American Welding Society
Safety and Health
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Airborne Contaminants and Their Occupational Exposure Limits

INTRODUCTION

Welding and its allied processes have the potential to produce airborne contaminants. It is necessary to make sure welders and other workers are not overexposed to these or other airborne contaminants during their workday. The Occupational Safety and Health Administration (OSHA) publishes exposure limits known as Permissible Exposure Limits (PELs) so that employers know what levels of different types of contaminants are safe for workers. OSHA's exposure limit standards are the legal limits in the U.S. The American Conference of Governmental Industrial Hygienists (ACGIH) also annually publishes exposure limits, known as Threshold Limit Values ((TLVs®)).

OCCUPATIONAL EXPOSURE LIMITS

The OSHA and ACGIH airborne exposure limits are most often used in the workplace. Other entities that publish limits include the National Institute for Occupational Safety and Health (NIOSH) and the American Industrial Hygiene Association (AIHA).

THE DIFFERENCE BETWEEN A PEL AND A TLV®

Often Safety Data Sheets (SDS) for welding consumables, chemicals or contaminant sources will list PELs, (TLVs®) and other applicable exposure limits in Section 8. PELs are OSHA's published regulatory values in the U.S. PELs are enforceable to protect workers against the potential health effects of overexposure to hazardous substances. PELs are regulatory limits that define the amount or concentration of a substance in the air, expressed in terms of an averaged 8-hour exposure period, called an 8-Hour-Time–Weighted-Average (TWA). Some states have their own occupational safety and health programs. For this reason, state exposure limits may be different, but they must be at least as low - or protective - as the federal OSHA limits.

OSHA strongly recommends that employers consider the ACGIH TLVs (along with NIOSH Recommended Exposure Limits) in the interest of better worker protection, as many of its own PELs have not been updated since 1971 and may be insufficiently protective.

OSHA has established other types of exposure limits. The Short-Term Exposure Limit (STEL) is expressed in terms of a concentration averaged over a 15-minute interval. A Ceiling Limit (C) indicates a level of exposure which may not be exceeded at any time, regardless of duration. Action Level (AL) is a level at which the employer must take specific administrative measures as defined by the regulatory authority (OSHA). For example,

the AL is typically 50% of the exposure limit for hexavalent chromium.

It is important to understand that specific contaminants may have one or more of these limits associated with them. OSHA PELs and other applicable limits can be found in OSHA 29 CFR 1910.1000, Tables Z-1, Z-2 and Z-3.

The ACGIH (American Conference of Governmental Industrial Hygienists) is an independent, not-for-profit, non-governmental corporation. The ACGIH members, who are industrial hygienists, review published studies and scientific literature to make recommendations and establish Threshold Limit Values (TLVs®). The ACGIH establishes TLVs® for use in the practice of industrial hygiene - and they are not intended to indicate a fine line between safe and unsafe exposures. They represent the opinion of the scientific community that has reviewed the data described in the documentation, such that exposure at or below the level of the TLV® does not create an unreasonable risk of disease or injury. TLVs® are not standards or regulations. The ACGIH also establishes recommended short-term and ceiling exposure thresholds.

Many potential fume constituents and gases produced by various welding and allied processes are listed by the ACGIH in: “Threshold Limit Values for Chemical Substances and Physical Agents, Biological Exposure Indices,” a guide which is issued annually. Other countries and regional authorities also establish their own occupational exposure limits which regulate or establish recommended safe levels of exposure for workers. Some countries tend to adopt ACGIH TLV®s as occupational exposure limits.

HOW ARE EXPOSURES MEASURED?

A qualified person such as an industrial hygienist conducts exposure monitoring in the workplace. Typically, they would place a sampling pump on the worker’s belt, which is connected with clear plastic tubing to a sample collection media cassette, mounted on the worker’s collar - or in the case of welding - inside the welder’s welding helmet. While the workers go about their normal activities, the pump draws a known volume of air while collecting contaminants on the sample media throughout the work shift. Once the media is analyzed in a laboratory for the contaminant(s) of interest, an 8-hour, time-weighted-average airborne exposure level or concentration for the work shift is obtained. When a sufficient number of these industrial hygiene exposure measurements are collected, compliance with exposure levels can be assessed by comparing the results with the established workplace limit(s). Employers must inform affected employees regarding the results of such exposure sampling.

HOW DO I KNOW WHAT I’M EXPOSED TO?

The employer has the obligation to understand the nature and composition of contaminants or agents to which workers are potentially exposed, based on their knowledge about the materials used in the workplace and the nature of the operations taking place. Employers must inform workers about specific exposure hazards associated with their work activities.

A safety and health professional, such as an industrial hygienist, may assist employers with formal assessments of exposure potential. For example, when conducting welding on stainless steel, one can anticipate that the welder may be exposed to airborne contaminants such as complex metallic oxides of iron, manganese, chromium and nickel. The welder may also be exposed to hexavalent chromium as well as gases including ozone and carbon monoxide. Depending on the welding process, there may also be the potential for exposure to fluoride compounds. Then actual exposure testing can be conducted to measure exposure levels to these contaminants to make sure levels are safe, or to take appropriate actions to prevent overexposures.

Safety Data Sheets and product labeling for the consumables and other products used in the workplace provide an effective means for understanding material composition and the potential exposures arising from product use. In addition, the required employer's hazard communication program should include training that discusses potential workplace exposures and how to avoid overexposures.

WHAT IF I FIND OUT MY EXPOSURE WAS OVER THE LIMIT?

When worker exposures are over the applicable exposure limit employers must take immediate actions to ensure overexposures are prevented. This can be accomplished through making changes in the process, substituting for less hazardous materials, and improving or providing additional engineering controls such exhaust ventilation systems. If these steps still do not adequately control exposure, then personal protection such as a respirator must be utilized to ensure that the worker remains safe.

SUMMARY

It is important to understand the levels of airborne contaminants to which workers may be exposed while executing their assigned work. Employers have the responsibility to assess worker exposures, and, where necessary, to conduct exposure sampling in their workplaces. Legal exposure limit standards, such as the OSHA PEL, exist for many known potentially harmful contaminants. Other limits such as the ACGIH (TLVs®) utilize a review of current scientific literature in order to establish recommended protective exposure limits for chemical and physical agents to which workers may be exposed. Workplace measurements must be compared to these limits to determine if existing exposures are acceptable. Where they are not acceptable, employers must take immediate steps to control and limit exposures such that workers are adequately protected. It is advised that employers consider using the more protective of the available or applicable exposure limit values. Product SDSs provide valuable information about potential exposures during product use and guidance about the hazards present. The exposure limit information they provide also helps employers to understand the limits applicable to their operations and to prevent workplace overexposures.

INFORMATION SOURCES

ACGIH, *Threshold Limit Values for Chemical Substances and Physical Agents and Biological Exposure Indices,* American Conference of Governmental Industrial Hygienists, <www.acgih.org>.

ANSI Z49.1, *Safety in Welding, Cutting, and Allied Processes*, American Welding Society,< site: www.aws.org>.

AWS Safety and Health Fact Sheets, American Welding Society, <www.aws.org>.

OHSA Title 29, 1910, *Occupational Safety and Health Standards*, Occupational Safety and Health Administration, Code of Federal Regulations, www.osha.gov>.

OHSA Title 29, 1926, *Safety and Health Regulations for Construction,* Occupational Safety and Health Administration, Code of Federal Regulations, <www.osha.gov>.