpha'- diamine - Skin	1432	1477-55-0		C 0.1			None		
Xylidine - Skin	1433	1300-73-8	2	10			5	25	
Zinc chloride fume	1435	7646-86-7		1		2		1	
Zinc oxide fume	1437	1314-13-2		5		10		5	5 mg/m ³ TWA; 15 mg/m ³ ceiling (15 min)

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Tabulation of NIOSH Reviews of Proposed PELs
NIOSH Table N2 - Proposed PELs
(NIOSH non-concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL		ppm	mg/m ³	
			ppm	mg/m ³	ppm	mg/m ³			
Acrylic acid	1009	79-10-7	10 (NIC 2	30 6)			None		
n-Butyl glycidyl ether (BGE)	1052	2426-08-6	25	135			50	270	4.4 ppm (30 mg/m ³) ceiling (15 min)
Camphor, synthetic	1063	76-22-2	2	12	3	18	0.3	2	
Caprolactam Vapor	1065	105-60-2	5 (NIC 0.25	20 1)	10	40	None		
Coal dust <5% quartz	1096			2, Respirable fraction				2.4	
>5% quartz	1097			0.1 Respirable quartz				10÷(%SiO ₂ +2)	
Disulfoton	1152	298-04-4		0.1			None		
Ethyl bromide	1163	74-96-4	200	890	250	1,110	200	890	
Ethyl ether	1164	60-29-7	400	1,200	500	1,500	400	1,200	
Ethylene glycol vapor	1169	107-21-1	C 50	C 125			None		
Fenthion - Skin	1175	55-38-9		0.2			None		
Fluorine	1179	7782-41-4	1	2	2	4	0.1	0.2	

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Tabulation of NIOSH Reviews of Proposed PELs
 NIOSH Table M2 - Proposed PELs
 (NIOSH non-concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Formamide (NIC - skin)	1182	75-12-7 (NIC	20 10	30 15)	30	45	None		
Furfural - Skin	1183	98-01-1	2	8			5	20	
Heptane (n-Heptane)	1194	142-82-5	400	1,600	500	2,000	500	2,000	85 ppm (350 mg/m ³) TWA; (Mixtures not to exceed 350 mg/m ³ TWA); 440 ppm (1,800 mg/m ³) ceiling (15 min) singly or mixtures; Action level set at 200 mg/m ³ for C5-C8 alkanes
Hexane isomers	1201		500	1,800	1,000	3,600			100 ppm (350 mg/m ³) TWA; (Mixtures not to exceed 350 mg/m ³ TWA); 510 ppm (1,800 mg/m ³) ceiling (15 min) singly or mixtures; Action level set at 200 mg/m ³ for C5-C8 alkanes
2-Hexanone (Methyl n-butyl ketone)	1202	591-78-6	5	20			100	410	1 ppm (4 mg/m ³) TWA
Isopropoxyethanol	1223	109-59-1	25	105			None		
Isopropyl acetate	1224	108-21-4	250	950	310	1,185	250	950	

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Tabulation of NIOSH Reviews of Proposed PELs
 NIOSH Table N2 - Proposed PELs
 (NIOSH non-concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Isopropylamine	1228	75-31-0	5	12	10	24	5	12	
Manganese tetroxide	1238	1317-35-7		1			None		
Mesityl oxide	1243	141-79-7	15	60	25	100	25	100	10 ppm (40 mg/m ³) TWA
Octane	1296	111-65-9	300	1,450	375	1,800	500	2,350	75 ppm (350 mg/m ³) TWA; (Mixtures not to exceed 350 mg/m ³ TWA); 385 ppm (1,800 mg/m ³) ceiling (15 min) singly or mixtures; Action level set at 200 mg/m ³ for C5-C8 alkanes
Ozone	1301	10028-15-6 (NIC C 0.1)	0.1 C 0.1	0.2 C 0.2	0.3	0.6	0.1	0.2	
Pentane	1306	109-66-0	600	1,800	750	2,250	1,000	2,950	120 ppm (350 mg/m ³) TWA; (Mixtures not to exceed 350 mg/m ³ TWA); 610 ppm (1,800 mg/m ³) ceiling (15 min) singly or mixtures; Action level set at 200 mg/m ³ for C5-C8 alkanes
2-Pentanone (Methyl propyl ketone)	1307	107-87-9	200	700	250	875	200	700	150 ppm (530 mg/m ³) TWA

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Tabulation of NIOSH Reviews of Proposed PELs
 NIOSH Table N2 - Proposed PELs
 (NIOSH non-concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Silica -- Amorphous* Diatomaceous earth (uncalcined)	1352	68855-54-9		10				6	
m-Toluidine - Skin	1401	108-44-1	2	9			None		
Triethylamine	1408	121-44-8	10	40	15	60	25	100	
Vinyl acetate	1424	108-05-4	10	30	20	60	None		4 ppm (15 mg/m ³) ceiling (15 min)
Zirconium compounds, as Zr	1439	7440-67-2		5		10		5	

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Tabulation of NIOSH Reviews of Proposed PELs
NIOSH Table N3A - Established PELs Not Addressed in Current Rulemaking
(NIOSH concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
2-Aminopyridine		504-29-0	0.5	2			0.5	2	
n-Amyl acetate		628-63-7	100	530			100	525	
sec-Amyl acetate		626-38-0	125	665			125	650	
Antimony & compounds, as Sb		7440-36-0		0.5				0.5	0.5 mg Sb/m ³ TWA
Antimony trioxide Handling and use, as Sb		1309-64-4		0.5			None		0.5 mg Sb/m ³ TWA
ANTU		86-88-4		0.3				0.3	
Azinphos-methyl - Skin		86-50-0		0.2				0.2	
Barium, soluble compounds, as Ba		7440-39-3		0.5				0.5	
Benzoyl peroxide		94-36-0		5				5	5 mg/m ³ TWA
Biphenyl		92-52-4	0.2	1.5			0.2	1.5	
Boron trifluoride		7637-07-2	C 1	C 3			C 1	C 3	No exposure limit recommended due to the absence of a reliable monitoring method
Bromoform - Skin		75-25-2	0.5	5			0.5	5	
sec-Butyl acetate		105-46-4	200	950			200	950	

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Tabulation of NIOSH Reviews of Proposed PELs
 NIOSH Table N3A - Established PELs Not Addressed in Current Rulemaking
 (NIOSH concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
tert-Butyl acetate		540-88-5	200	950			200	950	
Butylamine - Skin		109-73-9	C 5	C 15			C 5	C 15	
Carbaryl		63-25-2		5				5	5 mg/m ³ TWA reproductive effects; minimum exposure during pregnancy
Chlorinated diphenyl oxide		55720-99-5		0.5		2		0.5	
Chlorine trifluoride		7790-91-2	C 0.1	C 0.4			C 0.1	C 0.4	
Chloroacetaldehyde		107-20-0	C 1	C 3			C 1	C 3	
alpha-Chloroacetophenone		532-27-4	0.05	0.3			0.05	0.3	
Chlorobromomethane		74-97-5	200	1,050	250	1,300	200	1,050	
Chloropicrin		76-06-2	0.1	0.7	0.3	2	0.1	0.7	
Chromium (II) compounds, Cr (Soluble)				0.5				0.5	
Chromium (III) compounds, Cr (Soluble)				0.5				0.5	
Copper Dusts & mists, as Cu		7440-50-8		1				1	
Crutonaldehyde		4170-30-3	2		7		2		

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Tabulation of NIOSH Reviews of Proposed PELs
NIOSH Table N3A - Established PELs Not Addressed in Current Rulemaking
(NIOSH concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Cumene - Skin		98-82-8	50	245			50	245	
Cyclohexane		110-82-7	300	1,050			300	1,050	
Cyclohexene		110-83-8	300	1,015			300	1,015	
Cyclopentadiene		542-92-7	75	200			75	200	
2,4-D		94-75-7		10				10	
Demeton - Skin		8065-48-3	0.01	0.1				0.1	
Diacetone alcohol		123-42-2	50	240			50	240	50 ppm (240 mg/m ³) TWA
Diazomethane		334-88-3	0.2	0.4			0.1	0.4	
Diborane		19287-45-7	0.1	0.1			0.1	0.1	
Dibutyl phthalate		84-74-2		5				5	
o-Dichlorobenzene		95-50-1	C 50	300			C 50	C 300	
Dichlorodifluoromethane		75-71-8	1,000	4,950			1,000	4,950	
1,2-Dichloroethylene		540-59-0	200	790			200	790	
Dichlorotetrafluoroethane		76-14-2	1,000	7,000			1,000	7,000	
Dichlorvos - Skin		62-73-7	0.1	1				1	

Tabulation of NIOSH Reviews of Proposed PELs
 OSH Table N3A - Established PELs Not Addressed in Current Rulemaking
 (NIOSH concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV							
			TWA		STEL		PEL		REL	
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³		
2-Diethylaminoethanol - Skin		100-37-8	10	50			10	50		
Difluorodibromomethane		75-61-6	100	860			100	860		
Diisopropylamine - Skin		108-18-9	5	20			5	20		
Dimethyl acetamide - Skin		127-19-5	10	35			10	35		
Dimethylamine		124-40-3	10	18			10	18		
Dimethylformamide - Skin		68-12-2	10	30			10	30		
Dimethylphthalate		131-11-3		5				5		
Dinitro-o-cresol - Skin		534-52-1		0.2				0.2		0.2 mg/m ³ TWA
Dinitrobenzene (all isomers) - Skin		528-29-0; 99-65-0; 100-25-4; 25154-54-5	0.15	1				1		
Endrin - Skin		72-20-8		0.1				0.1		
EPN - Skin		2104-64-5		0.5				0.5		
Ethyl acetate		141-78-6	400	1,400			400	1,400		
Ethyl alcohol		64-17-5	1,000	1,900			1,000	1,900		
Ethyl amyl ketone		541-85-5	25	130			25	130		

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Tabulation of NIOSH Reviews of Proposed PELs
NIOSH Table N3A - Established PELs Not Addressed in Current Rulemaking
(NIOSH concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Ethylamine		75-04-7	10	18			10	18	
Ethyl butyl ketone		106-35-4	50	230			50	230	
Ethylenediamine		107-15-3	10	25			10	25	
Ethyl formate		109-94-4	100	300			100	300	
Fluorides, as F				2.5				2.5	2.5 mg F/m ³ TWA
Formic acid		64-18-6	5	9			5	9	
Hafnium		7440-58-6		0.5				0.5	
Hexachloronaphthalene		1335-87-1		0.2				0.2	
sec-Hexyl acetate		108-84-9	50	300			50	300	
Hydrogen chloride		7647-01-0	C 5	C 7			C 5	C 7	
Hydrogen peroxide		7722-84-1	1	1.5			1	1.4	
Hydrogen selenide, as Se		7783-07-5	0.05	0.2			0.05	0.2	
Iodine		7553-56-2	C 0.1	C 1			C 0.1	C 1	
Isoamyl acetate		123-92-2	100	525			100	525	
Isobutyl acetate		110-19-0	150	700	187	875	100	750	

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Tabulation of NIOSH Reviews of Proposed PELs
 NIOSH Table N3A - Established PELs Not Addressed in Current Rulemaking
 (NIOSH concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Lindane - Skin		58-89-9		0.5				0.5	
Lithium hydride		7580-67-8		0.025				0.025	
L.P.G. (liq. petr. gas)		68476-85-7	1,000	1,800			1,000	1,800	
Maleic anhydride		108-31-6	0.25	1			0.25	1	
Methyl acetylene		74-99-7	1,000	1,650	1,250	2,040	1,000	1,650	
Methyl acrylate - Skin		96-33-3	10	35			10	35	
Methylal		109-87-5	1,000	3,100			1,000	3,100	
Methylamine		74-89-5		12			10	12	
Methylene bis(phenyl isocyanate (Diphenylmethane diisocyanate; MDI)		101-68-8	C 0.02	C 0.2			0.02	0.2	50 µg/m ³ (5 ppb) TWA, 200 µg/m ³ (20 ppb) ceiling (10 min).
Methyl isocyanate - Skin		624-83-9	0.02	0.05			0.02	0.05	
Methyl methacrylate		80-62-6	100	410			100	410	
Nickel Metal		7440-02-0		1				1	
Nicotine - Skin		54-11-5		0.5				0.5	
Nitric oxide		10102-43-9	25	30			25	30	25 ppm (30 mg/m ³) TWA

Tabulation of NIOSH Reviews of Proposed PELs
 NIOSH Table N3A - Established PELs Not Addressed in Current Rulemaking
 (NIOSH concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Nitrobenzene - Skin		98-95-3	1	5			1	5	
Nitroethane		79-24-3	100	310			100	310	
Nitrogen trifluoride		7783-54-2	10	30			10	29	
1-Nitropropane		108-03-2	25	90			25	90	
Pentachloronaphthalene		1321-64-8		0.5				0.5	
Pentachlorophenol - Skin		87-86-5		0.5				0.5	
Perchloromethyl mercaptan		594-42-3	0.1	0.8			0.1	0.8	
p-Phenylene diamine - Skin		106-50-3		0.1				0.1	
Phosphorus (yellow)		7723-14-0		0.1				0.1	
Phosphorus pentachloride		10026-13-8	0.1	1				1	
Pindone		83-26-1		0.1			None		
Platinum Soluble salts, as Pt		7440-06-4		0.002				0.002	
Propane		74-98-6	E (Single asphyxiant)				1,000	1,800	
Pyrethrum		8003-34-7		5				5	
Pyridine		110-86-1	5	15			5	15	

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Tabulation of NIOSH Reviews of Proposed PELs
 NIOSH Table N3A - Established PELs Not Addressed in Current Rulemaking
 (NIOSH concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				REL		
			TWA		STEL		PEL		
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Quinone		106-51-4	0.1	0.4			0.1	0.4	
Rotenone (commercial)		83-79-4		5				5	
Selenium compounds, as Se		7782-49-2		0.2				0.2	
Selenium hexafluoride, Se		7783-79-1	0.05	0.2			0.05	0.4	
Silver Soluble compounds, as Ag		7440-22-4		0.01				0.01	
Stibine		7803-52-3	0.1	0.5			0.1	0.5	
Strychnine		57-24-9		0.15				0.15	
Sulfotep - Skin		3689-24-5		0.2				0.2	
Sulfur hexafluoride		2551-62-4	1,000	6,000			1,000	6,000	
Sulfuric acid		7664-93-9		1				1	1 mg/m ³ TWA
2,4,5-T		93-76-5		10				10	
Tellurium & compounds, Te		13494-80-9		0.1				0.1	
Tellurium hexafluoride, Te		7783-80-4	0.02	0.2			0.02	0.2	
IEPP - Skin		107-49-3	0.004	0.05				0.05	
1,1,1,2-Tetrachloro-2,2- difluoroethane		76-11-9	500	4,170			500	4,170	

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Tabulation of NIOSH Reviews of Proposed PELs
NIOSH Table N3A - Established PELs Not Addressed in Current Rulemaking
(NIOSH concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
1,1,2,2-Tetrachloro-1,2-difluoroethane		76-12-0	500	4,170			500	4,170	
Tetrachloronaphthalene		1335-88-2		2				2	
Tetramethyl succinonitrile		3333-52-6	0.5	3			0.5	3	1 ppm (6 mg/m ³) ceiling (15 min); When present as mixtures or with other sources of cyanide, exposure to be considered additive and environmental limit to be calculated
Tetranitromethane		509-14-8	1	8			1	8	
Tetryl - Skin		479-45-8		1.5				1.5	
Thallium Soluble compounds, as Tl		7440-28-0		0.1				0.1	
Thiram		137-26-8		5				5	
Trichloronaphthalene		1321-65-9		5				5	
Trifluorobromomethane		75-63-8	1,000	6,100			1,000	6,100	
Triphenyl phosphate		115-86-6		3				3	
Turpentine		8006-64-2	100	560			100	560	

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Tabulation of NIOSH Reviews of Proposed PELs
 OSH Table N3A - Established PELs Not Addressed in Current Rulemaking
 (NIOSH concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV						REL
			TWA		STEL		PEL		
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Warfarin		81-81-2		0.1				0.1	
Yttrium		7440-65-5		1		3		1	

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Tabulation of NIOSH Reviews of Proposed PELs
 NIOSH Table N3B - Established PELs Not Addressed in Current Rulemaking
 (NIOSH non-concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Acetylene tetrabromide		79-27-6	1	15			1	15	
Chlorobenzene		108-90-7	75	350			75	350	
Chromium (II) compounds, Cr (Insoluble)				0.5				1.0	
Chromium (III) compounds, Cr (Insoluble)				0.5				1.0	
Cresol, all isomers - Skin		1319-77-3	5	22			5	22	2.3 ppm (10 mg/m ³) TWA
Manganese dust & compounds		7439-96-5		C5 (NIC 5)				C5	
Molybdenum, as Mo Soluble compounds		7439-98-7		5				5	
Nitromethane		75-52-5	100	250			100	250	
Parathion - Skin		56-38-2		0.1				0.1	0.05 mg/m ³ TWA

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Tabulation of NIOSH Reviews of Proposed PELs
NIOSH Table N4 - Nuisance Dusts

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL	PROPOSED TABLE NUMBER**
			TWA		STEL					
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³		
alpha-Alumina*	1014	1344-28-1		10				15		N2
Aluminum Metal & oxide	1016	7429-90-5		10				15		***
Ammonium sulfamate	1024	7773-06-0		10				15		N1
Barium sulfate*	1031	7724-43-7		10				15		***
Benomyl	1032	17804-35-2		10				15		N2
Bismuth telluride (undoped)	1035	1304-82-1		10				15		***
Boron oxide	1039	1303-86-2		10				15		N1
Calcium carbonate*	1057	1317-65-3		10				15		***
Calcium silicate*	1061	1344-95-2		10				15		***
Calcium sulfate*	1062	7778-18-9		10				15		***
Cellulose (paper fiber)*	1076	9004-34-6		10				15		***
2-Chloro-6-trichloromethyl pyridine (Nitrpyrin)	1082	1929-82-4		10		20		15		N1

*The value is for total dust containing no asbestos and <1% free silica

**The proposed table number that NIOSH has assigned based on an evaluation of the health effects

***NIOSH has not evaluated these chemicals in-depth

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Tabulation of NIOSH Reviews of Proposed PELs
NIOSH Table N4 - Nuisance Dusts

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				REL	PROPOSED TABLE NUMBER**		
			TWA		STEL				PEL	
			ppm	mg/m ³	ppm	mg/m ³			ppm	mg/m ³
Clopidol	1095	2971-90-6		10		20		15		N1
Crag Herbicide (Sesone)	1102	136-78-7		10				15		N1
Dicyclopentadienyl iron	1133	102-54-5		10				15		N1
Emery*	1155	112-62-9		10				15		N2
Ferbam	1176	14484-64-1		10				15		N1
Fibrous glass dust	1178			10				Nuisance dust PEL applies, 15 mg/m ³ total dust; 5 mg/m ³ respirable fraction	3 million fibers/ m ³ TWA (fibers ≤3.5 μm diameter and ≥10 μm length); 5 mg/m ³ TWA (total fibrous glass)	N6B
Glycerin (mist)*	1188	56-81-5		10				15		N2
Graphite (synthetic)*	1191A			10				15		N2
Gyp.	1192	see HS #1062								***
Kaolin*	1230			10				15		***
Limestone*	1232	see HS #1057								***
Magnesite*	1233	546-93-0		10				15		***

*The value is for total dust containing no asbestos and <1% free silica

**The proposed table number that NIOSH has assigned based on an evaluation of the health effects

***NIOSH has not evaluated these chemicals in-depth

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Tabulation of NIOSH Reviews of Proposed PELs
NIOSH Table M4 - Nuisance Dusts

CHEMICAL NAME	HS NUMBER	CAS NUMBER	11V				PEL	REL	PROPOSED TABLE NUMBER*
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³			
Magnesium oxide fume	1234	1309-48-4		10			15		N2
Malathion - Skin	1235	121-75-5		10			15	15 mg/m ³ TWA	N1
Marble*	1239	see HS #1057							***
Methoxychlor	1246	72-43-5		10			15		N6A
Mineral wool fiber*	1277			10			15		N6B
Molybdenum, as Mo Insoluble compounds	1278	7439-98-7		10			15		N2
Nuisance particulates*	1294			10			15		†
Oil mist, mineral (excluding vapor)	1297	8012-95-1		5		10	5		N1
Pentaerythritol*	1305	115-77-5		10			15		***
Perlite*	1310			10					***
Picloram (Tordon)	1328	1918-02-1		10		20	15		N2
Plaster of Paris*	1331	see HS #1062							***

*The value is for total dust containing no asbestos and <1% free silica

**The proposed table number that NIOSH has assigned based on an evaluation of the health effects

***NIOSH has not evaluated these chemicals in-depth

†See testimony

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Tabulation of NIOSH Reviews of Proposed PELs
NIOSH Table M4 - Nuisance Dusts

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL	PROPOSED TABLE NUMBER*
			TWA		STEL					
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³		
Portland cement*	1333	65997-15-1		10				15		***
Rouge*	1351			10				15		N2
Silicon*	1359	7440-21-3		10				15		***
Silicon dioxide*	1360	409-21-2		10				15		***
Starch*	1369	9005-25-8		10				15		***
Sucrose*	1374	57-50-1		10				15		N1
Temephos (abate)	1383	3383-96-8		10				15		N1
4,4'-methyl- butyl-m-cresol)	1391	96-69-5		10				15		N1
Titanium dioxide*	1396	13463-67-7		10				15		M6B
Vegetable oil mists* (except castor oil, cashew nut, or similar irritant oils)	1423			10				15		N1
Zinc stearate*	1434	557-05-1		10				15		N1
Zinc oxide dust*	1438	1314-13-2		10				5	5 mg ZnO/m ³ TWA; 15 mg ZnO/m ³ ceiling (15 min)	N2

*The value is for total dust containing no asbestos and <1% free silica

**The proposed table number that NIOSH has assigned based on an evaluation of the health effects

***NIOSH has not evaluated these chemicals in-depth

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Tabulation of NIOSH Reviews of Proposed PELs
NIOSH Table N5 - NIOSH RELs not Included in OSHA Rulemaking

CHEMICAL NAME	HS NUMBER	CAS NUMBER	ILV				PEL		PEL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Acetone cyanohydrin		75-86-5	None				None		1 ppm (4 mg/m ³) ceiling (15 min), Nitriles
Acetylene		74-86-2	E (simple asphyxiant)				None		No exposure >2,500 ppm (2,662 mg/m ³)
Adiponitrile		111-69-3	None				None		4 ppm (18 mg/m ³) TWA Nitriles
n-Butyronitrile		109-74-0	None				None		8 ppm (22 mg/m ³) TWA Nitriles
Cetylmercaptan		2917-26-2	None				None		1-Hexadecanethiol: 0.5 ppm (5.3 mg/m ³) Ceiling (15 min)
Cyclohexylmercaptan		1569-69-3	None				None		Cyclohexanethiol: 0.5 ppm (2.4 mg/m ³) Ceiling (15 min)
Decylmercaptan		143-10-2	None				None		1-Decanethiol: 0.5 ppm (3.6 mg/m ³) Ceiling (15 min)
2,4-Diaminoanisole		615-05-4	None				None		Ca; reduce exposure to lowest feasible level
o-Dianisidine - based dyes		various	None				None		Ca; should be handled in the workplace with caution; exposure should be minimized

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Tabulation of NIOSH Reviews of Proposed PELs
NIOSH Table N5 - NIOSH RELs not Included in OSHA Rulemaking

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
bis(2-Dimethylamino-ethyl)ether		3033-62-3	None				None		Exposure be minimized to NIAX Catalyst ESN
Dimethylaminopropionitrile		1738-25-6	None				None		Exposure be minimized to NIAX Catalyst ESN
Dodecylmercaptan		112-55-0	None				None		1-Dodecanethiol: 0.5 ppm (4.1 mg/m ³) Ceiling (15 min)
Enflurane		13838-16-9	None				None		2 ppm (15.1 mg/m ³) Ceiling (1 hr) Waste Anesthetic Gases
Ethylene thiourea		96-45-7	None				None		Ca; should be used in encapsulated form in industry; worker exposure be minimized
Fluorene		406-90-6	None				None		2 ppm (10.3 mg/m ³) Ceiling (1 hr)
Glycolonitrile		107-16-4	None				None		2 ppm (5 mg/m ³) Ceiling (15 min), Nitriles
Halothane		151-67-7	None				None		2 ppm (16.2 mg/m ³) Ceiling (1 hr)
n-Heptylmercaptan		1639-09-4	None				None		1-Heptanethiol: 0.5 ppm (2.7 mg/m ³) Ceiling (15 min)

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Tabulation of NIOSH Reviews of Proposed PELs
NIOSH Table N5 - NIOSH RELs not Included in OSHA Rulemaking

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV						
			TWA		STEL		PEL		REL
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Hexamethylene diisocyanate (HDI)		822-06-0	None				None		35 µg/m ³ TWA, 140 µg/m ³ Ceiling (10 min), Diisocyanate
n-Hexylmercaptan		111-31-9	None				None		1-Hexanethiol: 0.5 ppm (2.4 mg/m ³) Ceiling (15 min)
Isobutyronitrile		78-82-0	None				None		8 ppm (22 mg/m ³) TWA; Nitriles
Kepone		143-50-0	None				None		Ca; 1 µg/m ³ TWA
Kerosene		8008-20-6	None				None		100 mg/m ³ TWA Refined Petroleum Solvents
Malononitrile		109-77-3	None				None		3 ppm (8 mg/m ³) TWA Nitriles
Methoxyflurane		76-38-0	None				None		2 ppm; (13.5 mg/m ³) Ceiling (1 hr)
Naphthalene diisocyanate (NDI)		25551-28-4	None				None		40 µg/m ³ TWA, 170 µg/m ³ Ceiling, (10 min) Diisocyanate
2-Nitro-naphthalene		581-89-5	None				None		Ca; reduce exposure to lowest feasible level

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Tabulation of NIOSH Reviews of Proposed PELs
NIOSH Table N5 - NIOSH RELs not Included in OSHA Rulemaking

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Nitrous oxide		10024-97-2	None				None		25 ppm TWA
n-Nonylmercaptan		1455-21-6	None				None		1-Nonanethiol: 0.5 ppm (3.3 mg/m ³) Ceiling (15 min)
Octadecylmercaptan		2885-00-9	None				None		1-Octadecanethiol: 0.5 ppm (5.9 mg/m ³) Ceiling (15 min)
n-Octylmercaptan		111-88-6	None				None		1-Octanethiol: 0.5 ppm (3.0 mg/m ³) Ceiling (15 min)
Pentachloroethane		76-01-70	None				None		To be handled with caution in the workplace due to similarity to carcinogenic chloroethanes
Pentylmercaptan		110-66-7	None				None		1-Pentanethiol: 0.5 ppm (2.1 mg/m ³) Ceiling (15 min)
Propionitrile		107-12-0	None				None		6 ppm (14 mg/m ³) TWA Nitriles
n-Propylmercaptan		107-03-9	None				None		1-Propanethiol: 0.5 ppm (1.6 mg/m ³) Ceiling (15 min)

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Tabulation of NIOSH Reviews of Proposed PELs
NIOSH Table N5 - NIOSH RELs not Included in OSHA Rulemaking

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Succinonitrile		110-61-2	None				None		6 ppm (20 mg/m ³) TWA Nitriles
2,3,7,8-Tetrachlorodibenzo- p-dioxin (TCDD)		1746-01-6	None				None		Ca; reduce exposure to lowest feasible level
1,1,1,2-Tetrachloroethane		630-20-6	None				None		To be handled in the workplace with caution due to similarity to carcinogenic Chloroethane
o-Tolidine based dyes		various	None				None		Ca; should be handled in the workplace with caution; minimize exposures
1-Undecanethiol		5332-52-5	None				None		Undecanethiol: 0.5 ppm (3.9 mg/m ³) Ceiling (15 min)
Vinyl fluoride		75-02-5	None				None		1 ppm TWA, 5 ppm Ceiling to be controlled as specified for vinyl chloride in 29 CFR 1910.1017
Vinylidene fluoride		75-38-7	None				None		1 ppm TWA 5 ppm Ceiling (15 min) to be controlled as specified for vinyl chloride in 29 CFR 1910.1017

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Tabulation of NIOSH Reviews of Proposed PELs
NIOSH Table N6A - Proposed PELs That Meet the OSHA Definition of "Potential Occupational Carcinogen"
(NIOSH concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Acrylamide - Skin	1008	79-06-1		0.03,A2			0.3		0.3 mg/m ³ TWA
Amitrole (3-Amino-1,2,4-triazole)	1020	61-82-5		0.2			None		
Aniline & homologues - Skin	1025	62-53-3	2	10			5	19	
Captafol - Skin	1066	2425-06-1		0.1			None		
Captan	1067	133-06-2		5			None		
Carbon tetrachloride - Skin	1073	56-23-5	5,A2	30,A2			10 ppm TWA, 25 ppm Ceiling, 200 ppm Max Ceiling		2 ppm (12.6 mg/m ³) ceiling 45 liter sample (60 min)
Chloroform	1086	67-66-3	10,A2	50,A2			C 50	C 240	2 ppm (9.78 mg/m ³) ceiling 45 liter sample (60 min)
Di-sec-octyl phthalate	1116	117-81-7		5		10		5	Reduce exposure to lowest feasible level
Dichloroacetylene	1123	7572-29-4	C 0.1	C 0.4			None		
Dichloroethyl ether - Skin	1127	111-44-4	5	30	10	60	C 15	C 90	
Dichloropropene -Skin	1129	542-75-6	1	5			None		

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Tabulation of NIOSH Reviews of Proposed PELs
 NIOSH Table NoA - Proposed PELs That Meet the OSHA Definition of "Potential Occupational Carcinogen"
 (NIOSH concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL		ppm	mg/m ³	
			ppm	mg/m ³	ppm	mg/m ³			
Diglycidyl ether (DGE)	1139	2238-07-5	0.1	0.5			C 0.5	C 2.8	0.2 ppm (1 mg/m ³) ceiling (15 min)
Dimethyl sulfate - Skin	1142	77-78-1	0.1,A2	0.5,A2			1	5	
Dioxane - Skin	1145	123-91-1	25	90			100	360	1 ppm (3.6 mg/m ³) ceiling (30 min)
Ethylene dichloride	1168	107-06-2	10	40			50 ppm TWA, 100 ppm Ceiling, 200 ppm Max Ceiling (5 min in 3 hr)		1 ppm (4 mg/m ³) TWA; 2 ppm (8 mg/m ³) ceiling (15 min)
Hexachlorobutadiene -Skin	1195	87-68-3	0.02,A2	0.24,A2			None		
Hexachloroethane - Skin	1197	67-72-1	10	100			1	10	Reduce exposure to lowest feasible level
		(NIC	1	10)					
Methyl iodide - Skin	1259	74-88-4	2,A2	10,A2			5	28	Exposure to methyl iodide should be reduced to the lowest feasible level

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Tabulation of NIOSH Reviews of Proposed PELs
 NIOSH Table N6A - Proposed PELs That Meet the OSHA Definition of "Potential Occupational Carcinogen"
 (NIOSH concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Nickel carbonyl, as Ni	1284	13463-39-3	0.05	0.35			0.001	0.007	1 ppb (7 µg/m ³) TWA (lowest detectable level)
Silica -- Crystalline Cristobalite	1354	14464-46-1		0.05, Respirable dust			5÷(%SiO ₂ +2) Respirable dust		50 µg/m ³ TWA, respirable free silica
Tridymite	1356	15468-32-3		0.05, Respirable dust			5÷(%SiO ₂ +2) Respirable dust		
1,1,2,2-Tetrachloroethane - Skin	1385	79-34-5	1	7			5	35	Reduce exposure to lowest feasible level
Toluene-2,4-diisocyanate (TDI)	1398	584-84-9	0.005	0.04	0.02	0.15	0.02	0.14	Toluene diisocyanate (TDI): 35 µg/m ³ (5 ppb) TWA, 140 µg/m ³ (20 ppb) ceiling (10 min)
o-Toluidine - Skin	1399	95-53-4	2,A2	9,A2			5	22	
Trichloroethylene	1406	79-01-6	50	270	200	1,080	100 ppm TWA, 200 ppm Ceiling, 300 ppm Max Ceiling, (5 min in 2 hr)		25 ppm TWA
1,2,3-Trichloropropane - Skin	1407	96-18-4	10,A2	60,A2			50	300	

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Tabulation of NIOSH Reviews of Proposed PELs
 NIOSH Table N6A - Proposed PELs That Meet the OSHA Definition of "Potential Occupational Carcinogen"
 (NIOSH concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Uranium		7440-61-1							
Insoluble compounds, as U	1418			0.2		0.6		0.25	
Soluble compounds, as U	1419			0.2		0.6		0.05	
Vinyl cyclohexene dioxide - Skin	1426	106-87-6	10,A2	60,A2			None		
Wood Dust, hardwood	1430a			1			None		

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Tabulation of NIOSH Reviews of Proposed PELs
 NIOSH Table N6A - Proposed PELs That Meet the OSHA Definition of "Potential Occupational Carcinogen"
 (NIOSH concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Aldrin - Skin		309-00-2		0.25			0.25		Lowest reliably detectable level
Anisidine (o-, p-isomers) - Skin		29191-52-4	0.1	0.5			0.5		
Chlordane - Skin		57-74-9		0.5		2	0.5		
Dieldrin - Skin		60-57-1		0.25			0.25		Lowest reliable detectable level
Dinitrotoluene - Skin		121-14-2		1.5			1.5		Reduce exposure to lowest feasible level
Heptachlor - Skin		76-44-8		0.5			0.5		
Hexamethyl phosphoramide		680-31-9	A2	A2			None		
Propylene imine - Skin		75-55-8	2,A2	5,A2			2	5	
1,1,2-Trichloroethane		79-00-5	10	45			10	45	Reduce exposure to lowest feasible level

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Tabulation of NIOSH Reviews of Proposed PELs
 NIOSH Tab e N6B - Proposed PELs That Meet the OSHA Definition of "Potential Occupational Carcinogen"
 (NIOSH non-concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Acetaldehyde	1001	75-07-0	100	180	150	270	200	360	
Asphalt (petroleum) fumes	1028	8052-42-4		5			None		5 mg/m ³ ceiling measured as total particulate (15 min)
Beryllium & compounds, as Be	1033	7440-41-7		0.002, A2			2 µg/m ³ TWA, 5 µg/m ³ Ceiling, 25 µg/m ³ Max Ceiling (30 min)		Not to exceed 0.5 µg Be/m ³
Chlorinated camphene - Skin	1078	8001-35-2		0.5		1		0.5	
Chromic Acid and chromates	1092	7440-47-3		0.05			0.1		25 µg/m ³ TWA 50 µg/m ³ ceiling (15 min)
Chromyl chloride	1094	14977-61-8	0.025	0.15				1	Carcinogenic Cr (VI): 1 µg/m ³ TWA;
DDT (Dichlorodiphenyl- trichloroethane)	1113	50-29-3		1				1	Lowest reliably detectable level; 0.5 mg/m ³ TWA
p-Dichlorobenzene	1125	106-46-7	75	450	110	675	75	450	
Epichlorohydrin - Skin	1158	106-89-8	2	10			5	19	Occupational exposure to epichlorohydrin to be minimized

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Tabulation of NIOSH Reviews of Proposed PELs
NIOSH Table N6B - Proposed PELs That Meet the OSHA Definition of "Potential Occupational Carcinogen"
(NIOSH non-concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Ethyl acrylate - Skin	1161	140-88-5	5	20	25 (NIC 15)	100 (61)	25	100	
Gasoline	1185	8006-61-9	300	900	500	1,500	None		
Hydrazine - Skin	1205	302-01-2	0.1,A2	0.1,A2			1	1.3	0.03 ppm (0.04 mg/m ³) ceiling (120 min)
Methyl bromide - Skin	1253	74-83-9	5	20			20	80	Exposure should be reduced to the lowest feasible level
Methyl chloride	1254	74-87-3	50	105	100	205	100 ppm TWA, 200 ppm Ceiling, 300 ppm Max Ceiling, (5 min in 3 hr)		Exposure to methyl chloride, should be reduced to the lowest feasible level
4,4'Methylene bis(2-chloroaniline) - Skin	1273	101-14-4	0.02,A2	0.22,A2			PEL revoked by OSHA August 1975		3µg/m ³ TWA (lowest detectable limit)
Nickel Soluble or (inorganic) compounds, as Ni	1283	7440-02-0		0.1			1		15 µg Ni/m ³ TWA
p-Nitrochlorobenzene	1288	100-00-5	0.5 (NIC 0.1)	3 (0.6)			1		
2-Nitropropane	1291	79-46-9	10,A2	35,A2			25	90	Reduce exposure to lowest feasible level

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Tabulation of NIOSH Reviews of Proposed PELs
 NIOSH Table No. 8 Proposed PELs That Meet the OSHA Definition of "Potential Occupational Carcinogen"
 (NIOSH non-concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Perchloroethylene	1308	127-18-4	50	335	200	1,340	100 ppm TWA, 200 ppm Ceiling, 300 ppm Max Ceiling, (5 min in 3 hr)	Minimize workplace exposure levels; limit number of workers exposed	
Phenyl glycidyl ether (PGE)	1315	122-60-1	1	6			10	60	1 ppm (5 mg/m ³) ceiling (15 min)
Phenylhydrazine - Skin	1317	100-63-0	5,A2	20,A2	10,A2	45,A2	5	22	0.14 ppm (0.6 mg/m ³) ceiling (120 min)
Propylene dichloride	1341	78-87-5	75	350	110	510	75	350	
Propylene oxide	1344	75-56-9	20	50			100	240	
Rosin core solder pyrolysis products, as formaldehyde	1350			0.1			None		0.1 ppm ceiling (15 min)
Silica -- Crystalline Quartz	1355	14808-60-7		0.1, Respirable dust			10÷(%SiO ₂ +2), Respirable dust		50 µg/m ³ TWA, respirable free, silica
Tripoli	1357	1317-95-9		0.1, Respirable dust			10÷(%SiO ₂ +2), Respirable dust		
Silica, fused	1358	60676-86-0		0.1, Respirable dust			10÷(%SiO ₂ +2), Respirable dust		
p-Toluidine - Skin	1400	106-49-0	2,A2	9,A2			None		

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Tabulation of NIOSH Reviews of Proposed PELs
 NIOSH Table N6B - Proposed PELs That Meet the OSHA Definition of "Potential Occupational Carcinogen"
 (NIOSH non-concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Vinyl bromide	1425	593-60-2	5,A2	20,A2			None		Controlled as specified for vinyl chloride in 29 CFR 1910.1017 with eventual goal of zero exposure
Vinylidene chloride	1428	75-35-4	5	20	20	80	None		Controlled as specified for vinyl chloride in 29 CFR 1910.1017 with eventual goal of zero exposure
Welding fumes	1430			5,B2			None		Lowest feasible level
Wood Dust, softwood	1430b			5		10	None		
Zinc chromate, as Cr	1436	13530-65-9		0.05,A2 (NIC 0.01,A1)				0.1	Carcinogenic Cr (VI): 1 µg/m ³ TWA; other Cr (VI): 25 µg/m ³ TWA; 50 µg/m ³ ceiling (15 min)

Tabulation of NIOSH Reviews of Proposed PELs
 NIOSH Table N6B - Proposed PELs That Meet the OSHA Definition of "Potential Occupational Carcinogen"
 (NIOSH non-concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Arsine		7784-42-1	0.05	0.2			0.05	0.2	2 µg As/m ³ (0.002 mg As/m ³) ceiling (15 min)
Benzo(a)pyrene		50-32-8		A2			None		
tert-Butyl chromate, as CrO3 - Skin		1189-85-1		C 0.1				C 0.1	1 µg/m ³ TWA
Carbon black		1333-86-4		3.5				3.5	3.5 mg/m ³ TWA; 0.1 mg/m ³ TWA in presence of polycyclic aromatic hydrocarbons
Chlorodiphenyl - Skin (42% Chlorine)		53469-21-9		1		2		1	1 µg/m ³ TWA (the minimum reliably detectable concentrat- ion using the recommended sampling and analytical methods)
Chlorodiphenyl - Skin (54% Chlorine)		11097-69-1		0.5		1		0.5	1 µg/m ³ TWA (the minimum reliably detectable concentrat- ion using the recommended sampling and analytical methods)

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NIOSH Table N6B - Proposed PELs That Meet the OSHA Definition of "Potential Occupational Carcinogen"
(NIOSH non-concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Chromite ore processing (Chromates) as Cr				0.05,A1			1		25 µg/m ³ (0.025 mg/m ³ TWA; 50 µg/m ³ (0.05 mg/m ³ ceiling (15 min) as noncarcinogenic Cr (VI)
Chromium (VI) compounds, Cr Water soluble Certain water insoluble				0.05 0.05,A1			0.5		Carcinogenic Cr (VI): 1 µg/m ³ TWA; Carcinogenic Cr (VI): 1 µg/m ³ TWA; other Cr (VI): 25 µg/m ³ TWA; 50 µg/m ³ ceiling (15 min)
Chrysene		218-01-9	A2	A2			None		To be controlled as an occupational carcinogen
Coal tar pitch volatiles, as benzene solubles		65996-93-2		0.2,A1			0.2		0.1 mg/m ³ TWA (cyclohexane- extractable fraction)
Dimethyl carbamoyl chloride		79-44-7	A2	A2			None		Reduce exposure to lowest feasible limit
1,1-Dimethylhydrazine - Skin		57-14-7	0.5,A2	1,A2			0.5		0.06 ppm (0.15 mg/m ³) ceiling (120 min)

Tabulation of NIOSH Reviews of Proposed PELs
 NIOSH Table N6B - Proposed PELs That Meet the OSHA Definition of "Potential Occupational Carcinogen"
 (NIOSH non-concurrence)

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Ethyl chloride		75-00-3	1,000	2,600			1,000	2,600	To be handled in the workplace with caution because of structural similarity to carcinogenic chloroethanes
Lead chromate as Cr		7758-97-6		0.05, A2			None		Carcinogenic Cr (VI): 1 µg/m ³ TWA; other Cr (VI): 25 µg/m ³ TWA; 50 µg/m ³ ceiling (15 min)
Methyl hydrazine - Skin		60-34-4	C 0.2, A2	C 0.35, A2			C 0.2	C 0.35	0.04 ppm (0.08 mg/m ³) ceiling (120 min)
Nickel sulfide roasting, fume & dust, as Ni				1, A1			None		15 µg Ni/m ³ TWA
N-Phenyl-beta-naphthylamine		135-88-6	A2	A2			None		Reduce exposure to lowest feasible level
Propane sultone		1120-71-4	A2	A2			None		
o-Tolidine - Skin		119-93-7	A2	A2			None		20 µg/m ³ ceiling (60 min)

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Tabulation of NIOSH Reviews of Proposed PELs
NIOSH Table N7 - Proposed PELs as TWAs for which NIOSH Recommends a Ceiling

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Butyl mercaptan	1054	109-79-5	0.5	1.5			10	35	1-Butanethiol: 0.5 ppm (1.8 mg/m ³) ceiling (15 min); mixtures of thiols to be controlled by calculation of equivalent concentrations
Hydrogen sulfide	1209	7783-06-4	10	14	15	21	20 ppm Ceiling; 50 ppm Max Ceiling (10 min)		10 ppm (15 mg/m ³) ceiling (10 min)
Isopropyl glycidyl ether (IGE)	1227	4016-14-2	50	240	75	360	50	240	50 ppm (240 mg/m ³) ceiling (15 min)
Methyl chloroform	1255	71-55-6	350	1,900	450	2,450	350	1,900	350 ppm (1,910 mg/m ³) ceiling (15 min)
Methyl mercaptan	1263	74-93-1	0.5	1			C 10	C 20	1-Methanethiol: 0.5 ppm (1.0 mg/m ³) ceiling (15 min); mixtures of thiols to be controlled by calculation of equivalent concentrations
Petroleum distillates (Naphtha; Rubber solvent)	1312		400	1,600			None		350 mg/m ³ TWA; 1,800 mg/m ³ ceiling (15 min); blood and urine monitoring required; action level: 200 mg/m ³ TWA

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Tabulation of NIOSH Reviews of Proposed PELs
 NIO 1 Table N7 - Proposed TLVs as TWAs for which NIOSH Recommends a Ceiling

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV						
			TWA		STEL		PEL		REL
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Phenyl mercaptan	1316	108-98-5	0.5	2			None		Benzenethiol: 0.1 ppm (0.5 mg/m ³) ceiling (15 min); mixtures of thiols to be controlled by calculation of equivalent concentrations
Vanadium, as V2O5		1314-62-1							
Respirable dust	1421			0.05			0.5 (dust)		0.05 mg/m ³ ceiling (15 min)
Fume	1422			0.05			0.1 (fume)		0.05 mg/m ³ ceiling (15 min)

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Tabulation of NIOSH Reviews of Proposed PELs
NIOSH Table N7 - Proposed PELs as TWAs for which NIOSH Recommends a Ceiling

CHEMICAL NAME	HS NUMBER	CAS NUMBER	TLV				PEL		REL
			TWA		STEL				
			ppm	mg/m ³	ppm	mg/m ³	ppm	mg/m ³	
Benzyl chloride		100-44-7	1	5			1	5	5 mg/m ³ ceiling (15 min)
Cyanides, as CN - Skin				5				5	4.7 ppm (5 mg CN/m ³) ceiling (10 min)
Sodium cyanide		151-50-8							
Potassium cyanide		143-33-9							
Hydroquinone		123-31-9		2				2	0.44 ppm (2 mg/m ³) ceiling (15 min)
Phenol - Skin		108-95-2	5	19			5	19	5.2 ppm (20 mg/m ³) TWA; 15.6 ppm (60 mg/m ³) ceiling (15 min)
Phosgene		75-44-5	0.1	0.4			0.1	0.4	0.1 ppm (0.4 mg/m ³) TWA; 0.2 ppm (0.8 mg/m ³) ceiling (15 min)

Tabulation of NIOSH Reviews of Proposed PELs

Key to Abbreviation

C	Ceiling
CAS	Chemical Abstracts Service
Chemical Name	The chemical name listed may be a mixture of common, IUPAC and/or trade names as used by OSHA
HS	Number designated by OSHA for this health standard rulemaking
$\mu\text{g}/\text{m}^3$	Micrograms per cubic meter
mg/m^3	Milligrams per cubic meter
NIC	Notice of Intended Change by ACGIH as listed in 1987-1988 TLVs
NOC	Not otherwise classified
PEL	Permissible Exposure Limit (OSHA)
ppm	Parts per million
REL	Recommended Exposure Limit (NIOSH)
STEL	Short-Term Exposure Limit (ACGIH)
TLV	Threshold Limit Value (ACGIH)
TWA	Time-Weighted Average