

No acute lethality data are available in humans. Qualitative data regarding human exposures indicate signs and symptoms of exposure consistent with a highly irritating chemical; ocular and dermal irritation, respiratory tract irritation, shortness of breath, and nausea.

Lethality data in animals are available for rats, cats, and guinea pigs. Cursory studies conducted nearly 100 years ago in Germany provided preliminary data on lethal and nonlethal effects in cats and guinea pigs following various treatment regimens with inhaled phosphorus trichloride. Although results of the studies indicated the respiratory tract to be a critical target, the methods and results of these studies were not verifiable. Weeks et al. (1964) reported 4-hour LC_{50} values of 104.5 ppm and 50.1 ppm for rats and guinea pigs, respectively. An unpublished study by Hazleton Laboratories (1983) identified a NOAEL of 3.4 ppm and a LOAEL (histopathologic changes in the respiratory tract) of 11 ppm following repeated exposure (6 hours/day, 5 days/week for 4 weeks) of rats. There are no data regarding reproductive/developmental toxicity, genotoxicity, or carcinogenicity of phosphorus trichloride. Definitive data regarding the mechanism of action of phosphorus trichloride are unavailable. Decomposition products (hydrogen chloride, phosphonic acid, and pyrophosphonic acids) are responsible, at least in part, for the contact irritation reported by humans, and the irritation and tissue damage observed in animal species.

The concentration-time relationship for may irritant and systemically acting vapors and gases may be described by $C^n \times t = k$, where the exponent n ranges from 0.8 to 3.5. Due to the limited toxicity data for this chemical, an empirical derivation of n was not possible. In the absence of an

empirically derived exponent (n), and to obtain conservative and protective AEGL values, temporal scaling was performed using $n = 3$ when extrapolating to shorter time points and $n = 1$ when extrapolating to longer time points using the $C^n \times t = k$ equation. For 10-minute AEGL-3 values were set at equivalence to the 30-minute values due to uncertainties in extrapolating from the experimental exposure durations of 4 hours and greater.

Quantitative data consistent with AEGL-1 effects were unavailable. Occupational exposures of humans to 1.8–3.6 ppm for 2–6 hours and exposure of rats to 3.4 ppm for 6 hours/day, 5 days/week for 4 weeks were without notable effect. These data can be considered a NOAEL for AEGL-1 effects. Because they were derived from controlled experiments, the AEGL-1 values were based upon the Hazleton Laboratories (1983) report. These data as well as the AEGL-1 values are supported by the human experience data reported by Sassi (1952). The interspecies uncertainty factor was limited to 3 because of the concordance of the animal data with the human experience and because the most sensitive species tested (guinea pig) was only about 2-fold more sensitive. The intraspecies uncertainty factor was limited to 3 because primary effects of phosphorus trichloride (irritation and subsequent tissue damage) appear to be due, in part, to hydrogen chloride and phosphonic acid resulting from chemical dissociation. Additional reduction of the AEGL-1 values would be inconsistent with available human and animal data.

Information consistent with AEGL-2 effects were limited to an occupational exposure report and a multiple exposure study with rats. For occupational exposures, there was notable irritation following 2–6 hours of exposure to approximately 14–27 ppm phosphorus

trichloride and more severe but reversible irritation following exposures of 1–8 weeks. Reports providing qualitative information but no exposure terms affirmed the potential for respiratory tract irritation following acute exposures to phosphorus trichloride. Data for rats showed upper respiratory tract involvement following multiple exposures over 4 weeks to 11 ppm but not to 3.4 ppm (Hazleton Laboratories, 1983). For development of AEGL-2 values, the 11 ppm exposure in rats was considered a NOAEL for AEGL-2 effects. Uncertainty factor application was the same as for the AEGL-1 tier.

AEGL-3 values were developed based upon a 3-fold reduction of the 4-hour LC_{50} (Weeks et al., 1964) as an estimate of the lethality threshold ($50.1 \text{ ppm}/3 = 16.7 \text{ ppm}$). A total uncertainty factor adjustment of 10 was used to develop the AEGL-3 values. Animal data indicated some variability in the toxic response to phosphorus trichloride with guinea pigs being the more sensitive among the species tested. Therefore, uncertainty adjustment regarding interspecies variability was limited to 3. To account for intraspecies variability, a factor of 3 was applied. The uncertainty of intraspecies variability was limited to 3 because primary effects of phosphorus trichloride (irritation and subsequent tissue damage) appear to be due, in part, to hydrogen chloride and phosphonic acid resulting from chemical dissociation. The total uncertainty factor of 10 may be justified by human exposure data showing that repeated 2 to 6-hour exposures of up to 27 ppm were without life-threatening consequences. Furthermore, the results of the Hazleton Laboratories (1983) study showed no fatalities in rats following multiple 6-hour exposures to 11 ppm.

The proposed AEGL values are listed in Table 10 of this unit.

TABLE 10.—SUMMARY OF PROPOSED AEGL VALUES FOR PHOSPHORUS TRICHLORIDE

Classification	10-minutes	30-minutes	1-hour	4-hours	8-hours	Endpoint (Reference)
AEGL-1 (Nondisabling)	0.78 ppm	0.78 ppm	0.62 ppm	0.39 ppm	0.26 ppm	NOAEL of 3.4 ppm in rats exposed 6 hours/day, 5 days/week for 4 weeks (Hazleton Laboratories, 1983)
AEGL-2 (Disabling)	2.5 ppm	2.5 ppm	2.0 ppm	1.3 ppm	0.83 ppm	NOAEL for AEGL-2 tier effects; based upon respiratory tract histopathology in rats exposed 6 hours/day, 5 days/week for 4 weeks (Hazleton Laboratories, 1983)