

A summary of reports* of experimental evidence and practical experience in the petroleum industry recites that no significant increase in fire safety is gained by the use of spark-resistant hand tools in the presence of gasoline and other hydrocarbon vapors.

However, some materials such as carbon disulfide, acetylene, and ethyl ether have very low ignition energy requirements. For these, and similar materials, the use of special tools designed to minimize the danger of sparks in hazardous locations can be recognized as a conservative safety measure.

Leather-faced, plastic, and wood tools are free from the friction-spark hazard.

Health Hazards

Toxic effects

Flammable liquids and their vapors may create health hazards from both surface contact and inhalation of toxic vapors. Irritation results from the solvent action of many flammable liquids on the natural skin oils and tissue. A toxic hazard of varying degree exists in practically all cases, depending on the concentration of the vapor. See Chapter 42, "Elements of Industrial Toxicology."

Some flammable vapors are heavier than air and will flow into pits, tank openings, confined areas, and low places in which they contaminate the normal air and thus cause a toxic as well as explosive atmosphere. Oxygen deficiency occurs in closed containers, such as a tank which has been closed for a long time and in which rusting has consumed the oxygen. All containers should be aired and tested for toxic and flammable atmosphere before any entry.

Combustible gas indicators

Unless tests prove otherwise, flammable and toxic mixtures should be assumed to be present in all tanks which have contained or have been exposed at any time to flammable liquids. Tests for flammable vapor-air mixtures in tanks and other vessels may be made by making a chemical analysis of samples or by using a combustible gas indicator.

The most commonly used combustible gas indicator is an instrument operating on the principle that when a mixture of flammable vapor and air is passed over a heated electric filament, the resistance of the filament will

be increased in direct proportion to the amount of combustible vapor present. The imbalance of the Wheatstone bridge is read on the galvanometer, usually as the percentage of the lower flammable limit of a calibration substance such as hexane.

In a vapor concentration of less than the lower explosive limit (LEL), the needle will be on scale. In a vapor concentration between LEL and the upper explosive limit (UEL), the needle will remain off scale above 100 per cent. In a vapor concentration above the UEL, the needle will swing rapidly off scale and then drop back to zero. Oxygen deficiency will produce unreliably low readings.

A combustible gas indicator should be used only by experienced persons, and the operator should follow the manufacturer's instructions on balancing the unit. For an accurate determination, the reading should be corrected from the graph for the specific gas present in the atmosphere being tested. Manufacturers supply correlation graphs for many combustible gases.

The operator can check it by placing several drops of the flammable liquid in a small jar, shaking it a few times to permit evaporation, and then holding the sample hose of the instrument in the mouth of the jar and pressing the aspirator bulb the required number of times. If there is any question as to the indicator's accuracy, it should be calibrated against a standard or returned to the manufacturer for checking.

The sampling hose should be kept where flammable liquid, steam, or water will not be drawn into the instrument. Any of these substances would put it out of service. Hot vapors also may affect the indicator if they condense inside. Lead contamination can be encountered when sampling leaded gasolines and can be avoided by use of special high temperature filaments.

A tank, tested before being cleaned, may be found vapor-free. However, if it contains sludge or scale, flammable liquid and vapor

* U.S. Department of Commerce, Office of Technical Services. *Sparking Characteristics and Safety Hazards of Metallic Materials*. Technical Report No. NGF-T-1-57, PB 131131.