AUTOMATIC FIRE PROTECTION REQUIREMENTS FOR LABORATORY FUME HOODS AND SIMILAR EXHAUSTED WORK STATIONS

Laboratory fume hoods and similar workstations frequently require automatic fire sprinklers in the duct, plenum, and/or over the work surface. These requirements are outlined below. Questions should be directed to the Fire Prevention Bureau at (925) 454-2362.

Reference: Current editions of NFPA 13 and 45 and the Mechanical Code and Section 5101.11 of the California Fire Code.

General Requirements

a) Exhaust Ducts: Internal fire sprinklers are required when:

   1) The duct material is not metal and does not meet combustibility limitations (see the Mechanical Code Section 609.1, 1995 edition), or
   2) When metal ducting exceeds 10" and carries flammable vapors (defined as exceeding 10% of the Lower Flammable Limit (LEL) of a flammable or combustible gas or liquid) (Mechanical Code Section 609.7, 1995 edition).

   This requirement applies regardless of whether the building is currently sprinklered. If the requirement applies and the building is not sprinklered, then the entire building must be sprinklers.

b) Plenums (air gathering space between work area and beginning of the duct) and branch exhaust connections: Combustible plenums/exhaust connections, plenums/exhaust connections serving combustible work stations and plenums/exhaust connections conveying flammable vapors must be provided with automatic fire sprinklers.

   This requirement applies regardless of whether the building is currently sprinklered. If the requirement applies and the building is not sprinklered, then the entire building must be sprinklered.

c) Work Surfaces: In sprinklered buildings, when the work surface is covered by a hood or other obstruction between the work surface and the ceiling fire sprinklers, then one or more fire sprinklers is required under the hood or obstruction unless all of the following are true:

   - The entire work station (including plenum, ducts, and cabinets below the work surface) are non-combustible, e.g., metal, granite), ***and***
   - The least horizontal dimension of the hood or obstruction does not exceed four feet, ***and***

- No flammable or combustible materials are used or produced in the work station or hood, other than ordinary combustibles (paper, cardboard, wood, etc.), ***and***
- The face of the hood/work surface is not and cannot be fully or partially shielded (example: no pull-down window).

Calculating Percent Lower Flammable Limit (LEL)

1) For hood of 15 square feet or less the potential to exceed 10% LEL is not present based on EPA utilized calculations and NFPA published data when (1) materials used at a hood or work station include only liquids (not including Class IA flammable liquids), solids and non-flammable gases, (2) no heating occurs under the hood, and (3) the ventilation rate is at least 1,000 cfm.

2) When the above conditions are not met, the Fire Department presumes the potential to exceed 10% LEL exists. While the details of such calculations are dependent upon the characteristics of individual situations (are gases present? are materials being heated? what size are the containers?, etc.) in general the calculation can be described as follows for liquids:

   CFM = cubic feet per minute ventilation as determined by the mechanical system designer

   Vpr = Maximum vapor production rate (see #3 below) per minute in standard cubic feet vapor/min at room temperature

   $$100 \times \frac{Vpr}{CFM} = \text{\% by volume vapor}$$

   - % by volume vapor $\leq$ 1/10 LEL then the system <u>does</u> <u>not</u> convey flammable vapors.

   - % by volume vapor > 1/10 LEL then the system does convey flammable vapors.

   This calculation may need to be repeated for each flammable and combustible liquid present since results vary by chemical.

3) Vpr can be calculated by using the following:

   A1. $$Vpr = \frac{0.106 \times u^{0.78} \times MW^{0.67} \times A \times Vp}{82.05\,(T + 273)} = \frac{lb}{min}$$

   where:
   u = windspeed/airspeed (M/S, see A.2 below)
   mw = molecular weight (g/gmole)
   A = area of spill (ft^2)

VP = vapor pressure (mm Hg at the temperature of the liquid or Torr) at the liquid's temperature
T = temperature of the liquid in ^{o}C

A2. Wind speed/airspeed in meters/sec needs to be estimated. For example, for a fume hood which is 8' long x 4' deep and has a 1,000 cfm ventilation system:

$$1{,}000 \text{ cfm} \times \frac{1}{32 \text{ ft}^2} = 31 \frac{\text{ft}}{\text{min}}$$

$$31 \frac{\text{ft}}{\text{min}} \times \frac{1}{196.85} = 0.16 \frac{\text{m}}{\text{sec}} \quad \frac{\text{m}}{\text{sec}} \times 196.85 = \frac{\text{ft}}{\text{min}}$$

B. Convert lb/min to standard cubic feet/min vapor produced

$$\frac{\text{lb.}}{\text{min}} * \frac{1}{\text{vapor density (lbs /scf)}} = \frac{\text{scf vapor}}{\text{mins}}$$