

CHAPTER XIII

MODIFICATION OF PELs FOR PROLONGED EXPOSURE PERIODS

A. Purpose and Scope. The 1968 ACGIH Threshold Limit Values (TLVs) adopted by OSHA as permissible exposure limits (PELs) are directly related to assumed conventional exposure periods or no more than 8 hours/day, 40 hours/week.

1. The 8-hour exposure limits for some substances may not provide appropriate protection from health hazards when novel work schedules are utilized; e.g., exposures longer than 8 hours/day, four 10-hour days/week, six 7-hour days/week, etc. This chapter identifies those PELs which may inadequately protect workers for prolonged exposure periods and describes how an "adjusted PEL" may be calculated.

2. Instructions on sampling and citation procedures shall be sought from the Assistant Regional Administrator (ARA) for Technical Support who shall in turn contact the Directorate of Technical Support.

B. Procedure.

1. Each substance listed in the Substance Toxicity Table in Chapter II has been assigned to one of the six "Work Schedule" categories described in Figure XIII-1 on the basis of the 1968 Documentation of TLVs published by ACGIH.

2. During a health inspection, the Industrial Hygienist has the responsibility of documenting any work schedules resulting in excessive exposures to a hazardous substance caused by exposure periods longer than 8 hours/day or 40 hours/week. This would include routine overtime shifts.

3. The Industrial Hygienist should determine an "adjusted PEL" as necessary for each hazardous substance samples, according to the specifications given for the category to which it is assigned.

4. No adjustment should be made to the PELs of substances in category 1. For all other categories, the equivalent PELs should be calculated according to the methods described in paragraphs

C.1 through 6 and used as a professional guide or in the evaluation of actual employee risk.

5. In all situations, the equivalent PEL will be equal to or lower (i.e. more restrictive) than the PEL values listed in 29 CFR 1910.1000.

6. The Industrial Hygienist should also elicit from the employees and document any symptomatology that may be related to the exposure.

C. Work Schedule Categories.

1. **Category 1A. Ceiling Limit Standards.** Substances in this category (e.g., butylamine) have ceiling limit standards which were intended never to be exceeded at any time, and so, are independent of the length or frequency of work shifts. The ceiling PELs for substances in this category should not be adjusted.

2. **Category 1B. Standards Preventing Mild Irritation.** Substances in this category have a PEL designed primarily to prevent acute irritation or discomfort (e.g., cyclopentadiene). There are essentially no known cumulative effects resulting from exposures for extended periods of time at concentration levels near the PEL. The PELs for substances in this category should not be adjusted.

3. **Category 1C. Standards Limited by Technologic Feasibility.** The PELs of substances assigned to this category have been set either by technologic feasibility (e.g., vinyl chloride) or good hygiene practices (e.g., methyl acetylene). These factors are independent of the length or frequency of work shifts. The PELs for substances in this category should not be adjusted.

4. Category 2. Acute Toxicity Standards.

a. The substances in this category have PELs which prevent excessive accumulation of the substance in the body during 8 hours of exposure in any given day (e.g., carbon monoxide).

b. The following equation determines a level which ensures that employees exposed more than 8 hours/day will not receive a dosage (i.e.

length of exposure X concentration) in excess of that intended by the standard.

$$\text{Equivalent PEL} = 8\text{-hour PEL} \times \frac{8 \text{ hours}}{\text{hours of exposure in one day}} \quad (\text{Equation XIII-1})$$

c. The Industrial Hygienist should normally conduct sampling for the entire shift minus no more than one hour for equipment set-up and retrieval (e.g., at least 9 hours of a 10-hour shift). In situations where an employee works multiple shifts in a day (e.g., two 7-hour shifts), and the Industrial Hygienist can document sufficient cause to expect exposure concentrations to be similar during the other shifts, the sampling should be done during only one shift.

5. Category 3. Cumulative Toxicity Standards.

a. Substances assigned to this category present cumulative hazards (e.g., lead, mercury, etc.). The PELs for these substances are designed to prevent excessive accumulation in the body resulting from many days or even years of exposure.

b. The following equation ensures that workers exposed more than 40 hours/week will not receive a dosage in excess of that intended by the standard.

$$\text{Equivalent PEL} = 8\text{-hour PEL} \times \frac{40 \text{ hours}}{\text{hours of exposure in one week}} \quad (\text{Equation XIII-2})$$

c. It is the responsibility of the Industrial Hygienist to conduct sufficient sampling to document exposure levels for the entire week when evaluating conditions on the basis of this equivalent PEL. For most operations the Industrial Hygienist will be able to sample during one shift only and then document sufficient cause to predict exposure concentrations during the other shifts.

6. **Category 4. Acute and Cumulative Toxicity Standards.** Substances in this category may present both an acute and a cumulative hazard. For this reason, the PELs of these substances should be adjusted by either equation XIII-1 or XIII-2; i.e. whichever provides the greatest protection.

7. **Refined Adjustment Equations for Specific Standards.** The adjustment equation presented for categories 2 and 3 reflect an oversimplification of the actual accumulation and removal of a toxic

agent from the body. Additional research, however, is needed in order to apply more complex equations to estimate resulting body burden and health risk due to prolonged exposure periods. This chapter will be updated when the necessary data become available. Industrial Hygienists having sufficient data to validate adjusting PELs by a more rigorous method such as those proposed in the following articles are encouraged to do so following approval from the ARA for Technical Support:

Brief, R.S. and R.A. Scala, "Occupational Exposure Limits for Novel Schedules," *Amer. Ind. Hyg. Assn. Jour.* 36:467, 1975.

Roach, S.A., "A More Rational Basis for Air Sampling Programmes," *Ann. Occup. Hyg.* 20:65, 1977.

Hickey, J.L.S. and P.C. Reist, "Application of Occupational Exposure Limits to Unusual Work Schedules," *Amer. Ind. Hyg. Assn. Jour.* 38:613, 1977.

FIGURE XIII-1

Summary of Work Schedule Categories

Work Schedule Category	Principle Group Characteristic	Conditions Resulting In Adjustment	Adjustment Formula
1A	Ceiling limit standards	None	None
1B	Irritants	None	None
1C	Technologic limitations	None	None
2	Acute toxicity only	Exposed greater than 8 hours/day	Adj. PEL = PEL x 8 hours/ hours exposed/day
3	Cumulative toxicity only	Exposed greater than 40 hours/ week	Adj. PEL = PEL x 40 hours/ hours exposed/week
4	Both acute and cumulative toxicity	Exposed greater than 8 hours/day and/or exposed greater than 40 hours/week	The equation for category 2 or 3, whichever results in the greatest protection

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