TABLE 38-E THRESHOLD LIMIT VALUES FOR CHEMICAL SUBSTANCES IN WORKROOM AIR, 1973 (*Continued*)

brated, in the laboratory, for response to this specific quantitative and qualitative air-vapor mixture, and also to fractional concentrations of this mixture, e g , 1/2 the TLV, 1/10 the TLV, 2 × the TLV, 10 × the TLV, etc)

TLV of mixture =

$$\frac{1}{\frac{f_a}{TLV_a} + \frac{f_b}{TLV_b} + \frac{f_c}{TLV_c} + \quad \frac{f_n}{TLV_n}}$$

Example No 1 Liquid solvent contains (by weight) 50% heptane (TLV = 2000 mg/m³) 30% methylene chloride (TLV = 1740 mg/m³) 20% perchloroethylene (TLV = 670 mg/m³)

$$\text{TLV of mixture} = \frac{1}{\frac{0\,5}{2000} + \frac{0\,3}{1740} + \frac{0\,2}{670}}$$

$$= \frac{1}{0\,00025 + \ 00017 + \ 0003} = \frac{1}{0\,00072}$$

$$= 1390 \text{ mg/m}^3$$

Of this mixture 50% or 695 mg/m³ is heptane, 30% or 417 mg/m³ is methylene chloride and 20% or 278 mg/m³ is perchloroethylene

These values can be converted to ppm as follows

Heptane—
2000 mg/m³ = 500 ppm
1 mg/m³ = 0 25 ppm
695 mg/m³ = 174 ppm

Methylene chloride—
1740 mg/m³ = 500 ppm
1 mg/m³ = 0 287 ppm
417 mg/m³ = 119 ppm

Perchloroethylene—
670 mg/m³ = 100 ppm
1 mg/m³ = 0 15 ppm
278 mg/m³ = 42 ppm

The TLV of this mixture =
174 + 119 + 42 = 335 ppm

1A c **Independent effects**
Air contains 0 15 mg/m³ of lead (TLV, 0 15) and 0 7 mg/m³ of sulfuric acid (TLV, 1)

$$\frac{0\,15}{0\,15} = 1, \qquad \frac{0\,7}{1} = 0\,7$$

Threshold limit is not exceeded

1B a General exact solution for mixtures of N components with additive effects and different vapor pressures

(1) $\frac{C_1}{T_1} + \frac{C_2}{T_2} + \quad + \frac{C_n}{T_n} = 1,$

(2) $C_1 + C_2 + \quad + C_n = T,$

(2 1) $\frac{C_1}{T} + \frac{C_2}{T} + \quad + \frac{C_n}{T} = 1$

By the Law of Partial Pressures,

(3) $C_i = ap_i$

And by Raoult's Law,

(4) $p_i = F_i p_i^\circ$

Combine (3) and (4) to obtain

(5) $C_i = aF_i p_i^\circ$

Combining (1), (2,1) and (5), we obtain

(6) $\frac{F_1 p_1^\circ}{T} + \frac{F_2 p_2^\circ}{T} + \quad + \frac{F_n p_n^\circ}{T} =$

$$\frac{F_1 p_1^\circ}{T_1} + \frac{F_2 p_2^\circ}{T_2} + \quad + \frac{F_n p_n^\circ}{T_n}$$

and solving for T,

(6 1) $T = \frac{F_1 p_1^\circ + F_2 p_2^\circ + \quad + F_n p_n^\circ}{\frac{F_1 p_1^\circ}{T_1} + \frac{F_2 p_2^\circ}{T_2} + \quad + \frac{F_n p_n^\circ}{T_n}}$

or

(6 2) $T = \frac{\sum_{i=1}^{i=n} F_i p_i^\circ}{\sum_{i=1}^{i=n} \frac{F_i p_i^\circ}{T_i}}$

T = Threshold Limit Value in ppm
C = Vapor concentration in ppm
p = Vapor pressure of component in solution
p° = Vapor pressure of pure component
F = Mol fraction of component in solution
a = A constant of proportionality

Subscripts 1,2, n relate the above quantities to components 1,2, n, respectively