

THE STANDARDS COMPLETION PROGRAM
DRAFT TECHNICAL STANDARDS ANALYSIS
and
DECISION LOGICS

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Cincinnati, Ohio 45202
June 1978

PREFACE

The National Institute for Occupational Safety and Health and the Occupational Safety and Health Administration jointly undertook under the Standards Completion Program to draft standards that would complement certain of the existing quantitative standards issued under the Occupational Safety and Health Act of 1970. An analysis of the standard setting process and the decision logic is presented to assist in understanding the following uniform rationale in writing the Draft Technical Standards. This would ensure that all substances with similar hazardous properties would be treated similarly in the regulatory requirements of a draft standard.

This analysis and these decision logics should be viewed not as the ultimate procedure but as a stimulus for further discussions on improving the standard setting process to ensure greater public understanding of the procedure and documentation used in these highly technical issues.

The Draft Technical Standards themselves have been made available to the public through inspection at OSHA headquarters and regional and area offices. They are also available at NIOSH headquarters in Rockville, Maryland.

Those substances covered by the Draft Technical Standards are listed in Attachment 9.

The Draft Technical Standards for the following SCP substances have been proposed as regulations and are listed below under the appropriate Federal Register issuance.

40 FR 20202 (8 May 1975)	40 FR 47262 (8 Oct 1975)
2-Butanone	p-tert-Butyltoluene
2-Pentanone	Cumene
Cyclohexanone	alpha-Methyl Styrene
Hexone	Styrene
Methyl n-Amyl Ketone	Vinyl Toluene
Ethyl Butyl Ketone	Cyclohexane
	Camphor
	Mesityl Oxide
	5-Methyl-3-Heptanone
	Ozone

NIOSH is also publishing a condensed version of the Draft Technical Standards in the form of data sheets.

ACKNOWLEDGMENTS

The assistance of the following NIOSH and OSHA Standards Completion Program Working Group Chairmen was essential for the success of the project and for the development of a meaningful rationale.

Group A (Training and Information)	Robert Vandervort
Group B (Personal Protection)	Allan Heins, Ph.D. Frank Mackison
Group C (Analytical Methods)	John Bryant
Group D (Medical)	Jack Butler, M.D.
Group E (Regulatory)	Richard Ronk

We gratefully acknowledge the assistance of Evelyn Jones, Division of Physical Sciences and Engineering, in the extensive efforts in manuscript preparation.

The editing of this document by Marion Curry, Writer-Editor, Information Support Services Section, NIOSH, is also acknowledged.

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BACKGROUND

The objective of the Standards Completion Program (SCP), begun in December 1973, was to complete the existing work-area level standards promulgated by the Department of Labor (DOL) in 1971. The Occupational Safety and Health Act (Public Law 91-596) stated that by December 1972 the Department of Labor should promulgate, as an occupational safety or health standard, any national consensus standard and any established Federal standard that would result in improved safety or health. Approximately 400 such chemical substance levels were first promulgated in May 1971.

Sections 6 and 8 of the Act provide the authority to supplement the work-area level standards. Briefly, in Section 6 there are requirements to (1) inform the employee of the hazards to which he is exposed, including the relevant symptoms, emergency treatment, and proper conditions of safe use or exposure, (2) provide for monitoring or measuring exposure, (3) prescribe protective equipment and controls, and (4) prescribe specific types and frequencies of medical examinations or related tests.

Section 8 requires employers to (1) inform the employee of any exposure he may have received and what corrective action is being taken, (2) provide the employee an opportunity to observe measurement and monitoring procedures, and (3) maintain records of employee exposures and to make available to that individual his records on exposure as well as monitoring records used in his work area.

Since the existing standards are not complete in the sense that the worker is not fully protected, The SCP was designed to complete the existing 29 CFR 1910.1000 standards through a coordinated effort by the Department of Health, Education, and Welfare's (DHEW) National Institute for Occupational Safety and Health (NIOSH) and DOL's Occupational Safety and Health Administration (OSHA). Both Agencies participated in all phases, from the initial data gathering and evaluation through the publication in the Federal Register of proposed rules expanding the existing standards. The effort of NIOSH was primarily to supply technical data and that of OSHA was primarily to prepare these standards for regulatory action. Completion of standards for the 400 substances should provide the additional protection required under the Act.

The development of the Draft Technical Standards was through an interactive relationship between NIOSH and OSHA in joint working groups. Each working group was responsible for a specific section in the Draft Technical Standard -- including

standards for: (1) informing the employee of potential hazards, (2) monitoring engineering and control mechanisms, (3) establishing effective sampling techniques and sampling intervals, (4) determining medical surveillance and testing programs, and (5) evaluating fire and other safety hazards. In addition other working groups coordinated outside reviews by appropriate State agencies and professional societies and prepared the required regulatory language. The specific functions of each of these working groups are given below:

The Program included technical participation by five contractors. NIOSH awarded approximately \$3 million in contracts for information to support technical drafts of the standards.

Each month a new set of Draft Technical Standards for about 18 chemically similar compounds was begun. At the end of the 15th week, a Draft Technical Standard for each of the 18 compounds was transmitted to the regulation writing working group chaired by an OSHA representative.

Following this, the Notice of Availability for each group of Draft Technical Standards was published in the Federal Register. Draft copies of the standards were then forwarded to the NIOSH and OSHA Regional Offices to be made available to interested individuals or organizations. Copies were also forwarded to selected professional societies, including the American Industrial Hygiene Association and the American Conference of Governmental Industrial Hygienists, which performed preliminary reviews.

Notices of Proposed Rulemaking for the first set of draft technical standards, which includes six Ketones, were published in the Federal Register on May 8, 1975 (40 FR 20202). The Preamble to these proposals provides much valuable information on the rationale used in preparing the various aspects of these standards.

DEFINITION OF TERMS

The permissible exposure for each substance remains unchanged from the values given in Tables Z-1, Z-2, and Z-3 of 29 CFR 1910.1000 (formerly Tables G-1, G-2, and G-3 of 29 CFR 1910.93). The intent of the proposed SCP Draft Technical Standards was to supplement these existing permissible exposure limits previously promulgated by OSHA.

Where the name of the substance listed in 1910.1000 is ambiguous and does not identify a specific compound to be regulated, the working groups, using the best available information, determined which compounds would be included in the Draft Technical Standard.

THE ACTION LEVEL

The purpose of an action level is to indicate when employee exposures to hazardous substances may be approaching the permissible exposure limit. Measurements of levels at or above this action level indicate that there is a high degree of certainty that the actual concentration of the contaminant exceeds the permissible exposure limit. Where employee exposure measurements are below the action level, employers are, in effect, exempted from the major requirements of the Draft Technical Standard.

For such employees, the employer would not have to train and inform them (unless they had skin contact or were working where the substance presented a fire or explosion hazard), obtain medical history statements, or measure their exposure again unless there was a change in production, process, or control measures that could result in an increase in airborne concentrations of the substance.

A literal interpretation of the word "exposure" could mean exposure to any quantity greater than one molecule of the substance. To interpret exposure as meaning any exposure whatsoever would result in an unreasonable burden upon employers without a significant increase in employee protection.

It has been recognized that a small number of occupational environmental samples can only yield an estimate of the true concentration of the substance measured. Because of this uncertainty, provision should be made for an allowance to protect the worker prior to the level reaching the permissible exposures given in Tables Z-1, Z-2, and Z-3 of 29 CFR 1910.1000. Leidel, Busch, and Crouse (1) determined this allowance, and the result is that an "action level" is one-half of the level of the permissible exposure.

This "action level" is a statistically derived concept permitting the employer to have confidence that if the measured exposure level is below this action level there is only a small probability that the actual exposure level is above the permissible exposure level.

The choice of an action level at one half the permissible exposure for all substances was based on several considerations: (1) different action levels for different substances would lead to unwarranted confusion on the part of employers, and (2) not enough information is available to calculate, quantitatively and precisely, a different action level for each substance that would ensure a known degree of protection. Since the action level is used for triggering employee exposure monitoring and since the monitoring program does not require sufficiently frequent measurements to be certain that the permissible exposure is not

exceeded when the average of the samples is close to the permissible exposure, the action level should be far enough below the permissible exposure to make it unlikely that it is exceeded when the sample results are below the action level. The statistics of employee exposure monitoring are discussed in detail by Leidel (2) and Leidel and Busch (3).

EXPOSURE DETERMINATION AND MEASUREMENT

The exposure determination and measurement provisions of the Draft Technical Standard direct the employer to meet certain employee exposure monitoring requirements, which consist of two steps: the exposure determination and the exposure measurement. At the first step, many employers will ascertain that they need not proceed to the second step. Therefore, only a small number of employers with significant employee exposure problems need perform the more burdensome monitoring programs required by the second step.

EMPLOYEE EXPOSURE DETERMINATION

The first step is the employee exposure determination. This step minimizes the burden on the employer by eliminating the requirements for a detailed monitoring program; yet it provides adequate employee protection where exposure conditions warrant such a program.

The exposure determination can be a simple calculation that frequently can be based on factors such as the amount of the substance present, the size of the workplace, the amount and type of ventilation, and the proximity of the employee to the source of the contamination. Guidelines for identifying typical sources of contamination have been published (4,5). Equations for estimating potential workplace concentrations are also available (6,7,8). Application of these guidelines and equations significantly reduce the number of employees required to be covered by the exposure measurement requirements. Only in those establishments where the substance is released into the workplace air is it necessary to calculate the initial exposure (or to recalculate when changing conditions warrant).

Where the release of a very small amount of the substance would produce irreversible damage (such as the sensitization that occurs with methylene bisphenyl isocyanate (MDI)), a determination is required if the substance is merely "present" rather than "released." The exposure determination would be affirmative if the substance is "released," regardless of the amount, and would necessitate a complete monitoring program.

OSHA inspections or NIOSH Health Hazard Evaluation toxicity determinations(9) indicating employee exposure levels would be

considered as "any information" as stipulated in paragraph (b)(2)(i) of the Draft Technical Standard. These inspections and determinations would be evidence that a substance has been and presumably is continuing to be released into the workplace air, thus requiring an exposure determination.

Receipt of "any information" on employee exposure levels does not require that new measurements of the employee exposure levels be taken, but receipt does require that reports of exposure levels be included in the written determination required in this first step.

The employer's recording the initial determination is an aid to any subsequent followup investigation by OSHA or NIOSH. The employer, however, has the option of skipping the exposure determination step altogether and going directly into the employee measurements; he is considered to have done the determination since the initial determination is based on measurement rather than calculation.

Employee Exposure Measurements

If the exposure determination indicates that any employee may be exposed above the permissible level, then the employer is required to take the second step -- exposure measurement. He measures the exposure of the employee who is "believed to have the greatest exposure" so that the measurement is "representative of the maximum 8-hour time-weighted-average exposure of the employee."

It is not difficult for an employer who is familiar with his places of employment to make an estimate of which employee is receiving the greatest exposure in a particular work situation and over what period of time the exposure occurs (8 hours for a time weighted average). The time period over which the exposure measurement is made is the period appropriate to the standard. Where there are numbers of work situations in which groups of workers are exposed, an exposure determination would be made for each such work situation.

An exposure measurement is necessary when the exposure determination indicated that exposure of an employee was over the action level. The concept of selecting work situations for measuring the maximum exposed worker was introduced and discussed by Roach and others (10,11).

Where employee exposure measurements are above the action level, all employees thus exposed must be identified and the exposure of each employee so identified must be measured. Since the intent is only to measure the exposure of employees who are exposed above the permissible exposure, the Draft Technical Standard requires the employer to define the population at risk.

and to develop and operate his own program measuring the exposure of these employees.

A more burdensome alternative would be to require routine exposure monitoring of every employee at that place of employment. This would not provide significantly more employee protection than merely requiring the employer to define the population at risk. NIOSH has developed a handbook containing a series of simple, easy to understand monitoring programs that an employer might use for different situations (12).

Where an employee's exposure measurements are above the action level but not above the permissible exposure, a measurement program is required. This program must provide the employer with some level of statistical confidence that employee exposure is not exceeding the permissible exposure. The minimum sampling frequency of at least once every 3 months is statistically sufficient to give the approximate employee exposure; it is not, however, sufficient to give statistical confidence in estimating the employee's future exposure. Less frequent sampling would result in even less confidence.

Four such exposure measurements during the year are considered minimal to detect any significant fluctuations in the average level of environmental contaminants. Employee exposure measurements four times per year per exposed employee are a reasonable minimum burden on the employer. The employer should not interpret this to be an absolute minimum that would always be appropriate to determine each employee's exposure. There is information (13) that indicates that a waiting time between sampling events (for typical data) of over 1 month results in a relatively low level of confidence in the exposure estimates. However, a maximum waiting time of 3 months between measurements should protect each employee and give some idea of variation without putting an inordinate burden on the employer.

The ultimate purpose of an employee exposure monitoring program is to measure each employee's exposure so that the exposure to the substance is known quantitatively with an adequate degree of confidence, under all work conditions. Ideally, this is accomplished by daily measuring the exposure of each employee with the use of personal dosimeters that integrate the concentration of the substance in the air breathed by the employee over short periods at the end of the appropriate exposure period as defined by the 1910 standard. This approach imposes a substantial burden on the employer and the employee without increasing the protection to the employee.

When the employee's exposure measurements are above the permissible exposure, in addition to the other steps required, a more intensive monitoring program (of once monthly measurements)

is needed to quickly identify increasing exposure trends. Twelve such monitoring events per year per exposed employee is considered a minimum burden on the employer.

If the use of respirators is allowed, the employer must know what the employee exposure condition is so that the proper respirator may be chosen from the permissible respiratory protection table found in each Draft Technical Standard.

Employee Notification

Section 8(c)(3) of the Act requires that when an employee has been exposed above the permissible exposure level, he shall be notified of his overexposure. This is done to make him aware of this high risk and the corrective action being taken by the employer to reduce his exposure to or below the permissible exposure.

The Draft Technical Standard requires that the employee be notified, in writing, within 5 days after the employer has received the records of the exposure measurement indicating overexposure, although the notification of corrective action itself is not necessary within 5 days. There may also be successive notifications of corrective actions as respirators and engineering controls are brought into use. When employees are being overexposed and are being notified, they have to be notified after each monthly overexposure measurement.

Measurement Termination

If the exposure measurement is erroneous, if the exposure has been reduced in some manner, or if changes result in a reduction of employee exposure, the exposure measurement program would then be terminated. Since day-to-day occupational exposure levels vary greatly because of normal environmental variability (14,15,16), an employee could be exposed to levels exceeding the permissible exposure if monitoring was terminated on the basis of one sample. Consequently, a minimum of two samples that measure concentrations below the action level per exposed employee are required. Since the employer is required to keep records of the employee exposure measurements, it appears feasible for the employer to make the determination that he may terminate monitoring by comparing the employee exposure measurements.

A 1-week separation between the two measurements is required so that monitoring will not be terminated solely because of short-term (several day) reductions in exposure resulting from temporary process or weather changes. Reductions in exposure due to long-term trends should and will result in termination of monitoring under this provision. Termination of exposure measurements under these conditions would adequately protect the employees and minimize the burden on the employer.

The regular and continued use of respirators, as allowed, does not constitute a reduction in employee exposure for monitoring purposes because the requirement for monitoring is determined by the concentration of the substance being released into the environment rather than what is actually present at the employee's breathing zone. Monitoring requirements are still in effect where respirators are used because it is necessary to know what exposure an employee would have without a respirator, (that is, at the environmental level) in order to select the proper respirator.

METHODS OF MEASUREMENT

The exposure of an employee is required to be determined by measurements that best represent the employee's actual exposure. There are three vital elements in any employee exposure measurement procedure: where the sample is collected, the duration and number of the sample, and the accuracy of the measurement techniques.

With respect to the first element, where the sample is collected, there are three basic occupational environmental sample collection techniques:

- (1) Personal - The sampling device is directly attached to the employee and worn continuously during all work and rest operations.
- (2) Breathing Zone - The sampling device is held by a second individual who attempts to sample the air in the "breathing zone" of the employee. The "breathing zone" sample best represents the air inhaled by the employee.
- (3) General Air - The sampling device is placed in a fixed location in the work area with the assumption that the air sampled represents that inhaled by the employee.

Breslin et al. (17) are often quoted as "proof" that general air samples yield highly accurate measurements of average daily employee exposures. However, their average daily exposures were calculated from both breathing zone and general air samples combined with time-and-motion studies. In addition they stated, "The foregoing measurements of average exposure represent the very best accuracy the study team could achieve and were based on far more samples than are collected on a routine survey."

Other authors have discussed the problems of general area or static samplers. Sherwood (18) concluded that "static samplers may grossly misrepresent the exposure of individual workers who are likely to be exposed to airborne activity of their own

making." Sherwood (18) has also shown the very wide variability (typically 100-fold) of air concentrations employees are exposed to at particular work operations. These data contradict the assumption that air concentrations can be expected to be the same everywhere at the work operation. Ayer and Burg (19) also presented data that showed the extreme variability in sampling data. Shulte (20) observed a median ratio of four between air concentrations determined from personal samplers and air concentrations determined from fixed samplers. This indicates that the two sampling approaches have significantly different results.

Tebbins (21) has pointed out that since the Act declares as Congressional policy the intent "to assure so far as possible every working man and woman in the nation safe and healthful working conditions," the thrust of sampling is thus individualized. Attention to workplace environments is refocused from that of "groups of persons" to that of "each person." This concern for individuals appears in the Federal Coal Mine Health and Safety Act of 1969 (22) and the MESA dust sampling requirements (23), a concern retained in the superseding Federal Mine Health and Safety Act. Mine compliance for dust is determined with respect to the individual and is done almost exclusively by personal monitoring. Tebbins (21) also stated, "It is the recognition of the probability of large temporal and spatial measurement errors which has led slowly to the concept of personal sampling or dosimetry, attaching the sensing element of a sampler to the worker himself -- he carries it about continuously, often during an entire workday."

Linch and co-workers have compared fixed station (area) monitors with personal samplers in sampling for tetraalkyl lead (24) and carbon monoxide (25). In neither case did they find correlation between the area and personal monitors. Regarding the tetraalkyl lead exposures, Linch et al. (24) concluded that fixed-station monitors did not disclose the true inhaled air concentrations of lead in a highly variable ambient work atmosphere. This was sufficient to justify the establishment of an extensive personnel monitoring survey. It was also concluded that:

"Fixed station air monitoring does not provide valid results required for organic lead exposure control based on air analysis.

"...in those cases where air analysis is required for exposure control, personnel monitoring is the preferred procedure for the collection of the sample."

For the carbon monoxide study of exposure in a large warehouse, in which gasoline-powered trucks were operated, Linch and Pfaff (25) concluded that "only by personal monitoring could a true exposure be determined."

Lastly, a study by Baretta et al. (14) concluded that continuous air sampling is valid for estimating an employee's individual daily exposure to vinyl chloride. The study featured multipoint air sampling, analysis using an infrared spectrophotometer, and data subsequently analyzed by computer. As with the study of Breslin et al. (17), this study demonstrated that area samplers provide an inadequate estimate of an employee's exposure. First, a comprehensive job study was required for each of four job classifications to determine the work areas frequented by the workmen and the time they spent in each area. The article of Breslin et al. (17) presents no data regarding the variability for individual workers for these time and motion studies or confidence intervals for percent of time spent at each work location. Second, a computer was required for analysis of the vast amount of data and calculation of exposure estimates. Third, no confidence estimates were given for the time-weighted average (TWA) exposures calculated from the continuous monitoring combined with the comprehensive job study. Fourth, the authors stated: "Continuous monitoring, however, is extremely costly both in time and in the equipment required. The scope of data acquired is limited by the number of sampling probes, and these probes are not always accurately measuring the individual's daily exposure experiences, especially should these involve unusual incidences such as chemical spills or exposures outside the monitored area."

It is the intent of the monitoring requirements of the Draft Technical Standard that samples taken for the purpose of measuring employee exposure normally be taken only by the "personal" or "breathing zone" methods. For samples taken by the "general air" method, it will be necessary to demonstrate that they accurately measure employee exposure for reasons demonstrated above.

With respect to the second element, Duration and Number of Samples, the Draft Technical Standard allows any combination of long-term or short-term sampling that permits estimating exposure over the period appropriate to the standard. The period appropriate for a particular substance is specified (Substance Technical Guidelines, Appendix B of the Draft Technical Standard). The requirement that measurements are best taken so that the average 8-hour exposure is determined from a single 8-hour sample or two 4-hour samples is based on a report by Leidel and Busch (3).

The third element, the Accuracy of Measurement Technique, is specified in the Draft Technical Standard in ranges varying with the concentration measured. The accuracy ranges are narrow enough to ensure that a determination of compliance can be made and yet broad enough to allow the application of a variety of measurement technologies. Accuracy requirements are given in lieu of prescribing a specific method for each substance. The

alternative would be to have no accuracy requirement and allow any method of measurement, no matter how poor, to be used. To prescribe a particular method of known high quality would impose a considerable financial burden on the employer without obtaining a significant increase in the protection of the employee. Since the overall accuracy of an estimate of employee exposure over a period of time based on occasional samples depends almost entirely on environmental variability, the use of a less accurate method of measurement causes no significant reduction in employee protection(3).

Sampling and analytical methods meeting the accuracy requirements were developed by NIOSH and are available from the National Technical Information Service, Department of Commerce, Springfield, Virginia 22161, under the title of "NIOSH Analytical Method for Set (depending on substance)".

The accuracy requirements were chosen so that gas detector tubes (certified by NIOSH under 42 CFR Part 84), if available for the substance, could meet them.

Accurate measurements help to categorize exposures reliably; this, in turn, minimizes employee risk while not burdening the employer with increased measurements that would be needed if a lesser accuracy were specified. Increasing monitoring frequency while using less accurate techniques can provide the same reliability as more accurate measurements performed less frequently.

The accuracy requirements of the Draft Technical Standard take into account the random and possible systematic errors in measurement. These are:

- (1) Random errors in the sampling procedure (reproducibility of the sampling procedure),
- (2) Random errors in the analytical procedure (reproducibility of replicate analysis of a given sample),
- (3) Systematic errors in the sampling method (bias of collection technique),
- (4) Systematic errors in the analytical procedure (bias of analysis procedure).

The term accuracy in the third provision refers to the difference between a measured value and the true concentration. Thus it includes both the random variation of the method about its own mean (commonly referred to as precision) and the difference between the average result from the method and the true value (commonly referred to as the bias of the method).

The Draft Technical Standard requires that the accuracy of the method be evaluated at a statistical confidence level of 95%. The meaning of this statement is that single measurements will lie within the stated required accuracy (percentage limits on each side of the true value) at least 95% of the time. If one assumes normally distributed errors for the method and for unbiased methods, one can use the coefficient of variation (CV or relative standard deviation) as a parameter to judge whether the method is accurate enough to meet the standard. The CV in percentage units is defined as the standard deviation of the method, times 100, divided by the true value. The required CV of the method is obtained by dividing the required accuracy by 1.96 (statistical standard normal deviate for 95% two-sided confidence limits, also referred to as Z-value). Typical required CV's would be:

CONCENTRATION	REQUIRED ACCURACY (% of true value)	REQUIRED CV of TECHNIQUE
Above permissible exposure	25	Less than 12.8%
At or below the permissible exposure and above the action level	35	Less than 17.9%
At or below the action level	50	Less than 25.5%

From above table it can be seen, for example, that for measurements at or below the action level the required accuracy is plus or minus 50%. This means, statistically, that in the long run single measurements would lie within plus or minus 50% of the corresponding true values at least 95% of the time.

COMPLIANCE

Paragraphs d(1) and d(2) of the Draft Technical Standard restate the duty already contained in 29 CFR 1910.1000(e). To achieve compliance so that no employee shall be exposed above the permissible exposure, engineering and work practice controls shall be instituted. To control employee exposure by engineering controls could require the installation of local exhaust ventilation or the modification of the process to reduce emission of the contaminant into the workplace. These methods of control are preferred since they do not rely on employee action to achieve their effect. Work practice control includes such things as housekeeping, dust vacuuming (instead of blowing), and actions taken by employees to avoid high concentration areas. When the principle sources of exposure result from poor work practices, these controls may be effective only if strong supervisory control is maintained.

Paragraph (d)(2) also requires that if feasible engineering and work practice controls do not reduce employee exposure to "at or below" the permissible exposure, they nevertheless must be used to reduce the exposure to the lowest level feasible even if not down to the permissible exposure. These controls then must be supplemented by the employer with the proper respirator.

This requirement ensures use of the more reliable engineering controls to reduce the employee exposure to the lowest level feasible rather than use of the less reliable alternative of depending upon respirators to lower the employee exposure to below the action level. Using engineering controls to reduce exposure to the lowest possible level feasible is considered a necessary requirement. A situation could exist that requires a self-contained breathing apparatus. By implementing reliable engineering controls, the exposure could be reduced to the point where a cartridge respirator would be adequate. If the self-contained breathing apparatus fails, the employee could be left in a dangerous concentration. However, if the cartridge respirator fails at the reduced concentration achieved through the use of engineering controls, the employee is not at such a serious risk by bypassing the failed respirator. He's also avoided wearing an uncomfortable breathing apparatus.

Testing of Ventilation System

Any ventilation system used to control exposure should be periodically tested to detect the otherwise imperceptible decreases in effectiveness that occur over a period of time. The required tests can be used to verify, by simple measurements, that the ventilation control system is operating effectively. Effective operation means continued control of an air contaminant to below the permissible exposure.

The employee exposure monitoring program requires measurements no more frequently than every 3 months. Based on this frequency, the employer cannot be confident that the employee is protected at all times. Therefore, it is necessary to determine whether or not the installed control system is functioning effectively to verify that the employee is protected at all times in view of this quarterly measurement schedule.

Quarterly measurements could alert the employer to changes in the ventilation system caused by seasonal changes in make-up air, for example from the building being tightly closed in winter.

Manometers or other simple pressure gauges can be used to measure ventilation systems. If a manometer with an attached recorder is placed on the side of a hood where it can be readily seen and if it is examined for change, the ventilation measurement provision has been complied with. Well-established (26) measurement schemes can be used to verify that the mechanical ventilation system continues to function effectively.

When a substance may logically be used in open-surface tanks, the specific sections of 29 CFR 1910.94 (ventilation) that may apply to the particular substance (together with the classification of that substance for open-surface tank operations) are referenced in the Draft Technical Standard itself. To develop this classification following the procedure in Tables G-12 and G-13 of 1910.94, relative evaporation rates may be used along with either the flash point for that substance or the permissible exposure for that substance in 1910.1000, whichever happens to be lower.

Respirators

Although it is theoretically possible to routinely protect employees by means of respirators, the following events must all occur for the employee to be protected:

- (1) The proper respirator must be selected,
- (2) It must fit the employee when it is worn as it usually is worn by the employee.
- (3) The employee must wear the respirator,
- (4) The respirator filter cartridge, or canister, must be replaced before it ceases to work.
- (5) The respirator body must be maintained properly.

Several NIOSH studies (27-29) have shown that, in general, these conditions do not occur, and as a consequence, the

protection of employees by respirators is inadequate in the majority of occupational situations. Shulte (30) stated that "It is one of the fundamentals of industrial hygiene that personal protective devices are 'last resort' type of controls, to be used only where engineering controls cannot be used or made adequate." Shulte points out several of the fallacies involved in selecting respirators over engineering controls as a regular means of personal protection.

Full discussion of the use of respirators with the employees, training in their use, and instructions for care and maintenance are very important and are specifically required by 29 CFR 1910.134(b) and (a). These requirements are not being met by some employers where respirators are used (27-29). Shulte (30) stated that "handing a man a respirator and telling him to use it is not only an ineffective technique, but it can be very dangerous." Lastly, "There will always be a temptation to resort to respirators as a cheap substitute for a ventilation system. If this is done it is clear management has not carefully considered the alternatives since reliance on, and effective use of, respirators is definitely not cheap."

Paragraph d(4) of the Draft Technical Standard restricts the use of respirators to certain specific emergency and nonroutine situations. However, this paragraph, which allows for use of respirators when engineering controls are not feasible, does not apply to tank entry, because engineering controls are feasible. They may be awkward, expensive, and somewhat impractical, but they are, nevertheless, feasible even through, traditionally, respirators have been used in tanks in place of engineering controls. Specific hazardous operations where respirators have been commonly used are identified; all other situations must use engineering controls to the extent that they are feasible, and only then will respirators be allowed.

Table 2 of each Draft Technical Standard lists the respirators that must be used for various concentrations above permissible exposure. The Respirator Decision Logic and the approval requirements of 30 CFR 11, which govern the technical appropriateness of the respirators, determine the permitted respirators for each substance. Respirators not specifically listed in Table 2 of the Draft Technical Standard may not be used for protection against any concentration of that substance above the permissible exposure. One or more devices are generally commercially available for each application.

Respirators approved by the Mine Safety and Health Administration (MSHA- formerly the Bureau of Mines and Mining Enforcement and Safety Administration (MESA)) or by NIOSH (under 30 CFR 11) must be used. In addition the respiratory protection program required by 29 CFR 1910.134(b), (d), (e), and (f) must be established. Respirators are only effective when they are used

as part of a respiratory protection program and when they are properly fitted and maintained.

See Attachment I for Respirator Decision Logic.

FIRE AND SAFETY

Section 6 (b)(7) of the Act requires that standards promulgated contain provisions for "appropriate forms of warning as are necessary to insure that employees are apprised of all hazards to which they are exposed ... and proper conditions and precautions of safe use."

The Draft Technical Standards do not prescribe new requirements for fire and safety emergency procedures. Existing OSHA regulations prescribing such procedures are referenced. The following cross-references are cited:

1910.57 regarding the type of fire extinguisher required,
1910.106 regarding handling, storage, and use of materials,
1910.178 regarding the class and group of hazardous locations for the use of power operated industrial trucks, and
1910.309 in which the specific class and group for the hazardous location has been determined.

See Attachment 2 for the Fire and Safety Decision Logic.

PERSONAL PROTECTIVE EQUIPMENT

This provision requires the employer to provide and require the employee to wear protective clothing wherever the employee could be injured by contact with a substance. For example, absorption of certain substances through the skin may cause systemic poisoning. Dermatitis or sensitization may result from skin contact with certain substances. It is not necessary, however, to require the use of protective clothing regardless of the nature of the contaminant or the likelihood of skin contact; this would impose an excessive burden without benefit to the employees.

See Attachment 3 for the Personal Protective Equipment and Sanitation Regulatory Language Decision Logic.

SPILLS AND DISPOSAL

Requirements for cleaning up spills are specified in the Draft Technical Standard where applicable: (1) to prevent fires resulting from spills, and (2) to prevent evaporation and/or dispersion of the substance into the workplace so that the permissible exposure might be exceeded.

See Attachment 4 for the Spills and Disposal Decision Logic.

SANITATION

This provision requires that employees be provided showers and that employee clothing contaminated by toxic materials be laundered where the acute hazard of the substance warrants. Laundering of contaminated employee work clothing is required where a highly toxic material may cause illness if an employee is permitted to wear contaminated work clothing home or where the toxic material may cause a fire hazard in a home laundry.

See Attachment 3 for Personal Protective Equipment and Sanitation Regulatory Paragraph Decision Logic.

TRAINING AND INFORMATION

This section establishes that where a hazardous substance is present in the workplace, the employer is required to have a copy of the Draft Technical Standard readily available to employees. Employers having this substance present in the workplace would be covered by this provision.

There is a need to inform the employee because an informed employee can better protect himself against a hazard. An effective employee education system must address itself to the specific hazards to which an employee is exposed.

Where employees are required to be informed, a record is required to be maintained specifically documenting that the employee has been informed. This more stringent provision is required where it is known by measurements that employees are at significant risk. Using a substance data sheet, which is provided with the Draft Technical Standard (Substance Safety Data Sheet, Appendix A), is a feasible way for this information to be given to the employee; its use also minimizes the employer's burden.

If the employer has a training program that covers all of the material included in Appendix A of the Draft Technical Standard, he may use that in lieu of the Substance Safety Data Sheet.

See Attachment 5 for the Training and Information Decision Logic.

MEDICAL SURVEILLANCE

The Act requires that, where appropriate, standards promulgated under section 6(b)(7) prescribe "the type and frequency of medical examinations or other tests which shall be made available by the employer, or at his cost, to employees exposed to such hazards in order to determine whether the health of such employee is adversely affected by such exposure".

The application of the Medical Surveillance Decision Logic is thus triggered by (1) exposure of the employee to concentrations exceeding the action level or (2) the likelihood of an employee receiving an acute exposure trigger these provisions.

The examinations may be performed by a physician's assistant, a nurse practitioner, or other health professional. Since the Draft Technical Standard does not prohibit using nurses or para-professionals as long as they are under the direction of a physician and the resulting opinion is that of the physician. Most of the examinations are screening procedures and according to estimates only about 10 percent of the employees subject to health screening need to be examined. This reduces the possible burden on existing medical facilities.

When an employee reports that he has one of the symptoms listed in Appendix A of the Draft Technical Standard and attributes that symptom to exposure, the employee must be examined. Whenever an examination is performed, whether or not by the physician, a written opinion is required.

One of three different types of medical surveillance provisions is used for each substance depending on the nature and severity of the health effects attributable to that substance. These health effects were first summarized on a toxicity rating sheet, which includes a decision logic for medical surveillance standards. Based on this decision logic, a determination was then made by the Medical Working Group as to which of the three types of medical surveillance provisions was required for each substance.

(1) For those substances with low potential for serious health effects the standards require that the employer, through questioning of the employee, screen for a history of preexisting medical conditions that may predispose the employee to adverse health effects as a result of exposure. The employer is required to make a physician's examination available only if the employee provides a positive history of specified preexisting medical conditions.

This screening type of medical surveillance (as determined by the decision logic) is required if the substance present in the workplace is:

(i)an acute systemic toxin -- but one that is rapidly metabolized and reversible in its effects,

(ii)relatively low in toxicity to the average employee at other than accidental overexposure levels,

(iii)only a skin and eye irritant at levels just above the permissible exposure level.

(2)For more toxic and hazardous substances, a preplacement medical examination is required, especially for substances that have insidious onset as a result of the cumulative effect of chronic exposure.

A required preplacement examination establishes a baseline appraisal of the employee's health by which to judge later whether or not his health is being adversely affected by exposure; and screens the employee for preexisting medical conditions that place him at increased risk to exposure. Note that the permissible exposure level may not protect persons who may have certain health impairments. This preplacement examination is required for several reasons:

(i)To establish a baseline for the functioning of certain organ systems that are known to be affected by the substance.

(ii)To detect medical conditions that may predispose an employee to the toxic effects of the agent even though the medical condition itself may not be affected.

(iii)To detect medical conditions that may have similar medical findings as those caused by the substance and thus make a judgment about the cause of such findings (should they then occur) difficult or impossible.

These examinations (as determined by the decision logic) are required if the substance is: a possible carcinogen; strongly antigenic; cumulative in its systemic effects by causing repeated acute tissue damage with eventual functional impairment; cumulative in its systemic effects by being slowly metabolized or retained in body with accumulation to toxic levels; or a significant toxin if absorbed through skin or gastro-intestinal tract.

When medical examinations are required, the following possible tests are specified in the medical surveillance provisions of the Draft Technical Standard.

- Medical history and physical examination
- 14" x 17" chest roentgenogram
- FVC and FEV (1 sec)
- Urinalysis

- Electrocardiogram
- A complete blood count
- Liver function tests
- Blood tests
- Prothrombin time
- Pelvic roentgenogram
- Cholinesterase determination
- Sputum cytology examination
- Urinary cytology examination

(3) For those substances that are not reported to cause the effects listed above for the screening or examination type medical surveillance, no medical surveillance (as determined by the decision logic) is required nor is surveillance required if reported effects are related to physical displacement of oxygen nor if the effects are not severe, if they are reversible, and if they are not likely to occur even if with extreme levels of exposure. These classifications are made on the basis of toxicity information developed by the Medical Surveillance Working Group.

The medical requirements in each Draft Technical Standard should not be considered optimum. They are only intended to protect the the employee from the toxic effects of the individual substance covered by the Draft Technical Standard. They do not address other hazards to which the employee may be exposed including synergistic effects of other substances present. On the other hand, where good occupational medicine is being practiced, the requirements of such standards are probably being met.

Periodic medical examinations are not routinely required for those substances with a relatively low toxicity or hazard rating unless the employer is informed by the employee of the development of medical conditions that may increase his risk to exposure. The employer then must obtain a medical opinion regarding future exposure. In Draft Technical Standards covering more toxic and hazardous substances, routine medical examinations are usually required. In most cases, the required examination is limited to those bodily systems known to be affected by the agent. If other systems may be indirectly affected, however, periodic monitoring may include an assessment of these systems. For example, for agents that may cause anoxia, the status of the employee's cardiovascular system would be of importance since an employee with an impaired coronary artery system would be at increased risk to the effects of exposure. The timing of these periodic examination is based on the intervals at which those employees who are exhibiting no overt sign or symptom of toxic exposure or have not experienced unusual exposure should be examined to ensure that subclinical affects are not occurring. These are not intended to reflect optimum intervals but are considered adequate to provide surveillance. Otherwise, the

rationale for requirements under periodic examination is identical to those for paragraph (2) medical examination, above.

In those standards requiring routine examinations, the employer may use an alternative examination to those stated in the Draft Technical Standard if the physician provides assurances to the employer that such examination is at least equally effective. This is in recognition of the development of new information with advancing technology. It is obvious that rigid requirements should not preclude a physician from employing new or better techniques of monitoring as these become available.

Routine periodic examinations are intended to monitor for effects of the substance that are not obvious to the employee or others who may observe him. If, in the interval between examinations, the employee develops overt symptoms or signs of toxic exposure or is exposed to a massive concentration of the toxic substance for any reason, an interim medical examination must be made available to the employee.

Informing the Physician

The employer, in arranging for the required medical examination, must provide the physician with the following:

(1) A copy of the Draft Technical Standard including Appendixes A, B, and C. Appendix C (the Medical Surveillance Guidelines) provides information on the toxicity of the substance, the reasons for the medical tests, and interpretation of the tests. This Appendix C provides the employer a source of information to make available to the physician. The employer is given this responsibility because physicians cannot be expected to be knowledgeable about all toxic substances used in industry and in many instances it is difficult to find information in the usual medical library. This helps ensure that the physician has adequate information to conduct a meaningful examination.

(2) A description of the employee's duties as they relate to his exposure so that the physician will understand the circumstance that could lead to exposure to the substance.

(3) A description of any personal protective equipment the employer requires the employee to use. The physician may then offer an opinion on whether the employee is able to wear this equipment. Finally, the employer should make known to the physician any considerations that would affect that individual's ability to wear that equipment. For instance, if the employee must wear impervious clothing or respirators, the physician will need to know if the employee is physically

able to conform with these requirements or if he has a medical condition that could be aggravated by such requirement.

(4)The results of exposure measurements, if any have been made, so as to reveal the extent of the risk. If no exposure measurements have been made, as in the case of a new employee, anticipated exposure based on measurements of other employees should be supplied.

(5)If any previous medical examinations have been made of the employee, the physician may request this information to identify trends. The employee's consent to transfer of this information is needed if the physician is not the employer or employees' physician. This may be an important consideration in monitoring for toxic effects. The Draft Technical Standard only requires the information be given to the physician; it does not require that he assimilate it. If the physician routinely takes care of the same group of people, he will not have to re-assimilate it for each case.

To avoid unnecessary duplication of tests required by these Draft Technical Standards requiring medical procedures, the tests need not be repeatedly performed if records of such tests performed within the past 6 months are acceptable to the examining physician.

Physician's Opinion

As part of the employee's medical record, the physician must furnish the employer a written opinion with the results of the required tests.

The specific medical procedures needed to render this opinion are agreed upon between the employer and the physician. Specific requirements are, however, set forth where certain tests are sufficiently objective and widely accepted as good practice for the monitoring of body systems.

The written opinion of the physician should be a short statement specifically concerning to the employee's risk of exposure to the substance. If the employee does have medical conditions that the physician believes would be aggravated by exposure or if the employee is developing signs and symptoms associated with the toxic effects of the substance, the physician should provide this information to the employer in sufficient understandable detail. If no specific tests are required, the physician must only provide the employer his written opinion regarding those aspects of the patient's health that are stipulated in the Draft Technical Standard. The physician must not provide the employer with medical information that has no bearing on an employee's occupational exposure nor with specific

diagnosis. For example, the physician may reveal that an employee has a lung condition that places him at increased risk to the substance in question, but should not reveal the specific diagnosis. It is important that the physician specifically state whether or not, in his opinion, an employee may be at increased risk to exposure since the employer cannot be expected to interpret the meaning of medical information. There is no intent to require the physician to furnish the employer a warranty of an employee's fitness. The opinion is not a guarantee.

The employer must furnish the employee with a copy of the physician's written opinion so that the employee is aware of the basis for any action by the employer.

When specific tests are required, the employer must also receive from the physician the results of the test examinations, a copy of or the chest x-ray itself, a recording of the blood count, urinalysis, pulmonary function tests, EKG. (The physician need not provide his interpretation of the tests to the employer.) The rationale for this requirement is that employers may, over a period of time, employ several physicians to conduct required medical examination. The employer, then, will be able to supply these test results to the physician who is monitoring for functional changes in an organ system and needs to detect subtle changes or trends in the functioning of a body system.

The employer is responsible for determining whether an employee is to be exposed to a substance. The employer must obtain certain medical information, including the physician's written opinion, and must consider the physician's opinion in making his decision regarding exposure; he may, however, consider other factors. If the physician does express the opinion that the employee may be at increased risk, the employer must provide this information to the employee before exposing the employee to the substance.

The physician may not reduce the employer's authority and responsibility. The employer has the option to gather additional medical opinions or even to take action contrary to medical opinion if he believes it to be prudent. The employer shall base his determination on any information available to him including the physician's written opinion.

Employee Refusal

The employee may refuse a medical examination. The employer must inform the employee of possible health consequences known to the employer of his refusal and obtain a signed statement by the employee stating he understands the risk of the refusal. What action an employer may take as a consequence of that refusal is not clear at this time.

The Decision Logic for the Medical Surveillance Guidelines is
in Attachment 8.

RECORDKEEPING

The employer must keep a record of all required employee exposure determinations and measurements to document that he has examined his workplace and has considered whether or not a potentially hazardous situation exists. This record must contain at least the information specified by paragraph (b)(2) of each Draft Technical Standard. Only the latest record is retained. This is generally the same information as would be obtained by an industrial hygienist taking samples.

The employer is also required to maintain a record of ventilation system tests for effectiveness to verify that the tests were conducted. This record can also be compared with previous tests to detect any trends that may be occurring and to determine which control system may be inoperative or defective.

All training and information received by the employee must be recorded for the employer to be certain that new employees and employees who have changed jobs or have changed exposure status are properly informed.

The employer is required to maintain an accurate medical surveillance record for each employee. The record must include the physician's medical opinion and other medical documents as specified. This is necessary to ensure that the employer, did in fact, observe the recommendations given in the physician's medical opinion with respect to future exposure of an employee.

For employees exposed to substances whose toxic effects are usually acute and do not result in permanent impairment, the medical records are retained for the duration of the employment.

For employees exposed to substances whose toxic effects are known or suspected to be cumulative based upon animal or human data, the records must be kept during the period of employment and for 5 years after termination of employment.

For employees exposed to substances that are known or suspected to be carcinogenic based upon either animal or human data, the records must be kept during the period of employment and for 30 years after termination of employment. These records have definite value in helping physicians diagnose disease many years after exposure has ceased and in assessing the efficacy of established standards and control procedures.

The medical records are also useful in preserving the rights of a deceased employee's survivors and may be of value for surveillance of disease patterns.

The employer is required to make the required records available to NIOSH or OSHA representatives. The representative

can then determine whether the prior provisions have been complied with, evaluate what measurements or other investigations would be appropriate, and evaluate good faith efforts on the part of the employer. Records of employee's exposure determinations and measurements must be made available to that employee or former employee or his designated representative. Reports of employee medical records must be provided to an employee-designated physician on receipt of the written request of the employee. These records are considered to be of value in the future treatment of occupational and other diseases.

OBSERVATION OF MONITORING

Section 8(c)(3) of the Act requires regulations promulgated under the Act to provide "employees or their representatives with an opportunity to observe such monitoring or measuring." Section (1) Draft Technical Standard implements this requirement by providing that the employee furnish certain specific information to the observer. This ensures that the right to observe is meaningful by conveying to the observer information that may not be apparent by a simple observation.

SUBSTANCE SAFETY DATA SHEET DRAFT TECHNICAL STANDARD
(APPENDIX A)

Appendix A is provided to assist the employer in complying with the Draft Technical Standard requirements for Training and Information and Medical Surveillance. All of the information contained in the appendix is informative and has been derived from the same sources and decision logics used to formulate each Draft Technical Standard. Where information is stated as a requirement, it merely reflects a duty established in the Draft Technical Standard. An attempt has been made to use language in the appendix that is readily understandable to the employee. The information contained in this appendix could be used as a basic foundation on which to build an employee education program.

Without this appendix, the employer would need to search a variety of sources to obtain equivalent information. Such independent searching may result in the compilation and communication of information that is less complete, accurate, or understandable than that contained in this appendix. An additional consideration is that it is much easier to provide information than it is to describe the information without providing it.

See Attachment 6 for the Substance Safety Data Sheet Decision Logic.

SUBSTANCE TECHNICAL GUIDELINES DRAFT TECHNICAL STANDARD
(APPENDIX B)

The substance technical guidelines provide the employer more detailed information on the hazards, use and handling and storage of a substance so he can develop specific instructions applicable to his own individual establishment. These instructions should then be conveyed to the employee as part of normal operating procedures. This appendix is included to lessen the burden on the employer and to make it feasible for him to comply with other complex requirements of the regulation where specific technical information is needed.

All of the material contained in this appendix is informative. Where information is stated as a requirement, it merely reflects a duty established in an earlier section of the standard.

Additionally, providing the employer with these information sources reduces the likelihood of control actions being instituted on the basis of incomplete or inappropriate information.

See Attachment 7 for the Substance Technical Guidelines Decision Logic.

MEDICAL SURVEILLANCE GUIDELINES (APPENDIX C)

This appendix gives the employer a convenient way to provide the physician examining an affected employee the information he needs to interpret the results of the examination. Since in most cases the physician will not be an expert in occupational medicine, it is necessary to explain what effect exposure to a specific substance can have on the health of the employee. The literature (31,32) contains examples of instances where employees with occupational disease were examined by presumably uninformed physicians who did not recognize the disease. The Draft Technical Standard requires that this Appendix be furnished to any examining physician.

See Attachment 8 for the Medical Surveillance Guidelines Decision Logic.

USE/EXPOSURE AND CONTROL DOCUMENT

The use/exposure and control document was developed as a reference document for the working groups to develop an awareness of the actual exposure and control situations likely to be encountered. This contractor-developed document lists in descending order of importance, the use/exposure situation with the principal route of entry to the worker of the substance and the currently used control technology.

Several factors were included in evaluating the relative impact of different substance use/exposure situations upon employee health: the number of employees exposed to the toxic substance, the amount of toxic substance released (dust, fume, gas, etc.), and a factor that assesses the physical conditions or circumstances surrounding the release of the substance. This final factor considers the following situations:

- Release of pure compounds and mixtures
- Release of substances at elevated and ambient temperatures
- Release of substances directly into the breathing zone.

The ranking for each use/exposure situation reflects consideration of the above factors. However, judgment was also applied to readjust rankings as appropriate.

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ATTACHMENT 1

RESPIRATOR DECISION LOGIC

1 February 1978

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I. INTRODUCTION

The purpose of the Respirator Decision Logic is to provide the necessary criteria for the selection of respirators and to assure technical accuracy and uniformity when selecting respirators for different substances having similar characteristics. The decision logic is a step-by-step elimination of inappropriate respirators until only the acceptable ones remain. The judgment of persons who are knowledgeable about inhalation hazards and respiratory protection equipment is essential to ensure appropriate selection of respirators.

The primary technical criteria for what constitutes a permissible respirator is based on the technical requirements of 30 CFR Part 11 (Department of the Interior, Bureau of Mines, Respiratory Protective Devices and Tests for Permissibility). The Draft Technical Standards permit only the use of respirators approved by the Bureau of Mines (or Mining Enforcement and Safety Administration (MESA)) and NIOSH under 30 CFR 11. Classes of respirators are only included when at least one device has been approved. The 30 CFR 11 approval categories for respirators are: Self-Contained Breathing Apparatus (Subpart H); Gas Masks (Subpart I); Supplied-Air Respirators (Subpart J); Dust, Fume, and Mist-Respirators (Subpart K); Chemical Cartridge Respirators (Subpart L); and Pesticides Respirators (Subpart M).

Protection factors are criteria, designed to afford adequate protection to the wearer, that are used in determining what limiting concentrations are to be permitted for each type of respirator. The referenced subparts of 30 CFR 11 give technical descriptions concerning each type or class of respirators referenced in the Decision Logic. 30 CFR 11 should be used with this Decision Logic to properly understand the criteria for the specification of allowable respirators.

II. GENERAL DECISION LOGIC FLOWCHART

Step 1 - Assemble information on substance.

Assemble necessary toxicological, safety, and research information for the particular contaminant. Typically the following are required:

- 1) Permissible exposure limits specified in 29 CFR 1910.1000 (Tables Z-1, Z-2, and Z-3). These are the former 29 CFR 1910.93 tables.
- 2) Warning properties if the substance is a gas or a vapor. Refer to Part IV(B) of this Logic.
- 3) Eye irritation potential of the substance. Refer to Part IV(D) of this Logic.
- 4) Lower flammable limit (LFL) for the substance. Refer to Part IV(F) of this Logic.
- 5) Immediately dangerous to life and health (IDLH) concentration for the substance. Refer to Part IV(E) of this Logic.
- 6) Any possibility of poor sorbent efficiency at IDLH concentration and below. Refer to Part IV(C) of this Logic.
- 7) Any possibility of systemic injury or death resulting from absorbance of the substance (as a gas or vapor) through the skin. Refer to Part IV(A) of this Logic.
- 8) Any possibility of severe skin irritation resulting from contact of the skin with corrosive gases, vapors or particulates (Refer to Part IV(A) of this Logic).
- 9) The vapor pressure of the substance (and equivalent ppm).
- 10) Any possibility of high heat of reaction with sorbent material in cartridge or canister.
- 11) Any possibility of shock sensitivity of substance sorbed on sorbent of cartridge or canister.

Step 2 - Determine physical state of substance.

Determine the physical state(s) of the substance as it is likely to be encountered in the occupational environment. It will be either:

- a) Gas or vapor,
- b) Particulate (dust, fume or mist), or
- c) Combination of (a) and (b).

Step 3 - Assemble table of permissible respiratory protection for substance

This is done using the material from Step 1 and the appropriate Specific Decision Logic Chart from Part III of this Logic and the Respirator Protection Factors in Appendix I.

Classes of respirators are only included where at least one device has been approved.

III. SPECIFIC DECISION LOGIC CHARTS

A. SPECIFIC DECISION LOGIC CHART FOR RESPIRATORY PROTECTION AGAINST GASES OR VAPORS

CONDITION

SELECTION SEQUENCE

Routine use

Consider:

- a) Skin irritation and sorption of the material through the skin (see IV (A)).
- b) Poor warning properties - eliminate all air purifying respirators (See IV (B)).
- c) Eye irritation - eliminate or restrict use of half-mask respirators (See IV (D)).
- d) IDLH or LFL - above this concentration, eliminate all but positive-pressure, self-contained breathing apparatuses, and combination positive-pressure, supplied-air respirators with auxiliary positive-pressure self-contained breathing apparatus (See IV (E) and (F)).

List all allowed respirators by condition of use and type.

Entry and escape from unknown concentrations

Use positive-pressure, self-contained breathing apparatus or combination positive-pressure, supplied-air respirator with auxiliary positive-pressure self-contained breathing apparatus.

Firefighting

Use positive-pressure, self-contained breathing apparatus.

Escape

Use gas mask or escape self-contained breathing apparatus (See IV (C)).

B. SPECIFIC DECISION LOGIC CHART FOR RESPIRATORY PROTECTION AGAINST PARTICULATES

<u>CONDITION</u>	<u>SELECTION SEQUENCE</u>
Routine use	Consider: <ul style="list-style-type: none">a) Skin irritation or sorbtion of the material through the skin (See IV (A)).b) Eye irritation - eliminate or restrict use of half-mask respirators (See IV (D)).c) Systemic poison - eliminate single-use respirators.d) For permissible exposures less than 0.05 mg/m³-eliminate dust, fume, and mist (DFM) respirators except with high-efficiency particulate filter.e) IDLH or LFL - Above this concentration, eliminate all but positive-pressure, self-contained breathing apparatuses and combination positive-pressure, supplied-air respirators with auxiliary positive-pressure, self-contained breathing apparatus (See IV (E)).
	List all allowed respirators by condition of use and type.
Entry and escape from unknown concentration	Use positive-pressure, self-contained breathing apparatus or combination positive-pressure, self-contained breathing apparatus.
Firefighting	Use positive-pressure, self-contained breathing apparatus (See IV (F)).
Escape	Use any dust, fume, or mist respirator, except single-use, or any escape self-contained breathing apparatus.

C. SPECIFIC DECISION LOGIC CHART FOR RESPIRATORY PROTECTION AGAINST COMBINATION OF GAS OR VAPOR AND PARTICULATES

CONDITION

SELECTION SEQUENCE

- Routine use Consider:
- a) Eliminate all respirators except those with combination sorbent/particulate filter.
 - b) Skin irritation or skin sorption of the material through the skin (See IV (A)).
 - c) Poor warning properties or inadequate sorbent efficiency - eliminate all air purifying respirators (See IV (B) and (C)).
 - d) Eye irritation - eliminate or restrict use of half-mask respirators (See IV (D)).
 - e) For permissible exposures less than 0.05 mg/m³ - eliminate all respirators except with sorbent/high-efficiency particulate filter.
 - f) IDLH or LFL - above this concentration, eliminate all but positive-pressure, self-contained breathing apparatuses and combination positive-pressure, supplied-air respirators with auxiliary positive-pressure self-contained breathing apparatus (See IV (e)).

List all allowed respirators by condition of use and type.

Entry and escape from unknown concentration Use positive-pressure, self-contained breathing apparatus or combination positive-pressure, supplied-air respirator with auxiliary positive-pressure, self-contained breathing apparatus.

Firefighting Use positive-pressure, self-contained breathing apparatus (See IV (F)).

Escape Use gas mask or escape self-contained breathing apparatus (See IV (C)).

IV. DECISION LOGIC CRITERIA

A. SKIN ABSORPTION AND IRRITATION

Personal protection requirements for protection against exposure to substances that may cause injury by absorption through the skin from materials splashed or spilled on the skin are covered in Section (f) of each Draft Technical Standard substance standard. Respirator selection criteria are based primarily on the inhalation hazard of the substance. A supplied-air suit may provide skin protection for extremely toxic substances that may be absorbed through the skin, or for substances that may cause severe skin irritation or injury.

Supplied-air suits are not covered in 30 CFR 11. Data are not available upon which to make recommendations for supplied-air suits for all types of exposures.

Where information is available indicating systemic injury or death resulting from absorbance of a gas or vapor through the skin or where severe skin irritation or injury may occur from exposure to a gas, corrosive vapor, or particulate, the following statement is included as a footnote to the respirator table prepared for that particular substance and both the employee and employer are cautioned in the appendices of the Draft Technical Standard concerning their use:

"Use of supplied-air suits may be necessary to prevent skin contact and respiratory exposure from airborne concentrations of ****substance****. Supplied-air suits should be selected, used, and maintained under the immediate supervision of persons knowledgeable in the limitations and potential life endangering characteristics of supplied-air suits. Where supplied-air suits are used above a concentration which may be immediately dangerous to life and health, (concentration) an auxiliary positive-pressure self-contained breathing apparatus must also be worn."

The decision whether or not to include the footnote is made by the NIOSH/OSHA review committees based on available information. Since most information concerning skin irritation is not quantitative, but rather presented in commonly used descriptive terms, such as "a strong skin irritant, highly irritating to the skin", "corrosive to the skin", etc., the decision made by the committees concerning skin irritation is a judgmental decision often based on nonquantitative information. As a guideline for inclusion of the supplied-air suit statement for substances that are sorbed through the skin, a single skin penetration LD50 of 2 g/kg for any animal species is used.

The supplied-air suit footnote is advisory in nature and its inclusion does not make the use of supplied-air suits mandatory.

Further, employers may use supplied-air suits in any situation where they provide adequate protection, whether or not there is an advisory footnote in the respirator table. To ensure the health and safety of persons using supplied-air suits, it is imperative that they be used under the immediate supervision of persons knowledgeable in the limitations and potential life endangering characteristics of supplied-air suits.

B. POOR WARNING PROPERTIES

It is important to realize that 30 CFR 11 NIOSH/MSHA approvals for air-purifying (organic vapor) devices prohibit their use against organic vapors with poor warning properties. Specifically, 30 CFR 11.90(b) (Note 4) covers gas masks (canister respirators) and 30 CFR 11.150 (Note 7) covers chemical cartridge respirators. Thus these approvals are only for organic vapors with adequate warning properties and not for all organic vapors.

Warning properties include odor, eye irritation, and respiratory irritation. Warning properties relying upon human senses are not foolproof. However, they provide some indication to the employee that the effectiveness of the sorbent is exhausted, or that the fit of the facepiece is poor, or that there is some other respirator malfunction.

Adequate warning properties can be assumed when the odor, taste, or irritation effects of the substance are detectable and persistent at concentrations "at" or "below" the permissible exposure limit.

It is expected that environmental concentrations will vary considerably, and, therefore, warning of a respirator failure would soon be perceived at contaminant concentrations somewhat above the permissible exposure limit.

If the odor or irritation threshold of a substance is more than three times greater than the permissible exposure limit, this substance should be considered to have poor warning properties. If the substance odor or irritation threshold is somewhat above the permissible exposure limit (not in excess of three times the limit) and there is no ceiling limit for the substance, consideration is given as to whether or not undetected exposure in this concentration range could cause serious or irreversible health effects. If the substance could not cause serious or irreversible health effects, it is considered to have adequate warning properties. Some substances have extremely low thresholds of odor and irritation (i.e., are easily detected) in relation to the permissible exposure limit. Because such substances can be detected by a worker wearing a properly functioning and fitted respirator they are considered to have poor warning properties. The danger of such substances is that

at dangerous concentrations the respirator wearer would not be warned by the odor itself.

Though 30 CFR 11 does not specify eliminating air purifying respirators for pesticides with poor warning properties, the SCP Respirator Review Committee believes the Standards Completion Program should not allow pesticide respirators for any gases and vapors with poor warning properties.

C. SORBENTS

Where supporting evidence exists on immediate (less than 3 minutes) breakthrough time at the IDLH concentration and below for a cartridge or canister sorbent, air-purifying devices shall not be allowed for any use, escape or otherwise.

Where there is reason to suspect that the commonly used sorbents (e.g., activated charcoal) do not provide adequate sorption efficiency against a specific contaminant, use of such sorbents shall not be allowed. However, where another sorbent material has been demonstrated to be effective against a specific contaminant, approved respirators using the effective sorbent material shall be allowed. The statement in the respirator table prepared for that substance shall read, "Any chemical cartridge respirator providing protection against **substance**", and "Any gas mask providing protection against **substance**".

Where there is reason to suspect that a sorbent has a high heat of reaction with a substance, use of that sorbent is not allowed. In such cases, only sorbents providing safe protection against **substance** may be used. For such a substance, a footnote is added to the respirator table that reads as follows: "**substance** is a strong oxidizer and should be kept away from oxidizable material. Some cartridges and canisters may contain activated charcoal and shall not be used to provide protection against **substance**. Only nonoxidizable sorbents are allowed." Where the oxidizable material may be an oxidizable filter, the footnote reads: "**substance** is a strong oxidizer and should be kept away from oxidizable substances. Only air purifying respirators with nonoxidizable filters are allowed."

Where there is reason to suspect that a substance sorbed on a sorbent of a cartridge or canister is shock sensitive, use of air purifying respirators is disallowed.

D. EYE IRRITATION

For routine work operations, any perceptible eye irritation is considered unacceptable. Therefore, only full facepiece respirators are permissible in contaminant concentrations that produce eye irritation. Note that 30 CFR 11.90(b)(Note 6) specifies that eye protection may be required in certain

concentrations of gases and vapors. For escape, some eye irritation is permissible if it is determined that such irritation would not inhibit escape and such irritation is reversible.

Where quantitative eye irritation data cannot be found in the literature reference and theoretical considerations indicate the substance should not be an eye irritant, half-facepiece respirators are allowed.

Where a review of the literature indicates a substance causes eye irritation but no eye irritation threshold is specified, the data will be evaluated to determine whether quarter- or half-facepiece respirators are to be included in the respirator tables. When a table is developed for such a substance, the respirators with quarter and half facepieces shall be footnoted as follows: "When an employee informs his employer that he is experiencing eye irritation from **substance** while wearing a respirator allowed in Table 2, the employer shall provide and ensure that the employee use an equivalent respirator with a full facepiece, helmet, or hood."

E. IMMEDIATELY DANGEROUS TO LIFE OR HEALTH (IDLH)

The definition of IDLH provided in 30 CFR 11.3(t) is:

" 'Immediately dangerous to life or health' means conditions that pose an immediate threat to life or health or conditions that pose an immediate threat of severe exposure to contaminants, such as radioactive materials, which are likely to have adverse cumulative or delayed effects on health."

The purpose of establishing an IDLH exposure concentration is to ensure that the worker can escape without injury or without irreversible health effects from an IDLH concentration in the event the respiratory protective equipment fails. The IDLH is considered a maximum concentration above which only a highly reliable breathing apparatus providing maximum worker protection is permitted. Since IDLH values are conservatively set, any approved respirator may be used up to its maximum use concentration below the IDLH.

In establishing the IDLH concentration the following two factors are considered:

1. Escape without loss of life or irreversible health effects. (Thirty minutes is considered the maximum permissible exposure time for escape.)

2. Escape without severe eye or respiratory irritation or other reactions that would prevent escape without injury.

IDLH should be determined from the following sources:

1. Specific IDLH provided in the literature such as the AIHA Hygienic Guides (See Appendix II)
2. Human exposure data,
3. Acute animal exposure data, and
4. (When such data are lacking), acute toxicologic data from analogous substances.

The following guidelines should be used to interpret toxicologic data reported in the literature for animal species:

1. Where acute exposure animal data are available (30 minute to 4-hour exposures), the lowest exposure concentration causing death or irreversible health effects in any species is determined to be the IDLH concentration.
2. Chronic exposure data may have no relevance to the acute effects and should be used in determining the IDLH concentration only upon competent toxicologic judgment.
3. Where there is no toxicologic evidence of an IDLH concentration, 500 times the permissible exposure limit shall determine the upper limit above which only highly reliable breathing apparatus providing maximum worker protection is used.

F. LOWER FLAMMABLE LIMIT (LFL) AND FIREFIGHTING

Contaminant concentrations in excess of the LFL are considered to be immediately dangerous to life or health. At or above the LFL, the use of respirators is limited to those devices that provide the maximum protection, i.e., positive-pressure, self-contained breathing apparatus, and combination positive-pressure, supplied-air respirators with auxiliary positive-pressure, self-contained breathing apparatus.

Firefighting is defined by ANSI Z88,5-1971 as being immediately dangerous to life. For firefighting, the only device providing adequate protection is the positive-pressure, self-contained breathing apparatus.

G. VARIATIONS FROM 30 CFR 11

The Type A supplied-air respirator is allowed in 30 CFR 11 for use in IDLH atmospheres. However, the air flow requirement of 50 l/min is insufficient to maintain a positive pressure in the facepiece under all working conditions. Therefore, this device should have the same protection factor that is available with other air-purifying and atmosphere-supplying respirators having a negative pressure in the facepiece (see Appendix I). 30 CFR 11 will need to be revised to eliminate approval of Type A supplied-air respirators for IDLH atmospheres.

30 CFR 11 does not contain protection factor requirements. Protection factors are used in the decision logic. An amendment to 30 CFR 11 is planned that will include protection factor requirements for dust, fume, and mist respirators. Future amendments are contemplated for other types of respirators.

30 CFR 11 does not permit the use of an escape gas mask against acid gases or organic vapors with poor warning properties. A change to 30 CFR 11 is necessary to permit an escape gas mask to be used against substances with poor warning properties.

H. ESCAPE

Where the employer provides escape respirators, they shall be selected from the escape category in the table in the Draft Technical Standard. The employer shall provide and ensure that employees carry an escape respirator where exposure may occur to extremely toxic substances. (An extremely toxic substance is defined as a gas or vapor having a rat LC50 of less than 10 ppm.)

The following statement is added to the introduction to the respirator table that is prepared for these substances:

"Employers shall provide each employee working in areas where ****substance**** may be released into the workplace air with an approved escape respirator as specified in Table 2. The employer shall ensure that each employee carry the escape respirator in the area where ****substance**** may be released into the workplace."

I. ENTRY INTO TANKS OR CLOSED VESSELS

Item (d)(4)(iv) of the Draft Technical Standards is a variable provision in the introductory statements to the respirator tables that lists the specific operations where a respirator is considered to be an acceptable means of control, e.g., for operations that require occasional entry into tanks or other closed vessels.

V. RESPIRATOR PROTECTION FACTORS

Protection factors are a measure of the overall effectiveness of a respirator. Filtering efficiency is a part of the protection factor and becomes a significant consideration for less efficient air purifying respirators.

The protection factors used in preparing the Draft Technical Standards are based on quantitative fit tests performed at Los Alamos Scientific Laboratory (Reference 44) and elsewhere and, in some instances, on professional judgment. The protection factors for each class of respirators listed are below in the check lists. The entries in each list are for an entire class of respirators, and are assigned the protection factor of the poorest performing device within each class (i.e., the device with the lowest protection factor).

A. PARTICULATE FILTER RESPIRATORS

Protection Factor	Permissible Respiratory Protection
5X	Any dust and mist respirator (30 CFR 11.130)
5X	Any dust and mist respirator, except single-use (30 CFR 11.130)
10X	Any dust and mist respirator, except single-use or quarter-mask respirator (30 CFR 11.130)
10X	Any fume respirator (30 CFR 11.130)
10X	Any high-efficiency particulate filter respirator (30 CFR 11.130)
50X	Any high-efficiency particulate filter respirator with a full facepiece (30 CFR 11.130)
1000X	Any powered air-purifying respirator with a high-efficiency particulate filter (30 CFR 11.130)

B. CHEMICAL CARTRIDGES AND GAS MASKS

Protection Factor	Permissible Respiratory Protection
10X	Any chemical cartridge respirator with a **substance** cartridge(s)* (30 CFR 11.150)
50X	Any chemical cartridge respirator with full facepiece and **substance** cartridge(s) (30 CFR 11.150)
50X	Any gas mask with a full facepiece and **substance** canister (30 CFR 11.90(a))
1000X	Any powered air-purifying chemical cartridge respirator with a **substance** cartridge***
Escape	Any gas mask providing protection against **substance** vapors (30 CFR 11.90)

NOTE: *The approved **substance** may consist of acid gases or or organic vapors as a class or specific acid gases, ammonia, or organic vapors. It may also consist of combinations of acid gases, organic vapors, and other gases and vapors.

**Classes of respirators are only included where at least one device has been approved.

***Class of device not listed in 30 CFR 11.

C. COMBINATION CHEMICAL CARTRIDGES AND PARTICULATE FILTERS, AND GAS MASKS AND PARTICULATE FILTERS*

Protection Factors	Permissible Respiratory Protection
10X	Any chemical cartridge respirator with **substance** cartridge(s)* and **substance** filter(s) (30 CFR 11.150 and 11.130)
50X	Any chemical cartridge respirator with a full facepiece, **substance** cartridge(s), and high-efficiency filter(s) (30 CFR 11.150 and 11.130)
50X	Any gas mask with a full facepiece, **substance** canister, and high-efficiency filter (30 CFR 11.90(a) and 11.130)
1000X	Any powered air-purifying, chemical-cartridge respirator with a **substance** cartridge and high-efficiency particulate filter
Escape	Any gas mask providing protection against **substance** and particulates (30 CFR 11.90 and 11.130)

Substance refers to any acid gas, alkaline gas, organic vapor, or other specific gas or vapor.

* A pesticide respirator is a special type of chemical cartridge respirator or gas mask with a combination sorbent and particulate filter. When the substance is a pesticide, the following phrase is added as a footnote to the respirator table: "Including pesticide respirators which meet the requirements of this class."

D. SUPPLIED-AIR RESPIRATORS

Protection Factor	Permissible Respiratory Protection
10X	Any supplied-air respirator (30 CFR 11.110(a))
50X	Any supplied-air respirator with a full facepiece, helmet, or hood (30 CFR 11.110(a))
1000X	Any Type C supplied-air respirator operated in pressure-demand or other positive- pressure or continuous-flow mode (30 CFR 11.110(a))*
2000X	Any Type C supplied-air respirator with a full facepiece operated in pressure- demand or other positive-pressure mode with a full facepiece, hood, or helmet operated in continuous-flow mode (30 CFR 11.110(a))

*This category is not fully covered by preceding category.

E. SELF-CONTAINED BREATHING APPARATUS

Protection Factor	Permissible Respiratory Protection
10X	Any self-contained breathing apparatus (30 CFR 11.70(a))
50X	Any self-contained breathing apparatus with a full facepiece (30 CFR 11.70(a))
10,000 and greater or fire-fighting	Self-contained breathing apparatus with a full facepiece operated in pressure-demand or other positive-pressure mode (30 CFR 11.70(a))
10,000 and greater	Any combination respirator that includes a Type C supplied-air respirator with a full facepiece operated in pressure-demand or other positive-pressure or continuous-flow mode and an auxiliary, self-contained breathing apparatus operated in pressure-demand or positive-pressure mode (30 CFR 11.70(b))
Escape	Any escape self-contained breathing apparatus (30 CFR 11.70(a))

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- b) Commerical Solvents
- c) Dow Chemical
- d) Eastman Kodak
- e) Exxon
- f) FMC
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- i) Rohm & Haas
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ATTACHMENT 2

FIRE AND SAFETY DECISION LOGIC

(I) LIQUIDS

(A) Local Exhaust Ventilation.

The statements used in paragraph (e) of the Draft Technical Standard are:

"In the design of open surface tank ventilation for the purposes of § 1910.94(d), operations involving **substance** shall be classified as ___ (classification determined from §1910.94(d)(2)(v)-(vi)). At 21 degrees C, (70 degrees F).";

"Open-surface tank operations shall be performed in accordance with § 1910.94(d).";

"Spray finishing operations shall be performed in accordance with §§ 1910.107 and 1910.94(c).":

"Dip tank operations shall be performed in accordance with §§ 1910.108 and 1910.94(d)."

(B) Fire Extinguishers.

The statement used in the Draft Technical Standard is, "For the purpose of compliance with § 1910.157, **substance** is classified as a Class ___ (classification determined from §1910.157) fire hazard."

(C) Storage, Handling And Use (1910.106)

The statement, "For the purpose of compliance with § 1910.106, liquid **substance** is classified as a Class ___ (As determined from §1910.106.) flammable liquid is used in the Draft Technical Standard.

(D) Electrical Wiring (1910.309).

The statement used in the Draft Technical Standard is, "For the purpose of compliance with § 1910.309, locations classified as hazardous locations due to the presence of **substance** shall be Class --, Group --." (As determined from §1910.309, referencing the National Electrical Code.)

Classification is not used if substance is not combustible (for liquids whose flash point is greater than 200 F).

(E) Industrial trucks (1910.178),

The statement used in the Draft Technical Standard is "For the purpose of compliance with § 1910.178, locations classified as hazardous locations due to the presence of **substance** shall be Class --, Group --. (As determined from §1910.178).

(F) "Fan in Ductwork",

The statement used in the Draft Technical Standard is, "Where a fan is located in ductwork in the ductwork in concentrations greater than ___ppm. (As determined from the lower flammable

limits if known. If not known, a concentration is estimated based on the available chemical properties of the substance.) (approximately 25% of the lower flammable limit), the fan rotating elements shall be of nonsparking material or the casing shall consist of, or be lined with, nonsparking material. There shall be sufficient clearance between the fan rotating element and the fan casing so as to prevent contact."

(G) Sources of Ignition

This statement in the Draft Technical Standard is the same for all flammable or combustible substances; "Sources of ignition such as smoking or open flames are prohibited where **substance** presents a fire or explosion hazard." In the case of Class 1A flammable liquids, the statement is, "Sources of ignition such as smoking or open flames are prohibited where **substance** is handled, used, or stored."

(II) METALS.

An "index of explosibility" is used to rate the hazard of the metal dusts. This empirical index is a function of the ignition temperature, minimum ignition energy, minimum explosive concentration, maximum explosion pressure, and maximum rate of pressure rise. These data are available from the Bureau of Mines and other sources. The hazard of the dusts are categorized by ratings of none, weak, moderate, strong, and severe. These are correlated as follows:

<u>Relative Explosion Hazard Index</u>	<u>Index of Explosibility</u>
None	0
Weak	Less than 0.1
Moderate	0.1 - 1.0
Strong	1.0 - 10.0
Severe	Greater than 10

The weak category is further broken down to those materials with indices "less than 0.1" and those with indices "much less than 0.1".

(A) Materials with "zero explosibility"

The only requirements are that of chemical incompatibilities or conditions of instability specific to the metal be specified.

(B) Materials With Indices Less Than 0.1.

- (1) Classify substance for fire extinguishers using §1910.157.
- (2) Use source of ignition statement.
- (3) Spills - "provide available ventilation, and then clean up the spill." (See Spills and Disposal section.)

Statements that are added to Appendix B. (See Draft Technical Standards, Appendix B.)

(C) Materials With Indices From 0.1 to 10.

- (1) Classify hazardous locations for §§ 1910.309 (electrical wiring) and 1910.178 (industrial trucks)
- (2) Use source of ignition statement
- (3) Classify for fire extinguishers using §1910.157 (with exception of paragraph (b)(2)(v))
- (4) Spills - insert "immediately eliminate potential sources of ignition." (See Spills and Disposal section.)

(D) Materials With Indices Greater Than 10

In addition to the above requirements, provisions are inserted based on the particular characteristics and use/exposure of the metal dust. For example, requirements pertaining to static electricity precautions, building construction, and special housekeeping procedures may be necessary.

(E) Exceptions

Exceptions to the rules for explosion hazard indices for metals include those for (1) pyrophoric metals necessitating special handling requirements, and (2) those metals for which recent fire experience demonstrate a need for electrical and powered truck classification (e.g., beryllium) even though their explosibility indices would indicate otherwise.

The substance specific requirements are used for special reactivity problems, incompatibilities etc. not covered by the implementation of the above provision's.

Fire hazards are covered so that all the safety hazards of a substance are included. Omitting fire hazards might imply that they did not exist.

Also to be noted is that the fan rotating element shall be nonsparking material or the casing shall consist of, or be lined with, nonsparking material since the concentration of a flammable substance could be very high in local exhaust systems ducts (even though low in the work-area air) and since a spark could cause an explosion. This provision will not be present for noncombustible substances.

ATTACHMENT 3
PERSONAL PROTECTIVE EQUIPMENT AND SANITATION
REGULATORY LANGUAGE DECISION LOGIC
1 February 1978

INTRODUCTION

The personal protective equipment and sanitation requirements in the Draft Technical Standards should be factual and consistent for similar chemicals. Adopting a formalized decision-making and requirement-selection procedure helps achieve the standardization of content and assists the decision-maker during an analysis of the requirements necessary to ensure adequate protection of workers' health and safety when exposed to toxic substances. Given the properties and toxic effects of a substance, the requirements (which insofar as possible are in the form of standardized statements) are determined.

To arrive at appropriate and consistent personal protective equipment and sanitation requirements, this decision logic was developed. The following three types of input information concerning a substance are required for its use:

Possible physical states of the substance in the exposure situation (liquid, gas/vapor, solid),

Routes of entry by which the substance affects the body (skin and eyes, inhalation, ingestion), and

Severity and types of the effects by each route of entry.

All probable exposure-effect situations that might arise when the employee encounters the substance in the occupational environment must be considered. This is done by applying practical industrial knowledge to the best available information obtained from an extensive literature search.

The existence of a substance in more than one physical state may have to be considered, because the equipment and sanitation requirements necessary to protect the worker are governed by the physical state of the hazardous substance. Therefore, guidelines for basing recommendations for equipment and other protective measures based upon three classifications of melting points of substances have been adopted as follows:

Melting point less than 10 degrees C (50 degrees F):
Potentially hazardous as liquid and vapor.

Melting point between 10 degrees C (50 degrees F) and 38 degrees C (100.4 degrees F): Potentially hazardous as solid, liquid, and vapor.

Melting point greater than 38 degrees C (100.4 degrees F): Potentially hazardous as solid and vapor. (Also this guideline applies if the common industrial use of the substance is as a liquid at elevated temperature.)

Once it has been determined which physical states of the substance are of interest and the routes of entry and their associated effects for each state have been defined, numerical classifications (derived from Tables I and II) are assigned to the substance for each of the three possible routes of entry. A decision table (Table III) is then used to determine the possible standard regulatory paragraphs that should be considered for various exposure-effect conditions. The list of standard paragraphs and their technical intent for application (Table IV) is then consulted to ensure that all qualifications and exceptions on usage are satisfied. Finally, the paragraphs ultimately selected by this procedure are reviewed by qualified professionals to ensure that the substance in question does not present any complications that are beyond the scope of the analysis procedure. This final review also ensures that the regulatory requirements for the substance are technically correct and complete and are not repetitive or overlapping.

CLASSIFICATIONS

Six classifications are used to describe the possible physical-state/effect-severity situations that can be encountered. These numerical ratings, one through six, simply delineate the various combinations of these possible physical states of the substance and two levels of effect severity; the ratings are assigned for each of the three possible routes of entry; skin absorption, eye contact, and ingestion. Additionally, classification of zero indicates that either the substance has negligible effects or it does not present a significant hazard in the industrial environment. Tables I and II, Classifications for Severe Effects and Classification for Moderate Effects, give detailed guidelines for assigning these classifications.

Many factors must be considered in the assignment of classifications. Briefly, they include:

Mode of action (local or systemic);

Type of effect (burn, liver degeneration, etc.);

Duration of effect (permanent, quickly reversible, not quickly reversible, etc.);

Amount and physical state of substance required to produce the effect;

Type of exposure required to produce the effect (repeated, prolonged, or brief).

SELECTION OF REGULATORY PARAGRAPHS

Table III, Standard Paragraph Applicability for Personal Protective Equipment and Sanitation, allows for identification of all standard regulatory paragraphs that are normally appropriate when a particular classification is assigned to a particular route of entry. Each of the numerous chemicals to which this decision analysis can be applied is usually capable of producing a wide variety of types and severities of effects. Therefore, this step alone does not guarantee that the paragraphs identified are completely adequate. Hence, Table IV, Standard Paragraphs for Personal Protective Equipment and Sanitation, must be studied to select requirements that encompass all distinguishing characteristics of the substance and all qualifications and exceptions on use of the individual paragraphs, and to decide whether other requirements may be necessitated by unusual characteristics of the substance.

Aside from the aforementioned data items and types of input information needed to classify the substance and its effects, the following physical and chemical data are also generally required:

Vapor pressure of the substance,

Flashpoint of the liquid,

Solubility of the substance as a percentage in water, and

Boiling point.

INTERPRETATION OF KEY PHRASES AND WORDS

Certain key phrases or words contained in these standardized paragraphs require clarification for proper interpretation and application. These key phrases and words are identified and discussed below.

When the toxic effects of skin or eye contact with a regulated substance are particularly severe, the phrase "where there is any possibility of" is used. That is, protective equipment or other actions (or both) are required whenever and

wherever there is any chance that contact with the substance could occur other than by consequence of an unpredictable event such as a collision, fire, explosion, or failure of a sealed, properly designed and constructed container such as a steel pipe or tank. For example, the driver of a tank truck containing a highly corrosive regulated substance would be exempt from the personal protective equipment requirements enroute, but would not be exempt while engaging or disengaging transfer lines.

The phrase requiring the use of personal protective equipment where skin or eye contact "may occur" is used where toxic effects of a regulated substance are moderately severe. These regulations apply whenever and wherever employee contact with a regulated substance is readily conceivable or reasonably foreseeable. Such situations include environments where the chemical agent is being used or handled in a manner where skin or eye contact is "likely to occur." Typical examples would be open-surface tank or spray-finishing operations and laboratory operations in which the substance is being poured from one container to another. In these operations the employee is closely involved with or in proximity to the operations and is likely to come in contact with the agent.

The phrase requiring that personal protective clothing and equipment be worn to prevent "repeated or prolonged" skin contact is used when the toxic effects of a regulated substance are minimal when it is only contacted infrequently or briefly. In these instances, personal protective equipment would not be required unless an employee's work repeatedly exposed him to contact with the agent or required his exposure for more than a few minutes.

The phrases "contaminated with" and "wet with" are used to indicate the extent of actual contact with a regulated substance required before a specified action need be performed. "Contaminated with" applies to any amount of the substance, however small, for which there is either visual or sensual (i.e., the sensations of wetness, odor, irritation) evidence of contact. Included would be clothing soiled with a solid substance or splashed with a few scattered drops of a liquid. "Wet with" applies to an amount of a liquid that covers or permeates a section of an employee's skin or clothing in such an amount that the substance will not evaporate before post-exposure control requirements (e.g., removal of the clothing and washing of the affected parts of the body) can be complied with.

This differentiation is made both to ensure that an employee takes the appropriate, necessary action involving skin or clothing known to be contaminated with a substance which, even in small quantities, can have severe, adverse effects on his health. This also allows an employee to ignore contact with substances

that are virtually harmless in small amounts but that, in large amounts, can produce harmful or otherwise undesirable effects.

The words "immediately" and "promptly" are used to describe the relative speed with which the required action must be taken. Where a requirement specifies that an action is to be taken "immediately," the action must be taken absolutely without hesitation, i.e., within seconds. Substances for which such immediate actions are required are those known to have the potential for causing severe local or systemic injury if not attended to immediately. Such substances would include highly corrosive materials and materials that are readily and rapidly absorbed through the skin.

Substances for which "prompt" actions are required are those for which a short delay in performing the required action would not result in any serious adverse health effects. Where a requirement specifies that an action is to be taken "promptly," the action to be taken should be delayed only as long as is necessary for the employee to walk to a change room, lavatory facility, or other appropriate place to perform the required action, i.e., within a few minutes.

TABLE I. CLASSIFICATION FOR SEVERE EFFECTS*

LIQUIDS	-	1
GASES	-	3
SOLIDS	-	5

*The classification numbers assigned for severe effects of liquids, gases, and solids through entry by skin, eyes, or ingestion.

The following criteria designate a severe effects classification for the different routes of entry.

1. SKIN: Any EFFECTS after contact such as:

A. Acute local skin effects that may threaten life or cause permanent physical impairment or disfigurement following a single skin exposure lasting seconds to minutes--such as deep burns caused by strong acids.

B. Acute local skin effects that may or may not be reversible, but that are not severe enough to cause serious permanent physical impairment or threaten life following a single skin exposure lasting seconds to minutes--such as sensitization or persistent eruptions.

C. Acute systemic effects that may threaten life or cause permanent physical impairment following a single skin exposure lasting seconds to minutes--such as permanent liver or kidney degeneration caused by substances readily and rapidly absorbed through the skin.

D. Systemic effects that may have severe cumulative or delayed effects on health following a single skin exposure lasting seconds to minutes.

2. EYES: Any EFFECTS after contact such as:

A. Acute local eye effects such as permanent injury following a single eye exposure lasting seconds to minutes--such as loss of vision or loss of the eye itself from contact with a strong acid.

b) Acute systemic effects that may or may not threaten life following a single eye contact exposure lasting seconds to minutes.

3. INGESTION: Any EFFECTS such as:

A. Acute or chronic effects on health of a severe or permanent nature following single or repeated oral doses of amounts of a liquid such as might remain on one's hands after they are wiped with a cloth and that could be ingested by hands being put into the mouth during the course of eating, etc.

B. Acute or chronic effects on health of a severe or permanent nature following single or repeated oral doses of solids in milligram amounts by hands being put into the mouth during the course of eating, etc.

TABLE II. CLASSIFICATION FOR MODERATE EFFECTS*

LIQUIDS - 2

GASES - 4

SOLIDS - 6

*See footnote in TABLE 1.

The following criteria designate a moderate effects classification for the different routes of entry.

1. SKIN: Any INJURY OR IRRITATION AFTER CONTACT such as:

A. Acute local skin effects that are reversible following a single skin exposure lasting more than a few minutes and that are not serious in nature -- such as minor burns, defatting of skin, etc.

B. Chronic local skin effects following repeated or prolonged (i.e., more than a minute or two) skin contact-- such as chronic dermatitis caused by a fat solvent.

C. Chronic systemic effects on health following repeated or prolonged (i.e., more than a minute or two) skin contact-- such as might be caused by a substance absorbed relatively slowly through the skin.

2. EYES: Any RAPIDLY OCCURRING EFFECTS after contact such as:

A. Acute local eye effects such as temporary lacrimation, temporary eye irritation, or transitory corneal injury following eye contact lasting seconds to minutes.

3. INGESTION: Any EFFECTS such as:

A. Moderate and reversible acute or chronic effects on health following ingestion of amounts of a liquid such as might remain on a person's hands after they are wiped with a cloth and that could be ingested by hands being put into the mouth during the course of eating, etc.

B. Moderate and reversible acute or chronic effects on health following ingestion of solids in milligram amounts or moderate or severe effects in gram amounts.

TABLE III. STANDARD PARAGRAPH APPLICABILITY FOR PERSONAL PROTECTIVE EQUIPMENT AND SANITATION

CLASSIFICATION	STANDARD PARAGRAPH NUMBER		
	EYES	SKIN	INGESTION
1. Liquids (or liquids containing solids); Severe effects	9, 13	1, (6),(8),(14) (20),(21)	19, (20)
2. Liquids (or liquids containing solids); Moderate effects	10	2, (7),(8),(16) or (17),(20), (21)	(20)
3. Gases/Vapors Severe effects	See Respirator Table of particular Draft Technical Standard	3, (8)	
4. Gases/Vapors Moderate effects	See Respirator Table of particular Draft Technical Standard	4	
5. Solids: Severe effects	11, 13	1, (5a),(6) (8),(14),(15) (20)	(5a), 19, (20)
6. Solids; Moderate effects	12	2, (5b),(7), (17),(20)	(5b), 19, (20)

NOTES: Paragraphs 5a, 5b, 7, 8, 14, 16, 17, 20, and 21 found in Table IV and indicated here with parentheses have qualifications and execeptions on usage. Consult list of paragraphs to determine technical intent for application.

Where low boiling liquids (a normal boiling point of 50 degrees F or lower is used as a guideline) are encountered, frostbite may result from skin contact with the liquid or from a splash of liquid into the eye. A special set of output paragraphs is used for such liquids and can be found following the set of regularly used statements at the end of Table IV.

When a substance is known to have severe cumulative or delayed effects on health following exposure (e.g., substances that are readily absorbed through the skin;

sensitizers, etc.), the output paragraphs called for by the above table are modified depending on the effects caused by the actual substance in question.

TABLE IV. STANDARD PARAGRAPHS FOR PERSONAL PROTECTIVE EQUIPMENT AND SANITATION

Paragraph Technical Explanation for Application

- (1) Employers shall provide and ensure that employees use appropriate protective clothing and equipment necessary to prevent any possibility of skin contact with ** substance **. Face shields shall comply with § 1910.133(a)(2), (a)(4), (a)(5), and (a)(6).

If it is concluded that a single brief skin contact with a liquid or solid has the potential for producing severe effects (classification for skin of 1 or 5), protective equipment is required as necessary to prevent any possibility of skin contact with the substance. Section 1910.133(a)(2) (a)(4), (a)(5), and (a)(6) requires that the design, construction, testing, or use of devices for eye or face protection shall be in accord with ANSI Standard Z87.1 - 1968.

- (2) Employers shall provide and ensure that employees use appropriate protective clothing and equipment necessary to prevent repeated or prolonged skin contact with **substance**. Face shields shall comply with § 1910.133(a)(2), (a)(4), (a)(5), and (a)(6).

If irritation or injury occurs only after repeated or prolonged (i.e., a few minutes or more) skin contact with a liquid or solid (classification for skin of 2 or 6), protective equipment is required as necessary to prevent repeated or prolonged skin contact with the substance. A few substances will be encountered that can cause rapidly occurring effects (e.g., a first degree burn) for which paragraph 1 is considered to be too stringent and for which paragraph 2 does not afford adequate protection. For such substances, paragraph 2 will be modified to prevent contact where contact "may" occur by deleting "repeated or prolonged" in the first sentence, and adding ",where skin contact may occur" after the name of the substance.

- (3) Employers shall provide and ensure that employees use appropriate protective clothing and equipment necessary to prevent any possibility of skin contact with **substance** vapor at or above a concentration of

- (4) Employers shall provide and ensure that employees use appropriate protective clothing and equipment necessary to prevent repeated or prolonged skin contact with

substance vapor at or above a concentration of

Contact prevention is required for situations where gases or vapors can be present in concentrations that may cause injury or irritation and the substance has a Classification for skin of 3 or 4. The protective equipment requirements for these materials will be related to known concentrations of contaminant when such information is available. Such requirements cannot be enforced unless they are related to a specific material concentration. If the gas or vapor can be readily absorbed through the skin, a note to the effect that supplied air suits may be necessary is inserted in the Respirator Protection Table of the Draft Technical Standard and discussed in Appendices A and B there.

- (5a) Employers shall ensure that employees whose clothing has had any possibility of being contaminated with ****substance**** change into uncontaminated clothing before leaving the work premises.
- (5b) Employers shall ensure that employees whose clothing may have become contaminated with ****substance**** change into uncontaminated clothing before leaving the work premises.

Output paragraphs 5a and b are used for solids that are of significant toxicity by ingestion or that can be absorbed through the skin in harmful amounts, or that may cause sensitization from prolonged contact with contaminated clothing. Paragraph 5a is used for substances that are so toxic by ingestion or skin absorption that under no circumstances may workers be exposed to any amount of it longer than a work shift and under no circumstances shall they be allowed to unintentionally carry a quantity of the material, however small, into their home. Paragraph 5b is for similar circumstances but is less stringent. It is for use when the substance must be considered hazardous but not hazardous enough to warrant the regulation where there is "any possibility" of the clothing being contaminated. Simply stated, 5b would be used where it would not really matter if the worker did occasionally and inadvertently carry a small quantity of the material home. These paragraphs are not generally applicable to liquids because amounts of liquids that might go undetected on clothing would in all likelihood either evaporate before the clothing is changed or would not be present in sufficient quantity to pose a significant hazard. They may, however, be used for solutions

normally containing solid toxic substances that would remain as a residue and would then have significant effects.

- (6) Employers shall ensure that clothing which has had any possibility of being contaminated with ****substance**** is placed in closed containers for storage until it can be discarded or until the employer provides for the removal of ****substance**** from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the ****substance****, the employer shall inform the person performing the operation of the hazardous properties of ****substance****.

Paragraph 6 is used for liquids or solids that produce severe effects (classification for skin of 1 or 5). It is used to ensure that contaminated clothing is handled properly and is not taken home by a worker. This paragraph will rarely be used for liquids because liquid contaminants evaporate and are readily detected on clothing. Paragraphs 7a or 7b are usually more appropriate for use with liquids.

- (7a) Employers shall ensure that clothing contaminated with ****substance**** is placed in closed containers for storage until it can be discarded or until the employer provides for the removal of ****substance**** from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the ****substance****, the employer shall inform the person performing the cleaning operation of the hazardous properties of ****substance****.

- (7b) Employers shall ensure that clothing wet with ****substance**** is placed in closed containers for storage until it can be discarded or until the employer provides for the removal of ****substance**** from the clothing. If the clothing is to be laundered or otherwise cleaned to remove the ****substance****, the employer shall inform the person performing the cleaning operation of the hazardous properties of ****substance****.

Paragraphs 7a and b are used to ensure that contaminated clothing is handled properly and not taken home by a worker. Paragraph 7a is used for solids or liquids that for reasons of oral toxicity, accumulative effects by skin absorption, etc. should not be taken home.

Paragraph 7b is used for all liquids with flashpoints less than 93.3 degrees C (200 degrees F) unless the liquid is sufficiently hazardous to warrant use of the more stringent statement 7a. Paragraph 7b can also be

used for substances that are similar to those requiring paragraph 7a but that are quickly volatilized. Paragraph 7b could also be used to minimize the risk of potentially dangerous airborne concentrations occurring as a result of evaporation from clothing wet with a substance having a low permissible exposure and IDLH (Immediately Dangerous to Life and Health) value. Note that some noncombustible materials only cause drying of the skin as a result of repeated or prolonged contact with the skin and are not very toxic by any other route of entry; these may require the use of either statement.

The above flashpoint was chosen as a dividing line because some laundry equipment is known to operate with water temperatures as high as 82.2 degrees C (180 degrees F). Incidents have occurred where washing machines containing clothing wet with insoluble combustible materials exploded when flammable vapor concentrations have accumulated in the machine's headspace.

(8a) Where there is any possibility of exposure of an employees body to ****substance****, employers shall provide facilities for quick drenching of the body within the immediate work area for emergency use.

(8b) Where exposure of an employee's body to ****substance**** may occur, employers shall provide facilities for quick drenching of the body within the immediate work area for emergency use.

Paragraph 8a requires adequate facilities for quick drenching of the body where there is "any possibility" of contact with a substance which would result in rapidly occurring severe effects. Paragraph 8b requires adequate facilities for quick drenching of the body only when contact may occur with a substance which would result in rapidly occurring effects of a less severe nature. It is intended that these facilities provide a sufficient quantity or flow of water to quickly remove the substance from any body areas likely to be exposed. The determination of what constitutes an adequate facility depends on the specific circumstances surrounding the use of the substance. For certain circumstances a deluge shower should be readily available, whereas for other circumstances the availability of water from a sink or hose could be considered adequate.

(9) Employers shall provide and ensure that employees use splash-proof safety goggles which comply with §

1910.133(a)(2)-(a)(6) where there is any possibility of liquid **substance** contacting the eyes.

If a single brief eye contact with the substance in liquid form can produce rapidly occurring severe effects (classification for eyes of 1), employees must wear splash-proof eye protection whenever there is "any possibility" of such liquid contacting the eyes.

- (10) Employers shall provide and ensure that employees use splash-proof safety goggles which comply with § 1910.133(a)(2)-(a)(6) where liquid **substance** may contact the eyes.

When eye contact produces rapidly occurring moderate effects (classification for eyes of 2), employees must wear splash-proof eye protection whenever such liquid "may" contact the eyes.

- (11) Employers shall provide and ensure that employees use dust-resistant safety goggles which comply with § 1910.133(a)(2)-(a)(6) where there is any possibility of solid **substance** contacting the eyes.

If a single brief eye contact with a substance in solid form (typically dusts) can produce rapidly occurring severe effects (classification for eyes of 5), employees must wear dust-resistant eye protection whenever there is "any possibility" of such solids contacting the eyes. The statement is not intended to apply to airborne concentrations of dust below the Permissible Exposure Limit of the substance.

- (12) Employers shall provide and ensure that employees use dust-resistant safety goggles which comply with § 1910.133(a)(2)-(a)(6) where solid **substance** may contact the eyes.

When eye contact with a solid substance (typically dusts) produces rapidly occurring moderate effects (classification for eyes of 6), employees must wear dust-resistant eye protection whenever such solid "may" contact the eyes. As in (11) above, the paragraph is not intended to apply to airborne concentrations of dust below the permissible exposure limit of the substance.

- (13) Where there is any possibility that an employee's eyes may be exposed to **substance**, employers shall provide an eye-wash fountain within the immediate work area for emergency use.

Paragraph 13 is required for substances that produce rapidly occurring severe effects on the eyes

(classification for eyes of 1, 3, or 5). The intent of this paragraph is to ensure that an eye-wash fountain is provided in areas where there is any possibility that employees could be exposed to substances capable of causing severe and/or irreversible eye damage -- irrespective of the requirement involving the wearing of eye protection. Should an accident occur where such a substance contacts the eyes, either as a result of breakage of containers or leakage of the eye protection being used or as a result of an employee's not wearing appropriate eye protection at the time of the accident, the immediate availability of an eye-wash fountain would be necessary to minimize eye damage. When available experimental animal data indicate that solutions containing less than a particular concentration of the chemical do not cause serious injury, the paragraph is only applied to solutions of higher concentration.

(14g) Employers shall ensure that non-impervious clothing which becomes contaminated with ****substance**** be removed immediately and not reworn until the ****substance**** is removed from the clothing.

(14i) Employers shall ensure that employees whose skin becomes contaminated with ****substance**** immediately wash or shower to remove any ****substance**** from the skin.

Paragraphs 14g and i are to be used with liquids or solids that can produce rapidly occurring severe effects. Such materials not only include corrosive substances, but also include certain materials that are readily absorbed through the skin. For liquids, a rabbit skin penetration LD50 of less than about 4.0 ml/kg would generally require that these paragraphs be used for the substance. Exceptions to the use of this guideline will usually involve substances that have higher skin penetration LD50's but that also have significant effects once small amounts have penetrated the intact skin. The degree of hazard presented by solids must be evaluated on an individual basis. Any material that is absorbed through the skin and that accumulates in the body could also qualify these paragraphs for use.

Non-impervious clothing contaminated with liquids or solids that may cause rapidly occurring severe effects (classification for skin of 1 or 5) upon momentary contact must be immediately without any hesitation removed and any contaminant cleansed from the skin. For substances that are not very soluble in water, the phrase "with soap or mild detergent and water" (to aid in removing the contaminant from the skin) is added

after "wash or shower" in paragraph 14i. As a guideline, this phrase is contained in the requirements for substances that are less than 5 percent soluble in water.

- (15) Employers shall ensure that all employees subject to skin contact with ****substance**** wash any areas of the body which may have contacted ****substance**** at the end of each work day.

Paragraph 15 is used for all solids (and occasionally for solutions containing normally solid chemical agents) that can produce severe and/or cumulative effects (classification for skin of 5) when they contact the skin. Its purpose is to ensure that any employee whose skin has been contaminated unknowingly with such a material not be exposed for longer than a single work day. Its use is necessary because dusts, powders, or mists can easily become lodged on the hair and other bodily areas and not be detected, especially if their primary effect is systemic and there is no associated local warning sensation.

Only under extraordinary circumstances do liquid chemical agents qualify for use of this paragraph. The primary reason is that the liquid would have to be so potent that an amount so small as to go undetected would cause injury. Since any such liquid would be assigned a classification of 1 for skin contact, it is not believed that a requirement specifying daily washing or showering is necessary. For substances that are not very soluble in water the phrase "with soap or mild detergent and water" is added after "wash" in paragraph 15 to aid in removing the contaminant from the skin. As a guideline, this phrase is contained in the requirements for substances that are less than 5 percent soluble in water.

- (16g) Employers shall ensure that non-impervious clothing which becomes wet with ****substance**** be removed promptly and not re-worn until the ****substance**** is removed from the clothing.

- (16i) Employers shall ensure that employees whose skin becomes wet with ****substance**** promptly wash or shower to remove any ****substance**** from the skin.

Paragraphs 16g and 16i are to be used with liquids that require a significant amount of time and quantity to produce any effect when in contact with the skin (classification for skin of 2). It is to be realized that the difference between paragraphs 16 and 17 is that

paragraphs 16 require only that skin "wet" with the material be washed and clothing "wet" with the material be removed whereas paragraphs 17 substitute the word "contaminated" for "wet." Before paragraphs numbered 16 are used, it must be ensured that a few drops of the substance, accidentally encountered numerous times daily, 5 days a week, will not cause harm if not removed. As a general rule of thumb, materials qualifying for this paragraph would have a vapor pressure above 30 mm Hg at 20 degrees C, would not be readily absorbed through the skin, and would not accumulate in the body. However, the paragraph may also be used for low vapor pressure liquids that are simply fat solvents. For substances that are not very soluble in water the phrase "with soap or mild detergent and water" is added after "wash or shower" in paragraph 16i to aid in removing the contaminant from the skin. As a guideline, this phrase is contained in the requirements for substances that are less than 5 percent soluble in water.

These paragraphs allow employees and employers to ignore small spills of substances on clothing that upon prolonged contact only cause inconsequential injury. For example, one may ignore a drop of acetone on a shirt sleeve, but should not ignore a shirt wet with the substance.

(17g) Employers shall ensure that non-impervious clothing which becomes contaminated with ****substance**** be removed promptly and not reworn until the ****substance**** is removed from the clothing.

(17i) Employers shall ensure that employees whose skin becomes contaminated with ****substance**** promptly wash or shower to remove any ****substance**** from the skin.

Paragraphs 17 are to be used with liquids that in small amounts, can be hazardous if allowed to remain on the skin for prolonged periods (classification for skin of 2). Usually, such liquids will have a vapor pressure less than 30 mm Hg at 20 degrees C and either will be capable of causing moderate local effects or will be capable of being absorbed through the skin in harmful quantities. The paragraphs also apply to solids that have effects of any sort that manifest themselves slowly and that do not accumulate in the body via skin absorption. For substances that are not very soluble in water, the phrase "with soap or mild detergent and water" (to aid in removing the contaminant from the skin), is added after "wash or shower" in paragraph 17i. As a guideline, this phrase is contained in the

requirements for substances that are less than 5 percent soluble in water.

(18) Reserved.

(19) Employers shall ensure that employees do not eat or smoke in areas where ****substance**** is handled, processed or stored.

Paragraph 19 is specified for toxic substances where ingestion of one or more doses of "small quantities such as might remain on a person's hands after they are wiped with a cloth" could result in significant systemic injury by ingestion (classification for ingestion of 1, 5, or 6): This is most frequently used for substances where data suggest adverse cumulative health effects if small amounts are ingested. This paragraph may also be used to prevent skin contact to a severe skin irritant or a sensitizer while an employee is drinking or smoking, since it is not unlikely for a worker to handle a beverage container or a cigarette while wearing contaminated gloves.

(20a) Employers shall ensure that employees who handle ****substance**** wash their hands thoroughly before eating, smoking, or using toilet facilities.

(20b) Employers shall ensure that employees who handle ****substance**** wash their hands thoroughly before eating or smoking.

Paragraphs 20 consist of two similar paragraphs (20a and 20b). Paragraph 20a is used where the substance is of significant toxicity by ingestion and is a sensitizer or irritant with delayed effects. It may also be used where the substance, although not having significant toxicity by ingestion, is considered to be a significant problem from the standpoint of sensitization or irritation. Paragraph 20b, on the other hand, is only specified for substances that are of significant toxicity by ingestion. For clarification purposes, it is noted that a liquid is considered to evaporate slowly if its vapor pressure is less than 30 mm Hg (20 degrees C); substances with higher vapor pressures would evaporate so quickly that these paragraphs need not be specified.

When a special material, formulation, or procedure is required to effectively remove a toxic material from the skin, the special nature of this control will require regulatory wording specifically tailored for the

situation. For substances that are not very soluble in water, the phrase "with soap or mild detergent and water" (to aid in removing the contaminant from the skin) is added after "thoroughly" in paragraphs 20a and 20b. As a guideline, this phrase is contained in the requirements for substances that are less than 5 percent soluble in water.

- (21) Employers shall ensure that clothing which becomes wet with ****substance**** be removed immediately and not reworn until the ****substance**** is removed from the clothing.

Paragraph 21 is used for flammable liquids having a flashpoint less than 37.8 degrees C (100 degrees F). It is not meant to protect an individual from the toxic effects of a material, but rather, it is intended to prevent a worker wearing clothing wet with a flammable liquid from being burned if the liquid should be ignited. The intent is that the worker "strip in place" (remove the wet clothing immediately at the location where it was wetted) and not move through the workplace past possible sources of ignition.

This paragraph, when used, precludes the use of paragraph 16g in the Standard because it is similar but more stringent.

Additional paragraphs to be used for low boiling liquids when the primary effect is frostbite:

Employers shall provide and ensure that employees use appropriate protective clothing and equipment necessary to prevent the skin from becoming frozen from contact with liquid ****substance**** or from contact with vessels containing liquid ****substance****.

For substances with a normal boiling point over 0 degrees C (32 degrees F), the portion "or from becoming frozen from contact with vessels containing ****substance****" is deleted as contact with vessels containing such substances should not result in the skin becoming frozen (i.e., "stuck to") the vessel.

Employers shall ensure that clothing which becomes contaminated with ****substance**** be removed immediately and not reworn until the ****substance**** has evaporated.

Employees shall provide and ensure that employees use splash-proof safety goggles which comply with \$

1910.133(a)(2)-(a)(6) where liquid ****substance**** may contact the eyes.

EXAMPLE

The following is an example of how Table III is used to decide on the regulatory language for the ketone 2-butanone:

Because of the effects of exposure to 2-butanone, it was given classifications of 2, 2, 0 with respect to skin, eyes, and ingestion, respectively. From Table III the paragraphs that should be considered are:

From the standpoint of skin contact: 2, 7, 16 or 17, 20, 21

From the standpoint of eye contact: 10

From the standpoint of ingestion: None

When and why each of the above paragraphs are used is detailed in Table II. For 2-butanone the reasons for the use of each statement are briefly summarized below:

Paragraph 2 is used to prevent repeated or prolonged skin contact with liquid 2-butanone that can result in dermatitis.

Paragraph 7b is used to prevent the possibility of an explosion occurring during laundering of clothing "wet" with 2-butanone, in household or commercial laundries. The flashpoint of 2-butanone is 21 degrees F.

Paragraph 10 is used to ensure that splash-proof eye protection is worn whenever 2-butanone is being handled or used in a manner where splashes are likely to contact the eyes because such contact could result in moderate eye irritation.

Paragraphs 16g and i are used (rather than paragraph 17) because 2-butanone would readily evaporate (vapor pressure of 70 mm Hg at 20 degrees C) from contaminated skin and because the liquid would require a significant amount of time and quantity to produce any effect when in contact with the skin. Paragraph 16i is used to ensure that employees whose skin becomes "wet" with liquid 2-butanone promptly wash or shower to remove it. Paragraph 16g only requires "prompt" removal of clothing wet with 2-butanone and is precluded by statement 21, which requires immediate removal.

Paragraphs 20a and b are not considered necessary for 2-butanone, either from a skin contact or ingestion standpoint because of its low toxicity and high vapor pressure.

Paragraph 21 is used to ensure that workers immediately remove clothing that has become "wet" with liquid 2-butanone to prevent a worker from possibly being burned should the clothing accidentally be ignited. 2-butanone is a flammable liquid.

ATTACHMENT 4

SPILLS AND DISPOSAL DECISION LOGIC

Draft Technical Standard Spills and Disposal Regulatory Statement Matrix

Substance/ State	Flamability	Operative Paragraph of Draft Technical Standard
<u>LIQUIDS</u> (Boiling Point greater than 50 F)	Flash Point less than 200 F	(g) Spills and Disposal. (1) In the event that liquid **substance** is spilled the employer shall immediately eliminate potential sources of ignition, provide available ventilation, and then clean up the spill. (2) Liquid **substance** shall not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion.
	Flash Point greater than 200 F	(g) Spills and Disposal. In the event that liquid **substance** is spilled the employer shall immediately provide available ventilation, and then clean up the spill.
<u>GASES</u> (Boiling Point less than 50 F)	Flammable Gas	(g) Spills and Disposal. In the event that **substance** is inadvertently released the employer shall immediately eliminate potential sources of ignition, provide available ventilation, and then disperse the gas.
	Nonflammable Gas	(g) Spills and Disposal. In the event that **substance** is inadvertently released, the employer shall immediately provide available ventilation and then disperse the gas.
<u>SOLIDS</u> (Melting Point greater than 100F)		(g) Spills and Disposal. In the event that **substance** is spilled, the employer shall immediately provide available ventilation and then clean up the spill.

The disposal of a combustible (liquids with a flashpoint less than 140 F) substance into a sewer or other confined space where an explosive concentration could occur is prohibited except that

"Sewers designed to preclude the formation of explosive concentrations of ****substance**** or its vapors are permitted"

ATTACHMENT 5

TRAINING AND INFORMATION DECISION LOGIC

Some of the regulatory language used in Section (i) of the Draft Technical Standard, the training and information section, varies for each substance and some is standard and remains unchanged in each of the Draft Technical Standards.

Paragraph (1) is a standard provision.

(1) Each employer who has a workplace in which ****substance**** is present shall keep a copy of this regulation with Appendixes A, B, and C at the workplace. This material shall be made readily available to affected employees.

Statements in (2) below follow the Draft Technical Standard language as to their appearance in this appendix.

(2) Each employer who has employees exposed to ****substance**** above the action level, without regard to the use of respirators, or employees who may have

- any possibility of skin or eye contact, or
- possibility of skin contact or who may have eye contact with
- skin contact or any possibility of eye contact,
- skin or eye contact,
- repeated or prolonged skin contact or who may have any possibility of eye contact,
- repeated or prolonged skin contact or who may have eye contact, or
- eye contact,
- with ****substance****; or where
- a spill of ****substance**** may occur,
- ****substance**** presents a fire or explosion hazard,

Note: Use of the two previous statements is triggered when the substance has a flash point below 200 F or when the substance has other significant fire and

explosive properties.

a potentially hazardous (release or spill/release) of ****substance**** may occur,

Note: The above statement is used for gases, fumes, and dusts where appropriate.

shall annually:

(i) Inform affected employees of the information contained in the Substance Safety Data Sheet for ****substance**** (Appendix A of this section);

(ii) advise affected employees as to the signs and symptoms of exposure to ****substance****;

Note: Statement (ii) is deleted if no signs or symptoms are known.

(iii) instruct affected employees to advise the employer of the development of signs and symptoms of overexposure to ****substance**** which are listed in Appendix A of this section;

Note: Statement (iii) is deleted when no signs or symptoms are known.

(iv) instruct affected employees to inform the employer if they develop any of the medical conditions listed in paragraph (j)(2) of this section; and

Note: Statement (iv) is deleted if paragraph (j)(2) of the Draft Technical Standard requires a physical examination or if paragraph (j) provides for no medical procedures.

(v) provide training to ensure that employees understand the precautions of safe use, emergency procedures, and the correct use of protective equipment relative to ****substance****.

ATTACHMENT 6

SUBSTANCE SAFETY DATA SHEET DECISION LOGIC

The following note precedes each appendix and is used as a disclaimer to emphasize that the appendix is not equivalent to the regulatory language.

NOTE: The information contained in the following appendix for ****substance**** is neither intended, by itself, to create any additional obligations not otherwise imposed, nor detract from any existing obligation. To the extent the information supplements this regulation for ****substance****, it is advisory in nature.

The information needed as input to the Appendix A Decision Logic is shown in the following table:

Table I. INPUT FOR SUBSTANCE SAFETY DATA SHEET, APPENDIX A

azard/ Classification/ PART	Non- flam gas	Flam gas	Non- flam liquid	Flam and combust liquid	Non- flam solid	Flam solid
<u>I</u> Substance Identification						
Substance	N	N	N	N	N	N
Permissible Exposure	CFR	CFR	CFR	CFR	CFR	CFR
Appearance and Odor	L	L	L	L	L	L
<u>II</u> Health Hazard Data						
Comments	CC	CC	CC	CC	CC	CC
Effects of Exposure						
Short-term Exposure	L-CC	L-CC	L-CC	L-CC	L-CC	L-CC
Long-term Exposure	L-CC	L-CC	L-CC	L-CC	L-CC	L-CC
Signs and Symptoms	S	S	S	S	S	S
<u>III</u> Emergency First Aid Procedure						
Eye and Face	CC-TL	CC-TL	?-TL-CC	CC-TL	?-TL-CC	CC
Breathing	CC	CC	CC	CC	CC	CC
Swallowing	none	none	CC	CC	CC	CC
<u>IV</u> Respirators and Protective Equipment						
Respirators	S-TL	S-TL	S	S	S	S
Protective Clothing	S	S	S	S	S/none	S/none
Eye and Face Protection	CC	CC	CC	CC	CC	CC
<u>V</u> Precautions for Safe Use, Handling, and Storage						
	CC	CC	CC	CC	CC	CC
<u>VI</u> Employee Medical and Exposure Records						
	CC	CC	CC	CC	CC	CC

- N = Name of substance.
- CFR = From standard itself as shown in the Code of Federal Regulations.
- L = Literature - The sources used are generally recognized reference works or widely available publications whenever possible. When discrepancies are found in data, additional sources are consulted. The working groups resolved discrepancies which could not be resolved by the literature search.
- CC = Committee Evaluations - These sections are the result of best professional opinion of the committee membership based on literature data. Working groups have recast the information found in the literature and in the body of the regulation into the format and style of the Draft Technical Standard appendix.
- TL = Specific Toxicity - To minimize confusion over shades of meaning, standard sentences were used whenever possible. The models for these statements for each substance class are contained in the Draft Technical Standard in which they first were used as indicated by the four letter code for the substance. All standard statements were checked for accuracy when reused for a similar class substance.

Some sections, indicated with entry "?-TL", required modification depending on the specific toxicity of the substance under consideration.

none = Part not used.

S = Same for all.

REGULATORY LANGUAGE OPTIONS

APPENDIX A

SUBSTANCE SAFETY DATA SHEET

FOR **substance**

Table II. Regulatory Language Options for Substance Safety Data Sheet

I. SUBSTANCE IDENTIFICATION

A. Substance: **substance**

B. Permissible Exposure:

- (1) Eight-hour TWA gas or vapor: ___part of **substance** per million parts of air (ppm) (___milligrams of **substance** per cubic meter of air (mg/M3)) averaged over an eight-hour workshift.
- (2) Eight-hour TWA particulate: ___milligrams of **substance** per cubic meter of air (mg/M3) averaged over an eight-hour workshift.
- (3) Z-1 Ceiling gas or vapor: ___parts of **substance** per million parts of air (ppm)(___milligrams of **substance** per cubic meter of air (mg/M3)) shall not be exceeded during any fifteen minute period during an eight-hour workshift.
- (4) Z-1 Ceiling particulate: ___milligrams of **substance** per cubic meter of air (mg/M3) shall not be exceeded during any fifteen minute period during an eight-hour workshift.
- (5) Z-2 eight-hour TWA: Same as (1) or (2)
- (6) Z-2 eight-hour TWA with Acceptable Ceiling: Same as (5) but add "___ppm or mg/M3 shall not be exceeded during an eight-hour workshift."
- (7) Z-2 eight-hour TWA with Acceptable Ceiling and Acceptable Maximum Peak: Same as (6) but add "___ppm or mg/M3 shall not be exceeded for more than ___ minutes during an eight-hour workshift."

C. Appearance and Odor:

Note: If only appearance is known, the words "and odor" are deleted. If the substance may be encountered in more than one physical state at normal temperatures, the following statement is added: "**substance** may be a liquid/solid at temperatures below ___C (___F)." When this appendix is covering a substance with several of its compounds, the

example compounds listed in Appendix B are included here with their respective appearance and odor descriptions.

II. HEALTH HAZARD DATA

A. Comments:

Note: A comment is inserted here only when special attention is to be drawn to a particular toxic or other property of the substance(s). If no "Comment" is made this entry is deleted.

B. Ways In Which The Chemical Affects Your Body:

(1) For toxic materials that are not significantly absorbed through the skin ****substance**** can affect your body if you inhale it or if it comes in contact with your eyes or skin. It may also affect your body if you swallow it."

(2) For toxic materials that are significantly absorbed through the skin, ****substance**** can affect your body if you inhale it, if it comes in contact with your eyes or skin, or if you swallow it. It may enter your body through your skin."

Note: Portions of these general statements are used or deleted as appropriate. Additional wording may be added in special cases.

C. Effects of Overexposure:

1. Short-term Exposure: ****substance**** may cause --

Note: The effects of overexposure to the substance as recited in Appendix C are inserted here, but reworded for common understanding of an average employee.

2. Long-term Exposure: (Repeated/Prolonged) exposure to ****substance**** may cause --

Note: When short and long term effects can not be differentiated, the titles "Short-term Exposure" and "Long-term Exposure" are deleted and symptoms are listed directly following the "1. Exposure to ****substance**** may cause". When no effects are known to result from short or long-term exposure or both, the words "Not Known" are used following the appropriate title.

3. Reporting Signs and Symptoms: You should inform your employer if you develop any signs or symptoms and suspect that they are caused by exposure to ****substance****.

Note: This section is used even if no effects are known. Inclusion of this statement serves to encourage employees to report any sign or symptom which they feel is related to their exposure. Since there is little reported human experience with many of these materials, this is an important safeguard.

III. EMERGENCY FIRST AID PROCEDURES

A. Eye Exposure:

- (1) For substances with eye hazard rating "1".
"If (physical form(s) of substance) ****substance**** get(s) into your eyes, wash your eyes immediately with large amounts of water lifting the upper and lower lids occasionally. Get medical attention immediately. Contact lenses should not be worn when working with this (these) chemical(s)."
- (2) For substances with eye hazard rating "1" in the molten form.
"If molten ****substance**** gets into your eyes, flush the eyes immediately with water to remove heat. Get medical attention immediately. Contact lenses should not be worn when working with this chemical."
- (3) For substances with eye hazard rating "2".
Use as the second sentence the same first and third sentences as in A (1) above, but use "If irritation (persists/is present) after washing, get medical attention."

Note: Other language may be utilized in specific cases. This section is deleted when the substance(s) has an eye hazard rating of "0". The physical form(s) of the substance may be stated with one or more of the following inserts:

(a) "If liquid ****substance**** -- ."
(b) "If ****substance****, or (liquids/solutions) containing ****substance**** -- ."
(c) "If (liquid) ****substance****, or strong concentrations of ****substance**** (vapors/gas) -- ."

B. Skin Exposure:

Note: Language used in this section basically tracks decisions made for the personal protective equipment and sanitation sections of the regulation. This section is deleted when the substance(s) has a skin hazard rating of "0". Physical form(s) of substance may be the same as in "Eye Exposure:".

- (1) For substances more than 5% soluble in water. "If (physical form(s) of substance) **substance** get(s) on your skin, (immediately/promptly) flush the contaminated skin with (large amounts of) water. If (physical form(s) of substance) **substance** (soaks/penetrates) through your clothing, remove the clothing (immediately/promptly) and flush the skin with (large amounts of) water." "Get medical attention (immediately/promptly)." or "If irritation (persists/is present) after washing, get medical attention."
- (2) For substances less than 5% soluble in water. "If (physical form(s) of substance) **substance** get(s) on your skin, (immediately/promptly) wash the contaminated skin with (large amounts of) soap or mild detergent and water. If (physical form(s) of substance) **substance** (soaks/penetrates) through your clothing, remove the clothing (immediately/promptly) and wash the skin with (large amounts of) soap or mild detergent and water." "Get medical attention immediately." or "If irritation (persists/is present) after washing, get medical attention."
- (3) For substances in the molten form. "If molten **substance** gets on your skin, flush the skin immediately with water to remove heat. If molten **substance** (gets on/penetrates through) your clothing, flush the clothing immediately with water to remove heat. Get medical attention immediately."

C. Breathing: "If you or any other person breathes in large amounts of **substance**, move the exposed person to fresh air at once. If breathing has stopped, perform artificial respiration. Keep the affected person warm and at rest. Get medical attention as soon as possible."

D. Swallowing:

Note: This section varies depending on whether the substance(s) is corrosive or whether the recommended emergency treatment includes directions to induce vomiting. In situations where virtually no possibility exists for swallowing the substance(s) (e.g., gas or fume), this section is deleted.

(1) For substance(s) requiring the inducement of vomiting.

"When (physical form(s) of substance) **substance** has been swallowed and the person is conscious, give the person large quantities of water immediately. After the water has been swallowed, try to get the person to vomit by having him touch the back of his throat with his finger. Do not make an unconscious person vomit. Get medical attention immediately."

(2) For substance(s) where vomiting is contraindicated

"When (physical form(s) of substance) **substance** has been swallowed, do not cause vomiting. Get medical attention immediately."

(3) For substance(s) that are corrosive.

"When (physical form(s) of substance) **substance** has been swallowed and the person is conscious, give him large quantities of water immediately to dilute the **substance**. Do not attempt to make the person vomit. Get medical attention immediately."

E. Rescue: "Move the affected person from the hazardous exposure. If the exposed person has been overcome, notify someone else and put into effect established emergency rescue procedures. Do not become a casualty yourself. Understand your emergency rescue procedures and know the location of emergency rescue equipment before the need arises."

NOTE: The "overcome" sentence is not included where the substance cannot overcome the worker.

IV. RESPIRATORS AND PROTECTIVE EQUIPMENT

A. Respirators:

Note: All wording in this section is standard with the exception of two statements. One is used if the substance has a recognized odor; the other is used if the Draft Technical Standard requires that escape respirators be carried.

These two statements are listed below and are followed by the boilerplate language with notations as to where the alternative statement is to be inserted.

- (1) "If you can smell ****substance**** while wearing a respirator, the respirator is not working correctly; go immediately to fresh air."
- (2) "If you work in areas where ****substance**** may be released, you should carry an escape respirator with you at all times."

"Respirators are not the best way to control exposure to ****substance****. You can only be required to wear them for routine use if your employer is in the process of installing controls or control measures prove inadequate. You may be required to wear respirators for nonroutine activities or in emergencies. (Statement (b) may be inserted here.) If respirators are worn, they must have a Mining Enforcement and Safety Administration (MESA) or National Institute for Occupational Safety and Health (NIOSH) approval label. (Older respirators may have a Bureau of Mines approval label.) For effective protection, respirators must fit your face and head snugly. Respirators should not be loosened or removed in work situations where their use is required. (Statement (a) may be inserted here.) If you experience difficulty breathing while wearing a respirator, tell your employer."

B. Protective Suits:

Note: The following statements are inserted if the use of supplied-air suits is specified in the Respirator Table (Table 2) of the Draft Technical Standard:

"In some work situations the wearing of supplied-air suits or other impervious coverings such as acid suits may be necessary. Your employer should instruct you in their proper use and operation."

C. Protective Clothing:

Note: Statements that track the requirements called out in paragraph (f) of the Draft Technical Standard are included here. The language is modified here to make it more understandable to employees. Since these statements correspond to requirements in the regulation, the use of the word "must" is appropriate and will not establish additional burden.

Statements included here are always followed by the statement:

"Replace or repair impervious clothing which has developed leaks."

The numbers of the output statements used in the main body of the regulation are listed below together with the corresponding statements used in this section. Although not specifically shown in the statements to follow, the physical form(s) of the material is inserted preceding the ****substance**** exactly as in the regulation. These statement numbers in parentheses refer to the appropriate numbered statements in the Personal Protective Equipment and Sanitation Regulatory Language Decision Analysis. (Attachment 3 of this publication.)

- (1) "You must wear appropriate protective clothing and equipment to prevent any possibility of skin contact with ****substance****."
- (2) "You must wear appropriate protective clothing and equipment to prevent repeated or prolonged skin contact with ****substance****."
- (2) (Modified) "You must wear appropriate clothing and equipment to prevent any possibility of skin contact with ****substance**** at or above a concentration of ****concentration****."
- (4) "You must wear appropriate protective clothing and equipment to prevent repeated or prolonged skin contact with ****substance**** at or above a concentration of ****concentration****."

When no personal protective equipment is required in the regulation, the words "None Required" are used here.

D. Eye Protection:

Note: Statements included in this section which track statements called out in paragraph (f) of the regulation, deal with the use of safety goggles only. The numbers of the output statements used in the main body of the regulation are listed below with the corresponding statements used in this

section. Although not specifically shown in the statements to follow, the physical form(s) of the material are inserted preceding the ****substance**** exactly as in the regulation.

- (9) "You must wear splash-proof safety goggles where there is any possibility of liquid ****substance**** contacting your eyes."
- (10) "You must wear splash-proof safety goggles where liquid ****substance**** may contact your eyes."
- (11) "You must wear dust-resistant safety goggles where there is any possibility of solid ****substance**** contacting your eyes."
- (12) "You must wear dust-resistant safety goggles where solid ****substance**** may contact your eyes."

When no personal eye protective equipment is required in the regulation, but the material is known to be an eye irritant at high concentrations (i.e., full facepiece respirators required), the following statement is used:

"Eye Protection: The respiratory protection equipment provided by your employer for exposures to high concentrations of ****substance**** will protect your eyes."

V. PRECAUTIONS FOR SAFE USE, HANDLING AND STORAGE

Note: Statements are included here that track some of the requirements of paragraph (e), (f), and (h) of the regulation.

Statements which track paragraph (e) of the Draft Technical Standards:

- (A) Flammable Liquids
"****substance**** is a flammable liquid. Its vapors can easily form explosive mixtures with air."
- (B) Combustible Liquids
"****substance**** is a combustible liquid. Its vapors can form explosive mixtures with air at elevated temperatures."
- (C) Combustible solids and dusts
"****substance**** is a combustible solid. Its dust can form explosive mixtures with air."

- (D) Storage
"**substance** must be stored so as not to come in contact with _____."
- Note: Materials with which contact must be avoided are the same as those mentioned in the corresponding statement in paragraph (e) of the regulation. They also track "Conditions contributing to instability" and "Incompatibilities" listed in Appendix B.
"**substance** must be stored in tightly closed containers in a cool well-ventilated area away from _____."
- Note: Track language in the same way as does the preceding storage statement.
- (E) Source of Ignition
- (i) For Class IA flammable liquids -
"Sources of ignition such as smoking and open flames are prohibited where **substance** is handled, used or stored."
- (ii) For other combustible and flammable materials -
"Sources of ignition such as smoking and open flames are prohibited where **substance** is used, handled or stored in a manner that could create a potential fire or explosion hazard."
- (F) Nonsparking tools, Bonding and Grounding
- (i) For Class I flammable liquids
"Metal containers in operations involving the transfer of five gallons or more **substance** should be grounded and bonded."
- (ii) For certain substances with low flash points and ignition temperatures that are readily ignited by sparks (e.g., carbon disulfide, ethyl ether, n-propyl nitrate), special nonsparking tools and precautions to prevent static electricity ignition are recognized by many to be prudent safety measures. For these substances the following statement is used:
"You must use nonsparking tools when opening or closing containers of **substance**, and metal containers should be bonded and grounded when pouring or transferring liquid **substance**."
- (G) General Note: Other specific statements are used to cover explosives, flammable gases, metal powders, etc. Their use is too infrequent to specify here.

Statements tracking paragraphs (f) and (h)

Note: The numbers of the output statements used in the main body of the regulation are listed below with the corresponding statements used in this section.

(5A) "If your work clothing has had any possibility of being contaminated with

- **substance**** you must change into uncontaminated clothing before leaving the work premises."
- (5B) "If your work clothing may have become contaminated with ****substance**** you must change into uncontaminated clothing before leaving the work premises."
- (14G) "You must immediately remove any non-impervious clothing that becomes contaminated with ****substance**** and this clothing must not be reworn until the ****substance**** is removed from the clothing."
- (14I) "If your skin becomes contaminated with ****substance****, you must immediately wash or shower (with soap or mild detergent and water) to remove any ****substance**** from your skin."
- (15) "If you are subject to skin contact with ****substance**** you must wash (with soap or mild detergent and water) any areas of the body which may have contacted ****substance**** at the end of each workday."
- (16G) "You must promptly remove any non-impervious clothing that becomes wet with liquid ****substance**** and this clothing must not be reworn until the ****substance**** is removed from the clothing."
- (16I) "If your skin becomes wet with liquid ****substance**** promptly wash or shower (with soap or mild detergent and water) to remove any ****substance**** from your skin."
- (17G) "You must promptly remove non-impervious clothing which becomes contaminated with ****substance**** and this clothing must not be reworn until the ****substance**** is removed from the clothing."
- (17I) "If your skin becomes contaminated with ****substance**** promptly wash or shower (with soap or mild detergent and water) to remove any ****substance**** from your skin."
- (19) "You must not eat or smoke in areas where ****substance**** is handled, processed or stored."
- (20A) "If you handle ****substance**** you must wash your hands thoroughly (with soap or mild detergent and water) before eating, smoking or using toilet facilities."

Sheet for **substance**. In addition, your employer must instruct you in the safe use of **substance**, emergency procedures, and the correct use of protective equipment.

- B. Your employer is required to determine whether you are being exposed to **substance**. You or your representative have the right to observe employee exposure measurements and to record the results obtained. If your employer determines that you are being overexposed, he is required to inform you of the exposure and the actions which are being taken to reduce your exposure.
- C. Your employer is required to keep records of your exposure and medical examinations. Your employer is required to keep exposure data for at least one year and to keep medical data during your employment and for a period of (one/five/thirty)* year(s) following your termination of employment. Your employer is required to make the exposure data available to you upon your request. Your employer is also required to release your medical records to your physician upon your written request.
- D. Your employer must give you a copy of the physician's written opinion for any physical examination required by this standard."

* Insertion of one/five/thirty year medical record retention tracks paragraph (k) of the Draft Technical Standard.

ATTACHMENT 7

SUBSTANCE TECHNICAL GUIDELINES (APPENDIX B) - DECISION LOGIC

Qualifier Statement for Substance and Compounds

The following statement is inserted parenthetically just below the heading "Substance Technical Guidelines" when a "substance and compounds" (where there is more than one substance being regulated) are being covered by the standard.

"This standard for **substance** should not be interpreted to apply only to the substance(s) listed below for which substance specific information has been provided."

The information needed as input to Parts I and II of Appendix B is shown in the following table:

INPUT FOR SUBSTANCE TECHNICAL GUIDELINES, APPENDIX B

Hazard Classification	Non-flam gas	Flam gas	Non-flam liquid	Flam & comb liquid	Non-flam solid	Flam solid
I Physical and Chemical Data						
Synonyms	L	L	L	L	L	L
Formula	L	L	L	L	L	L
Boiling point	L	L	L	L	L	L
Specific gravity	L	L	L	L	L	L
Vapor density	L	L	L	L	L	L
Melting point	L	L	L	L	L	L
Vapor pressure	L	L	L	L	L	L
Solubility*	L	L	L	L	L	L
Evap. rate**	L	L	L	L	L	L
App. & odor	L	L	L	L	L	L
II Fire, Explosion, and Reactivity Hazard Data						
Fire						
Flash point	none	none	none	"s"	none	none
Auto ignition temp.	"s"	"s"	"s"	"s"	"s"	"s"
Flammable limits in air	none	"s"	none	"s"	none	"s"
Extinguishing media	none	"s"	none	"s"	none	"s"
Special fire-fighting procedures	none	"s"	none	"s"	none	"s"
Unusual fire and explosion hazards	none	"s"	none	"s"	none	"s"
Combustible liquid classification	none	"s"	none	"s"	none	"s"
Conditions contributing to instability	L	L	L	L	L	L
Incompatibilities	L	L	L	L	L	L
Decomposition products	L	L	L	L	L	L

L = Literature - Generally recognized reference works or widely available publications whenever possible. When discrepancies were found in data, additional sources were consulted. Group A resolved discrepancies which could not be resolved by literature search. A list of these reference works appears in the Decision Logic for Appendix A.

none = Not applicable to this class.

"s" = Obtained from the Fire and Safety Working Group.

* = Solubility is expressed as "grams of **substance** per 100 grams of water at 20 degrees C."

** = Relative evaporation rate. This means that the higher the number, then the higher the rate, or in other words higher volatility. The evaporation rate is relative to the evaporation rate for ethyl ether (which is defined as 1.00). For example, the evaporation rate for benzene is 2.8. That is it takes benzene 2.8 times longer to evaporate than ethyl ether.

Standard Language for Part III "Spill, Leak and Disposal Procedures" Portion of the Substance Technical Guidelines (Appendix B) (Unless Special Precautions or Modifications Are Required for a Given Substance)

LIQUIDS (Combustible and Flammable)

I Flashpoint: less than 140 degrees F

Vapor pressure: less than 10mm Hg

- A. If ****substance**** is spilled or leaked, the following steps should be taken:
1. Remove all ignition sources.
 2. Ventilate area of spill or leak.
 3. For small quantities absorb on paper towels. Remove to a safe place (such as a fume hood) and burn the paper. Large quantities can be collected and reclaimed or atomized in a suitable combustion chamber. ****substance**** may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion. Sewers designed to preclude the formation of explosive concentrations of ****substance**** vapors are permitted.
- B Persons not wearing protective equipment should be restricted from areas of spills or leaks until cleanup has been completed.
- C Waste disposal methods: ****substance**** may be disposed of:
1. By absorbing in vermiculite, dry sand, earth, or a similar material and disposing in a sanitary landfill.
 2. By atomizing in a suitable combustion chamber.

II Flashpoint: less than 140 degrees F

Vapor pressure: greater than or equal to 10mm Hg

- A If ****substance**** is spilled or leaked, the following steps should be taken:
1. Remove all ignition sources.
 2. Ventilate area of spill or leak.
 3. For small quantities absorb on paper towels. Evaporate in a safe place (such as a fume hood). Allow sufficient time for vapors to completely clear hood ductwork, then burn the paper. Large quantities can be collected and reclaimed or atomized in a suitable combustion chamber. ****substance**** may not be allowed to enter a confined space, such as a sewer, because of the possibility of an explosion. Sewers designed to preclude the formation of explosive concentrations of ****substance**** vapors are permitted.

- B. Persons not wearing protective equipment should be restricted from areas of spills or leaks until cleanup has been completed.
- C. Waste disposal methods: ****substance**** may be disposed of by atomizing in a suitable combustion chamber.

III Flashpoint: greater than or equal to 140 degrees F
Vapor pressure: Probably in all cases will be less than
10mm Hg

- A. If ****substance**** is spilled or leaked, the following steps should be taken:
 - 1. Ventilate area of spill or leak.
 - 2. For small quantities absorb on paper towels. Remove to a safe place (such as a fume hood) and burn the paper. Large quantities can be collected and reclaimed or atomized in a suitable combustion chamber.
- B. Persons not wearing protective equipment should be restricted from areas of spills or leaks until cleanup has been completed.
- C. Waste disposal methods: ****substance**** may be disposed of:
 - 1. By absorbing in vermiculite, dry sand, earth, or a similar material and disposing in a sanitary landfill.
 - 2. By atomizing in a suitable combustion chamber. If liquid is made up of a compound or compounds that when burned could give off toxic substances (e.g., halogens, oxides of sulfur heavy concentrations of nitrogen oxides, acids, etc.), add phrase "...suitable combustion chamber equipped with an appropriate effluent gas cleaning device."

IV LIQUIDS (Non-combustible)

- A. If ****substance**** is spilled or leaked, the following steps should be taken:
 - 1. Ventilate area of spill or leak.
 - 2. Collect for reclamation or absorb in vermiculite, dry sand, earth or a similar material.
- B. Persons not wearing protective equipment should be restricted from areas of spills or leaks until cleanup has been completed.
- C. Waste disposal methods: ****substance**** may be disposed of by absorbing in vermiculite, dry sand, earth or a similar material, and disposing in a sanitary landfill.

V SOLIDS (Combustible)

- A. If ****substance**** is spilled, the following steps should be taken:
 - 1. Remove all ignition sources.

2. Ventilate area of spill.
 3. For small quantities, sweep onto paper or other flammable material, place in an appropriate container and burn in a safe place (such as a fume hood). Large quantities may be reclaimed; however, if this is not practical, dissolve in a flammable solvent (such as alcohol) and atomize in a suitable combustion chamber.
- B. Persons not wearing protective equipment should be restricted from areas of spills until cleanup has been completed.
- C. Waste disposal methods: ****substance**** may be disposed of:
1. By making packages of ****substance**** in paper or other flammable material and burning in a suitable combustion chamber.
 2. By dissolving ****substance**** in a flammable solvent (such as alcohol) and atomizing in a suitable combustion chamber. If solid is made up of a compound or compounds that when burned could give off toxic substances (e.g., halogens, oxides of sulfur, heavy concentration of nitrogen oxides, acids, etc.), add phrase "... suitable combustion chamber equipped with an appropriate effluent gas cleaning device."

VI SOLIDS (Non-combustible)

- A. If ****substance**** is spilled, the following steps should be taken:
1. Ventilate area of spill.
 2. Collect spilled material in the most convenient and safe manner for reclamation or for disposal in a sanitary landfill. If material is highly toxic, wording would be "...and safe manner and deposit in sealed containers for reclamation ..." Liquid containing ****substance**** should be absorbed in vermiculite, dry sand, earth, or a similar material.
- B. Persons not wearing protective equipment should be restricted from areas of spills until cleanup has been completed.
- C. Waste disposal methods: ****substance**** may be disposed of in a sanitary landfill. If material is soluble in water (i.e., greater than 10 percent by weight), add phrase "...disposed of in sealed containers in a sanitary landfill."

VII GASES

- A. If ****substance**** is leaked, the following steps should be taken:

1. Remove all ignition sources. (Do not use phrase if the substance is a non-combustible gas.)
 2. Ventilate area of leak to disperse the gas.
 3. Stop flow of gas. If source of leak is a cylinder and the leak cannot be stopped in place, remove the leaking cylinder to a safe place in the open air, and repair leak or allow cylinder to empty.
- B. Persons not wearing protective equipment should be restricted from areas of leaks until cleanup has been completed.
- C. Waste disposal methods "***substance**" may be disposed of by burning at a safe location or in a suitable combustion chamber." Do not use last sentence if substance is not normally stored in cylinders. Do not use this phrase if non-combustible gas but use instead: "allowing to disperse at a safe location."

VIII DUSTS, FUMES

- A. If potentially hazardous amounts of ***substance** are released, the following steps should be taken:
1. Remove all ignition sources.
 2. Ventilate area of release to disperse the (dust/fume).

Note: If the dust or fume is not combustible this statement reduces to: "If potentially hazardous amounts of ***substance** are released ventilate the area of the release to disperse the ***substance**."

- B. Persons not wearing protective equipment should be restricted from the area of the release until cleanup has been completed.

Note: If the dust could be spilled in the course of its normal use, then statements called for spills of dust may be used in a similar manner as for spills of solids. The resulting section may be a combination of "spill and release" for a particular dust.

PART IV MONITORING AND MEASUREMENT PROCEDURES - Standard Language

This standard language varies for the appropriate time period specified in the 1910.1000 standard.

- A. EXPOSURE ABOVE THE ACTION LEVEL:
1. Eight-Hour Exposure Evaluation: Measurements taken for the purpose of determining employee exposure under this section are best taken such that the eight-hour exposure may be determined from a single eight-hour sample or two four-hour samples. Several

short-time interval samples (up to 30 minutes) may also be used to determine the average exposure level. Air samples should be taken in the employee's breathing zone (air that would most nearly represent that inhaled by the employee).

2. Ceiling Evaluation: Measurements taken for the purpose of determining employee exposure under this section must be taken during periods of maximum expected airborne concentrations of ****substance**** in the employee's breathing zone. A minimum of three (3) measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.
 3. Peak Above Ceiling Evaluation: Measurements taken for the purpose of determining employee exposure under this section must be taken during periods of maximum expected airborne concentration of ****substance****. Each measurement should consist of a (sample time period) sample or series of consecutive samples totaling (sample time) in the employee's breathing zone (air that would most nearly represent that inhaled by the employee). A minimum of three measurements should be taken on one work shift and the highest of all measurements taken is an estimate of the employee's exposure.
 4. Monitoring Techniques: See Filter Statement.
- B. EXPOSURE ABOVE THE PERMISSIBLE EXPOSURE: The monitoring and measurements under this section should be essentially the same as described under paragraph IV. A. When sampling for peak or ceiling exposure evaluations, more than three (3) measurements should be taken during the work shift so that increased confidence maybe placed in the judgment that the employee has or has not, in fact, been exposed in excess of the permissible limit. Laboratories performing chemical analyses should be accredited in Industrial Hygiene Chemistry by the American Industrial Hygiene Association. The method of measurement must determine the concentration of (compound) to plus or minus 25% of the true value.
- C. METHODS: Methods meeting these accuracy requirements are available from the National Technical Information Service, U.S. Department of Commerce, Springfield, Virginia 22161 under the title "NIOSH Analytical Methods for Set XX (Order number XXXXXXXXXXXX).

Rationale for Collection Methods

1. The filter statement is used when the substance is considered to be an airborne particulate, mist, or aerosol having vapor pressures lower than 0.001 mm Hg

2. The combination filter and vapor statement is used when the substance is primarily a particulate, mist, or aerosol but having a significant vapor pressure (relative to the standard and the sampling period).
3. The gas and vapor statement is used when the substance is considered to have a significant vapor pressure (liquid or gas at greater than 0 degree C temp.)
4. The particle count statement is used when the standard is from Table Z-3 of § 1910.1000 and is specified as "million particles per cubic foot (mppcf)."

Filter Statement

Sampling and analyses may be performed by instruments such as detector tubes certified by NIOSH under 42 CFR Part 84, portable direct-reading instruments, dosimeters, or by collection of particulates using a high efficiency membrane filter with subsequent chemical analysis.

Combination Statement - Chemical with:

1. Melting point greater than 20 degree C., and
2. Vapor pressure less than 1.0 mm Hg and greater than 0.015 mm. Hg

Sampling and analyses may be performed by collection of the particulates and vapors using a high efficiency membrane filter followed by an absorption tube with subsequent chemical analysis of both the filter and absorption tube. Detector tubes certified by NIOSH under 42 CFR Part 84 or other direct-reading devices calibrated to measure ****substance**** may be used.

Gas and Vapor Statement

Sampling and analyses may be performed by instruments such as detector tubes certified by NIOSH under 42 CFR Part 84, portable direct-reading instruments, dosimeters, or gas and vapor absorption tubes with subsequent chemical analysis.

Particle Count Statement

Sampling and analysis may be performed by instruments calibrated and correlated to the standard particle count method or by collectin and subsequent microscopic counting of all particle sizes 0.5 micro-meters or greater.

Part V - MISCELLANEOUS PRECAUTIONS

Protective Suits Statement

The following statement is inserted under V. MISCELLANEOUS PRECAUTIONS when the use of supplied-air suits is required in Table 2 of the regulations.

***"Use of supplied-air suits or other impervious coverings (such as acid suits) may be necessary to prevent...

- i. skin absorption
- ii. skin irritation
- iii. skin irritation and absorption

"from **substance**. Supplied-air suits should be selected, used, and maintained under the immediate supervision of persons knowledgeable in the limitations and potential life and endangering characteristics of supplied-air suits."

Materials with explosion hazard indices greater than 0.1 but less than 10.0.

Unusual fire and explosion hazard **substance** is a combustible solid. Its dust can form explosive mixtures with air. All ignition sources must be controlled where **substance** is used, handled, or stored in a manner that could create potential fire or explosion hazard.

Materials with explosion hazard indices lower than 0.1.

Unusual fire and explosion hazard **substance** is a combustible solid. So, dust can form explosive mixtures in air. However, its "explosion hazard index" is very weak.

Part VI - COMMON OPERATIONS

The Use/Exposure document is used to generate this statement:

"Common operations in which exposure to **substance** is likely to occur are: During its production; during its use as
."

ATTACHMENT 8

Medical Surveillance Guidelines (Appendix C) - Decision Logic

Part I lists the routes of entry of the substance.

Possible effects of exposure on the health of the employee are contained in the toxicology part (Part II) of the Appendix usually in the following sequence:

- 1) The first sentence is a statement of the main effects.
- 2) This may be followed by animal data, when appropriate, to illustrate target organs and range finding exposure levels. Animal data are not used if there are sufficient human data to illustrate effects.
- 3) The next section describes effects on humans from inhalation or skin absorption. Occasionally, effects from ingestion are included if important.
- 4) Effects on the eyes are mentioned next; animal data are often included.
- 5) Effects on the skin are listed last; animal data are often included.

The Signs and Symptoms Section part (Part III) starts at the top of the body and proceed, downward, e.g., eyes, nose, central nervous system, lungs, liver, kidneys, skin, etc. Signs and symptoms by analogy to effects on animals are listed last.

The order is occasionally changed and skin effects are discussed first, if they are of chief importance. The Signs and Symptoms in Section III usually start at the top of the body and proceed downward. For example, eyes, nose, central nervous system, lungs, liver, kidneys, skin, etc.

Based on the possible effects exposure to a specific substance can have on the health of the employee, one of three different types of medical surveillance provisions may be required using the decision logic for medical surveillance standards described in paragraph (j) Medical Surveillance.

Parts IV (Special Tests), V (Treatment), VI (Surveillance and Preventive Considerations) and VII (References) were developed by the Medical Working Group (D Group) using information developed by the contractor and their own professional knowledge. A Toxicity Rating Sheet was developed to evaluate the toxicity of each substance. The Decision Logic for the medical surveillance sections was applied to develop section (j) of the draft technical standard.

ATTACHMENT 9

List of 29 CFR Part 1000 Substances Covered by S.C.P.

acetaldehyde
acetic acid
acetic anhydride
acetone
acetonitrile
acetylene tetrabromide
acrolein
acrylamide
acrylonitrile
aldrin
allyl alcohol
allyl chloride
allyl glycidyl ether
2- aminopyridine
ammonia
ammonium sulfamate
sec- amyl acetate
n- amyl acetate
aniline
anisidine (ortho and para isomers)
antimony and compounds
ANTU
arsine
aziphos-methyl
barium compounds, soluble
benzene
benzoyl peroxide
benzyl chloride
boron oxide
boron trifluoride
bromine
bromoform
butadiene
2- butanone
2- butoxy ethanol
sec- butyl acetate
tert- butyl acetate
butyl acetate
sec- butyl alcohol
tert- butyl alcohol
butyl alcohol
tert- butyl chromate
n- butyl glycidyl ether
butyl mercaptan
butylamine
p-tert- butyltoluene
cadmium fume
cadmium dust
calcium arsenate
calcium oxide
camphor
carbaryl
carbon black

carbon dioxide
 carbon disulfide
 carbon monoxide
 carbon tetrachloride
 chlordane
 chlorinated camphene
 chlorinated diphenyl oxide
 chlorine dioxide
 chlorine trifluoride
 chlorine
 1- chloro-1-nitropropane
 chloroacetaldehyde
 alpha- chloroacetophenone
 chlorobenzene
 o- chlorobenzylidene malononitrile
 chlorobromomethane
 chlorodiphenyl, 42% chloride
 chlorodiphenyl, 54% chloride
 chloroform
 chloropicrin
 chloroprene
 chromic acid and chromates
 chromium metal and insoluble salts
 chromium as soluble chromic and chromous salts
 coal tar pitch volatiles
 cobalt metal fume and dust
 copper dusts and mists
 copper fume
 cotton dust
 Crag herbicide
 cresol (all isomers)
 crotonaldehyde
 cumene
 cyanide
 cyclohexanone
 cyclohexane
 cyclohexanol
 cyclohexene
 cyclopentadiene
 2,4- D
 DDT
 decaborane
 Demeton
 diacetone alcohol
 diazomethane
 diborane
 dibutyl phosphate
 dibutylphthalate
 dichlorodifluoromethane
 1,2- dichloroethylene
 dichloromonofluoromethane
 dichlorotetrafluoroethane
 1,3- dichloro-5,5-dimethylhydantoin
 1,1- dichloroethane
 o- dichlorobenzene
 1,1- dichloro-1-nitroethane

p- dichlorobenzene
dichloroethyl ether
dichlorvos
dieldrin
diethylamine
diethylamino ethanol
difluorodibromomethane
diglycidyl ether
diisobutyl ketone
diisopropylamine
dimethylphthalate
dimethylamine
1,1- dimethylhydrazine
dimethylaniline
dimethyl-1,2-dibromo-2-2-dichloroethyl phosphate
dimethyl acetamide
dimethyl formamide
dimethylsulfate
dinitro-o-cresol
dinitrobenzene (all isomers)
dinitrotoluene
dioxane
diphenyl
dipropylene glycol methyl ether
endrin
epichlorhydrin
EPN
ethanolamine
2- ethoxyethylacetate
2- ethoxyethanol
ethyl acrylate
ethyl acetate
ethyl benzene
ethyl bromide
ethyl butyl ketone
ethyl chloride
ethyl ether
ethyl formate
ethyl mercaptan
ethyl silicate
ethylamine
ethylene chlorohydrin
ethylene dibromide
ethylene dichloride
ethylenediamine
ethylene glycol dinitrate and/or nitroglycerin
ethylene oxide
n- ethylmorpholine
ferbam
ferrovanadium dust
fluoride
fluorine
fluorotrichloromethane
formaldehyde
formic acid
furfural

furfuryl alcohol
glycidol
graphite, natural
hafnium and compounds
heptachlor
heptane
hexachloroethane
hexachloronaphthalene
hexane
2- hexanone
hexone
sec- hexyl acetate
hydrazine
hydrogen bromide
hydrogen fluoride
hydrogen selenide
hydrogen chloride
hydrogen peroxide
hydrogen cyanide
hydrogen sulfide
hydroquinone
iodine
iron oxide fume
isoamyl acetate
isoamyl alcohol
isobutyl acetate
isobutyl alcohol
isophorone
isopropyl acetate
isopropyl alcohol
isopropyl glycidyl ether
isopropylamine
isopropylether
ketene
lead and inorganic lead compounds
lead arsenate
lindane
lithium hydride
LPG
magnesium oxide fume
malathion
maleic anhydride
manganese
mercury
mesityl oxide
methoxychlor
methyl (n-amyl) ketone
5- methyl - 3-heptanone
methyl acetate
methyl acrylate
methyl alcohol
methyl acetylene
methyl acetylene-propadiene mixture
methyl bromide
methyl cellosolve acetate
methyl cellosolve

methyl chloride
methyl chloroform
methyl formate
methyl isobutyl carbinol
methyl iodide
methyl isocyanate
methyl methacrylate
methyl mercaptan
alpha- methyl styrene
methylal
methylamine
methylcyclohexane
o- methylcyclohexanone
methylcyclohexanol
methylene chloride
methylene bisphenyl isocyanate
mica
molybdenum soluble compounds
molybdenum insoluble compounds
monomethyl aniline
monomethyl hydrazine
morpholine
naphthalene
naptha, coal tar
nickel carbonyl
nickel metal and soluble compounds
nicotine
nitric acid
nitric oxide
p- nitroaniline
nitrobenzene
p- nitrochlorobenzene
nitroethane
nitrogen trifluoride
nitrogen dioxide
nitromethane
1- nitropropane
2- nitropropane
nitrotoluene
octachloronaphthalene
octane
di-sec- octyl phthalate
oil mist, mineral
organo mercury
osmium tetroxide
oxalic acid
oxygen difluoride
ozone
paraquat
parathion
pentaborane
pentachloronaphthalene
pentachlorophenol
pentane
2- pentanone
perchloryl fluoride

perchloromethyl mercaptan
petroleum distillates
phenol
phenyl ether
phenyl ether-biphenyl mixture
phenyl glycidyl ether
p- phenylene diamine
phenylhydrazine
Phosdrin
phosgene
phosphine
phosphoric acid
phosphorus, yellow
phosphorus pentachloride
phosphorus pentasulfide
phosphorus trichloride
phthalic anhydride
picric acid
Pival
platinum soluble salts
Portland cement
propane
n- propyl acetate
propyl alcohol
n- propyl nitrate
propylene oxide
propylene dichloride
propylene imine
pyrethrum
pyridine
quinone
rhodium metal fume and dusts
rhodium soluble salts
ronnel
rotenone
selenium hexafluoride
selenium compounds
silica, amorphous
silica, crystalline
silver metal and soluble compounds
soapstone
sodium fluoroacetate
sodium hydroxide
stibine
stoddard solvent
strychnine
styrene
sulfur dioxide
sulfur monochloride
sulfur pentafluoride
sulfuric acid
sulfuryl fluoride
2,4,5- T
talc
tantalum
TEDP

tellurium hexafluoride
tellurium and compounds
EPP
terphenyls
1,1,2,2- tetrachloro-1,2-difluoroethane
1,1,1,2- tetrachloro-2,2-difluoroethane
1,1,2,2- tetrachloroethane
tetrachloronaphthalene
tetrachloroethylene
tetraethyl lead
tetrahydrofuran
tetramethyl succinonitrile
tetramethyl lead
tetranitromethane
tetryl
thallium compounds, soluble
thiram
tin compounds, organic
tin compounds, inorganic
titanium dioxide
toluene
toluene-2,4-diisocyanate
o- toluidine
tributyl phosphate
1,1,2- trichloro-1,2,2-trifluoroethane
trichloronaphthalene
1,2,3- trichloropropane
1,1,2- trichloroethane
trichloroethylene
triethylamine
trifluoromonobromomethane
trinitrotoluene
triorthocresyl phosphate
triphenyl phosphate
turpentine
uranium insoluble compounds
uranium soluble compounds
vanadium pentoxide dust
vanadium pentoxide fume
vinyl toluene
warfarin
xylene
xylylidine
yttrium and compounds
zinc chloride fume
zinc oxide fume
zirconium compounds