INDUSTRIAL HYGIENE IN THE WORKPLACE
The Occupational Safety and Health Act establishes an employers’ criteria for protecting employees against health hazards and harmful materials. Industrial hygiene (IH) is the science devoted to the anticipation, recognition, evaluation, and control of workplace environmental factors or stresses that may cause illness, injury, impaired health or well-being, or significant discomfort for a worker. Employers are required to implement some element of an IH or occupational health program.

A qualified person called an industrial hygienist assists employers with carrying out IH duties in the workplace. The role of the industrial hygienist is to:

- Protect the health of the employees.
- Have an objective attitude toward occupational health hazards regardless of external influences to recognize, evaluate and control the hazards in the work environment for the safety of the employees.
- Counsel employees regarding the health hazards and the precautions necessary to avoid adverse health effects.
• Know the effects of the chemical and physical agents at various exposure levels on the employee’s health.

• Monitor and analyze the extent of exposure.

• Engineer methods of control to reduce or eliminate workplace hazards.

Five common IH areas that employers should assess in their workplace include:

• Noise,
• Ergonomics,
• Lighting,
• Temperature, and
• Air Sampling.

Noise

The Occupational Safety and Health Administration (OSHA) requires employers to determine if workers are exposed to excessive workplace noise. If so, the employer must implement feasible engineering or administrative controls to eliminate or reduce hazardous levels of noise. Employers must implement an effective hearing conservation program where controls are insufficient.

OSHA’s occupational noise exposure standard at 1910.95 protects general industry employees, such as those working in the manufacturing, utilities, and service sectors. It does not cover the construction or the oil and gas well drilling and servicing industries. These industries have separate noise exposure standards.

Evaluating Noise Exposure

The first step toward solving any noise problem is to define it. Employers must determine the level of noise their employees are exposed to in the workplace to determine which control methods are needed.

When evaluating which employees are potentially covered by OSHA’s standard, remember that the rule applies to employees with even one day of exposure to noise levels at or above 85 decibels on an eight-hour time weighted average (TWA). For example, if an employee visits a particular facility...

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only a few times per year, but is exposed to noise levels at or above 85 decibels on a TWA, that employee would be covered by the standard. Include such employees in the company’s hearing conservation program.

Employees who have not been exposed to noise levels equal to or exceeding 85 decibels (as an eight-hour TWA) for an entire year following their last annual audiogram may be removed from the hearing conservation program. The next step is to perform an assessment by performing a walk-around sound survey and sampling.

**Walkaround Sound Survey**

There is only one way to know if noise has reached a dangerous level — by having someone trained conduct a sound survey. Employers should engage a trained individual to conduct a walk-around sound survey of their workplaces. Anyone trained to use a sound level meter and a dosimeter and evaluate the data should be able to perform the survey.

The walk-around survey will screen for noise exposures and determine if additional monitoring is necessary. When screening for noise exposures, sound-level meter measurements and estimates of the duration of exposure are sufficient. The resulting spot readings can be used to determine the need for a complete evaluation. Survey steps to follow include:

- Touring the facility and developing a detailed understanding of facility operations and potential noise sources. Employers should take the tour with someone familiar with plant operations and maintenance requirements. Notes should be taken on a diagram of the floor plan if possible. The employer must look for indications that noise may be a problem.

- Using a sound level meter to take spot readings of questionable operations. It may be useful to mark the sound levels on a floor plan diagram. Take notes regarding what equipment is on or off.

- Estimating exposures by identifying employees and their locations and estimating the length of time they spend in different areas or how long they operate particular equipment or tools.

There is only one way to know if noise has reached a dangerous level — by having someone trained conduct a sound survey.
If the results of the walk-around survey indicate time-weighted average (TWA) exposures of 80 decibels or more, additional noise monitoring should be performed. Employers should take into account the accuracy of the sound level meter when making this estimation. For example, a Type 2 sound level meter has an accuracy of plus or minus 2 decibels.

**Work Shift Sampling**

Employers will need to implement additional monitoring if a walk-around sound survey indicates excessive noise levels.

When the results of the walk-around survey indicate that noise levels may exceed those outlined in the Occupational Safety and Health Administration (OSHA)’s *Occupational Noise Exposure* standard at 1910.95, additional monitoring is necessary. Sample the noise exposures of representative employees from each job classification that may be overexposed. Use a dosimeter with a threshold of 80 decibels (A-weighted sound pressure level) and 90 decibels to measure noise exposures. Most modern dosimeters use simultaneous 80 and 90 decibel thresholds.

- A dosimeter with a threshold of 80 decibels is used to measure the noise dose of those employees identified during the walk-around survey as having noise exposures that are in compliance with Table G-16 of OSHA’s noise standard 1910.95 but whose exposure may exceed the levels specified in Table G-16a [1910.95 Appendix A: *Noise Exposure Computation*]. In other words, the 80-decibels threshold is used to determine compliance with the 85 decibels time-weighted average (TWA) action level under OSHA’s noise standard.

- The dosimeter with a threshold of 90 decibels is used to measure the noise dose of those employees identified during the walk-around survey as having potential noise exposures that exceed the sound levels in Table G-16. In other words, the 90 decibels threshold is used to determine compliance with the permissible exposure limit (PEL).

Minimum sampling should be conducted for the length of time necessary to establish whether exposures are above the limits permitted by Table G-16 or Table G-16a.
Instrument accuracy must be taken into account. Employers should consider the following with respect to the monitoring results:

- TWA exposures at or above the action level of 85 decibels require a hearing conservation program (results obtained from the 80 decibels threshold).
- TWA exposures exceeding the PEL (Table G-16) require feasible engineering or administrative controls to be implemented (results obtained from the 90 decibels threshold).

Ensure you train employees on the effects of noise on hearing and the purpose and use of hearing protectors.

**Lighting**

Poor workplace lighting can lead to slips, trips, and falls, as well as the inability to exit a space safely, difficulty operating equipment, and a host of other hazards. Workplace lighting must consider quantity, quality, direction, and a number of other factors to ensure safety. OSHA does not usually specify the amount of illumination required in the workplace, although there are other standards that indicate recommended levels depending on the environment and the work being done.

**General Industry**

OSHA’s general industry regulations, for the most part, do not go into specifics about the amount of illumination required. OSHA’s *Powered Industrial Truck* standard is one of the few places where a specific illumination level is given. Paragraph 1910.178(h)(2) states, “Where general lighting is less than 2 lumens per square foot, auxiliary directional lighting shall be provided on the truck.” OSHA also addresses adequate lighting in the exit routes rule at 1910.37(b).

**Construction**

For the construction industry, OSHA sets minimum illumination standards for certain locations such as general construction areas, warehouses, corridors, exits, tunnels and underground work areas, and more.
OSHA requires in 1926.56(a) that construction areas, ramps, runways, corridors, offices, shops, and storage areas shall be lighted to not less than the minimum illumination intensities listed in Table D-3—Minimum Illumination Intensities In Foot-Candles while any work is in progress.

Consensus Standard

There is an American National Standards Institute (ANSI) standard for industrial lighting that is incorporated by reference (ANSI A11.1-65 — Practice for Industrial Lighting) in the OSHA standards for mechanical power-transmission apparatus (1910.219(c)(5)(iii)), pulp and paper mills (1910.261(a)(3)), and sawmills (1910.265(c)(2)).

In general, OSHA uses the General Duty Clause of the OSH Act to cite most hazards related to poorly-lit workplaces, often referencing the ANSI standard (which is now replaced by the Illuminating Engineering Society of North America (IESNA) RP-7: Practice For Industrial Lighting).

This industry standard provides recommended levels based on the type of work being done and the environment. Lighting needs vary depending on such things as the amount of activity, the hazards of the environment, and other factors, generally ranging from .5 foot-candles for low hazard areas (e.g., offices) to 5.0 for high hazards and activity levels such as machine shops or engine rooms. Lighting can be either artificial or natural.

Ergonomics

Ergonomics, or fitting a job to a person, is a process that helps lessen muscle fatigue, increases productivity, and reduces the number and severity of work-related injuries to the muscles, nerves, blood vessels, ligaments, and tendons.

Even though there is no specific ergonomics regulation, OSHA will continue to cite ergonomics-related hazards under the General Duty Clause of the Occupational Safety and Health Act, Section 5.

Employers are responsible for providing a safe and healthful workplace for their workers. The number and severity of musculoskeletal disorders (MSDs) resulting from physical overexertion, and their associated costs, can be substantially reduced by applying ergonomic principles.
Implementing an ergonomic process can be effective in reducing the risk of developing MSDs in high-risk industries as diverse as construction, food processing, manufacturing, office jobs, healthcare, transportation, and warehousing.

Over a million workers report MSDs, such as carpal tunnel syndrome, tendinitis, and back injuries, each year. A significant amount of them need to take time off work because of those injuries.

Work-related MSDs occur when the worker’s physical capabilities do not match the physical requirements of the job. Prolonged exposure to ergonomic risk factors can cause damage to a worker’s body and lead to MSDs.

**Assessing and Preventing Ergonomics Hazards**

Detecting and preventing ergonomics hazards in the workplace can often be easy. Employers can address the issue by:

- Establishing an ergonomics program, and
- Providing and encouraging employees to participate in the ergonomics program and in decisions affecting their safety and health.

Some types of tasks or work conditions which may affect employees include:

- Regular repetitive tasks.
- Forceful exertions.
- Inappropriate tools.
- Vibrations from power tools.
- Poor body mechanics.
- Restrictive workstations.
- Awkward postures.
- Lifting heavy or awkward objects.

Employers can control MSD hazards by properly designing the job or workstation and selecting the appropriate tools or equipment. Based on information from the job analysis, an employer can establish procedures to correct or control risk factors by using:

- Appropriate engineering controls.
- Proper work practices.
• Administrative controls.
• Personal protective equipment.

Effective ergonomic programs should include:

• Management commitment and employee participation.
• Job hazard analysis.
• Controlling ergonomic risk.
• Musculoskeletal disorder (MSD) management.
• Training and education.

To reduce workplace ergonomics hazards, employers should ask those employees working in the problem jobs to recommend measures to reduce hazards.

Office Ergonomics

Employers should offer office and clerical employees an ergonomic workstation assessment. The ergonomics assessment should look at how the person sits; arm, wrist, and hand positions when typing; and the positioning of the keyboard, monitor, and mouse. Follow these recommendations for workstation adjustment and proper work practices.

• **Seat height** — Chairs should be adjustable. Adjust the chair’s height so that the entire sole of the foot rests on the floor or footrest. Thighs should be parallel to the floor, and the chair seat should be just a little lower than the back of the knees, with the knees bent at approximately 90 degrees.

• **Backrest** — Adjust the lumbar support so that the contour of the chair provides lower back support. Adjust the backrest’s tilt, if possible, to support the body in an upright position, although a slight tilt either forward or backward is acceptable. The back should be snug against the seat to reduce stress on the spine and prevent crowding internal organs.

• **Armrests** — If the chairs have armrests, they should be adjusted to contact the elbows when resting comfortably at the side. Forearms should be parallel to the floor and rest horizontally. Wrists should be in line with the elbows and not bent downward, upward, or to one side. Armrests should not force one to elevate the shoulders or move the elbows out away from the body.
• **Monitor** — Adjust the monitor so that the top of the screen is at or slightly below eye level, and straight ahead of the viewer. The user’s head should be able to be held in an upright posture with the chin tucked in.

Take frequent breaks from keyboarding by performing other tasks, taking mini-breaks, or doing simple stretches.

**Handling Ergonomic Problems**

Employers have several options to choose from when controlling ergonomic hazards:

• **Engineering controls** — Redesigning tools, workstations, or equipment.

• **Administrative controls** — Reducing the duration, frequency, and severity of exposure to ergonomic stressors.

• **Good work practice controls** — Using proper work techniques, training, conditioning, monitoring, and feedback.

A medical management program helps to control MSDs through early identification and treatment.

**Temperature**

Your workplace may present your workers with a number of environments:

• Windy, cold, and/or wet environments (typical workers in these environments include truck drivers, firefighters, cold-storage and warehouse workers, fishermen, and utility and agricultural workers); or

• Hot environments (workers in foundries; laundries; construction projects; restaurant kitchens; glass, rubber, or ceramic production facilities; food canneries; chemical plants; smelters; steam tunnels; electrical utilities; and bakeries often face hot conditions which pose special hazards to safety and health).

Often employees indoors and out and in various lines of duty can be exposed to abnormal temperature extremes.
Often employees indoors and out and in various lines of duty can be exposed to abnormal temperature extremes. Some of those workers travel between extremely hot and cold environments and add extra stress to their bodies. Knowing how to handle and work through a range of temperatures and having the ability to identify illnesses related to temperature are important to their health and safety at work.

For many employees, the opportunity to work outdoors is of great value, but those outdoor workers are also the most susceptible to extreme temperatures. Temperature extremes are associated with many occupational health hazards, including heat stress, hypothermia, and frostbite. If your company is located in a very seasonal climate and your employees work outdoors, exposure to hot and cold environments will be unavoidable over the year.

**Assessing Temperature Extremes**

Working in hot and cold temperatures puts an extra strain on an employee’s body. With some understanding of how the body reacts to heat, they can prevent injuries.

Age, weight, degree of physical fitness, metabolism, medications, use of alcohol or drugs, water consumption, caffeine consumption, and various medical conditions, such as hypertension, all affect a person’s sensitivity to heat. It is difficult to predict who will be affected by the heat or cold or when someone will be affected.

Air temperature; humidity; radiant heat from the sun and other sources; conductive heat sources, such as the ground, air movement, workload severity and duration; protective clothing; and PPE are all other factors to consider during temperature extreme assessments.

Another factor is whether or not employees are accustomed to the heat or cold. By gradually being exposed to working in hot or cold conditions, an employee’s body develops a greater tolerance for working in extreme temperatures.

**Written Temperature Extreme Management Plan**

A temperature extreme management plan establishes guidelines to be followed by employees who work in extreme temperatures. The effectiveness of the temperature extreme management plan depends upon the support of employees. While this plan establishes guidelines and gives you sample procedures, you must decide how best to develop and implement your own written temperature extreme management plan.
Standards

OSHA does not have an extreme temperature standard addressing heat and cold stress. Instead, the General Duty Clause of the Occupational Health and Safety Act requires employers to provide a workplace free from recognized or known hazards. So, employers aware that warm and cold temperatures, whether outdoors or indoors, could present a hazard to employees need to take steps to mitigate that hazard.

In September 2021, OSHA stated it would increase measures to help protect workers from the heat through a National Emphasis Program. OSHA’s National Emphasis Program isn’t a standard; it’s simply a way that OSHA encourages employers to put in place a heat stress program to prevent heat-related illnesses and injuries.

The Fall 2021 OSHA Unified Agenda listed Heat Illness Prevention in Outdoor and Indoor Work Settings at the pre-rule stage. This is how OSHA announces its rulemaking activities and then asks questions through an advance notice of proposed rulemaking or a request for information posted in the Federal Register.

In October 2021, OSHA published an Advance Notice of Proposed Rulemaking (ANPRM) called Heat Injury and Illness Prevention in Outdoor and Indoor Work Settings in the Federal Register. With this publication, OSHA began the rulemaking process to consider a heat-specific workplace standard.

On May 3, 2022, OSHA hosted a virtual public stakeholder meeting discussing its activities to protect workers from heat-related hazards. This was an opportunity to learn about and comment on the various efforts OSHA is taking to protect workers from heat-related hazards, as well as hear about the Agency’s rulemaking process and ways for the public to participate.

On April 8, 2022, OSHA launched a National Emphasis Program (NEP) for Heat-Related hazards. The NEP will last three years unless canceled or suspended, targeting over 70 high-risk outdoor and indoor industries. Under the NEP, when the National Weather Service has announced a heat warning or advisory for the local area, OSHA will initiate inspections.

Additional rulemaking steps will include conducting Small Business Regulatory Enforcement Fairness Act (SBREFA) meetings. Eventually, the proposed rule gets published in the Federal Register. Then OSHA analyzes public comments and other information and develops a final rule. These additional steps could take months or even years. Finally, OSHA publishes the final
rule in the Federal Register and offers guidance to help everyone understand the rule.

An OSHA standard specific to heat-related injury and illness prevention, or even cold stress, would more clearly set forth employer obligations and the measures necessary to more effectively protect employees. The ultimate goal is to prevent and reduce the number of occupational injuries, illnesses, and fatalities caused by exposure to temperature extremes.

**Air Sampling**

Working around dusts, mists, fumes, aerosols, gases, and vapors can be hazardous to workers’ health. Depending on the contaminant, overexposure can cause lung disease; problems with the liver, kidneys, heart, or nervous system; or cancer.

To control airborne contaminants, operations can be enclosed or confined, general and local ventilation can be installed, or less toxic materials can be substituted. If these controls do not eliminate the risk, wearing an appropriate respiratory device can protect workers. To determine what respiratory exposures are present, employers need to perform air sampling.

Sampling is a critical part of any work environment where airborne hazards may be present, especially in enclosed spaces with limited access, such as a storage tank, manhole, tunnel, or ditches more than four feet deep. Sampling is required to evaluate the hazards of the space or work area and verify that conditions are acceptable and remain acceptable during entry.

**When to Sample**

The air must be tested to ensure workers are not exposed above occupational exposure limits for substances OSHA regulates. To properly evaluate the work area:

1. **Evaluate** work area conditions before entry is authorized and as necessary to ensure they are acceptable during work.

2. **Monitor** the air using the following guidelines:
   - Test for oxygen first because most gas meters are oxygen dependent and will not provide reliable readings in oxygen-deficient atmospheres.
   - Test for flammable gases and vapors second because the threat of fire or explosion is both more immediate and life threatening (in most cases).
   - Finally, test for toxic air contaminants.
Employers should use sensitive and specific equipment to identify and evaluate any hazardous atmosphere that may exist or arise so that proper procedures can be developed and acceptable entry conditions are established. The person in charge must know the proper use and calibration of monitoring equipment and supervise its use. When monitoring the air, follow the instrument manufacturer’s instructions.

Anticipate, recognize, evaluate, and control workplace environmental factors or stresses that may cause illness, injury, impaired health or well-being, or significant discomfort for a worker concerning noise, ergonomics, lighting, temperature extremes, and air sampling.

**Conclusion**

Industrial hygiene in the workplace contributes to the comfort and efficiency of employees because working under extreme conditions may harm employee productivity and health. In the last several years, a growing body of scientific evidence has indicated that environmental factors and stresses in working environments can cause sickness, impaired health and well-being, or significant discomfort among workers. Health and safety regulations and standards prioritize using industrial hygiene concepts as a tool for effectively enforcing safety and making America’s workplaces more healthful and safer.
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