

# Chapter 14

## INDUSTRIAL HYGIENE PROGRAM MANAGEMENT

SANDRA PARKER-MONK, CIH,\* AND JOHN W. YASALONIS, CIH<sup>†</sup>

---

INTRODUCTION

HISTORY

ORGANIZATION OF THE INDUSTRIAL HYGIENE PROGRAM

PRACTICING ARMY INDUSTRIAL HYGIENE

The Department of Defense Exposure Assessment Model

Army-Specific Requirements

Defense Occupational and Environmental Health Readiness System

Industrial Hygiene Metrics

SUMMARY

*\*Program Manager, Occupational Health Sciences, Army Public Health Center, 5158 Blackhawk Road, Aberdeen Proving Ground, Maryland 21010*  
*<sup>†</sup>Formerly, Lieutenant Colonel, US Army; Industrial Hygiene Consultant to The US Army Surgeon General, Headquarters, Department of the Army, 5109 Leesburg Pike, Falls Church, Virginia*

## INTRODUCTION

The intent of this chapter is to describe how the Army applies the art and science of industrial hygiene in its unique and challenging environment. The theory and practice of industrial hygiene is relatively consistent in private industry and the public sector. Both the American Industrial Hygiene Association (AIHA)<sup>1</sup> and the American Conference of Governmental Industrial Hygienists (ACGIH)<sup>2</sup> define *industrial hygiene* as “the science and art devoted to the anticipation, recognition, evaluation, and control of those environmental factors or stresses, arising in or from the workplace, which may cause sickness, impaired health and well-being, or significant discomfort and inefficiency among workers or among the citizens of the community.”

A fully competent industrial hygienist requires an interdisciplinary education covering the basic sciences, toxicology, ergonomics, and physiology. When Army

industrial hygienists couple their scientific knowledge with the art of industrial hygiene, they perform true preventive medicine: eliminating hazards before they cause harm. At all Army installations, industrial hygienists help protect the health and welfare of civilians and soldiers by reducing workplace risk. Controlling hazards, such as degreasing solvents, noise, or carbon monoxide, helps ensure the soldier is in a state of maximum combat readiness.

In this chapter, the term *industrial hygienist* denotes a qualified professional. The US Army’s military industrial hygienists are environmental science/engineer officers (area of concentration 72D). The Office of Personnel Management classifies civilian industrial hygienists as general schedule (GS) 690 and industrial hygiene technicians as GS 640 (health aide and technician). Defense contractors may also provide industrial hygiene support.

## HISTORY

The US Army became seriously involved in the development of industrial hygiene practice during World War I, when workers in military gas mask manufacturing plants needed protection from chemical agent gases and typical industrial, chemical, and physical hazards: varying (and various) gas concentrations, solvents, dust, and noise.<sup>3</sup> Both government- and contractor-operated factories received industrial hygiene evaluations during World War I, but those efforts ceased with the war’s end.

In October 1942, the Department of the Army (DA) established the US Army Industrial Hygiene Laboratory at Johns Hopkins University to conduct occupational health hazard surveys and investigations at Army industrial plants, arsenals, and depots.<sup>4</sup> Workers at these facilities had potentially hazardous exposures to military-unique and in-

dustrial maintenance operations. The laboratory concentrated on four technical and scientific areas: field survey, chemical sampling analysis, engineering design, and medicine/toxicology. Compared to World War I, fatalities caused by occupational diseases were brought to extraordinarily low numbers during World War II, and the fact that industrial hygiene personnel identified hazards and recommended control requirements played a significant role in reducing the rates.

The Army Industrial Hygiene Laboratory was transitioned into the US Army Environmental Hygiene Agency, then the US Army Center for Health Promotion and Wellness, then the US Army Public Health Command, and finally the Army Public Health Center (APHC), the de facto provider of industrial hygiene consultation to the Army today.

## ORGANIZATION OF THE INDUSTRIAL HYGIENE PROGRAM

The Army occupational safety and health program is divided organizationally and financially at the DA level into *occupational safety* and *occupational health*. The safety program (defined in Army Regulation [AR] 385-10, *The Army Safety Program*<sup>5</sup>) is managed and executed by safety personnel at Army commands, service components, direct reporting units, and installations. The occupational health program is a medical program (defined in AR 40-5, *Preventive Medicine*<sup>6</sup>) executed primarily by medical department activity and medical center personnel, who support all the commands,

components, units, and installations.

The Army occupational health program is divided into two main functional areas: *industrial hygiene* and *occupational healthcare* (which includes medicine and nursing). DA Pamphlet 40-503<sup>7</sup> describes the Army industrial hygiene program, which includes support of occupational healthcare personnel by:

- quantitatively defining the level of worksite exposures to hazardous materials, allowing clinic personnel to (a) make informed patient

- care decisions regarding medical surveillance and (b) target the hazards most likely to cause health effects on workers;
- recommending controls for existing hazards that, when implemented, can eliminate or greatly reduce medical surveillance requirements; and
- operating the Defense Occupational and Environmental Health Readiness System (DOEHRS), a comprehensive health database that provides exposure and other worksite data to occupational healthcare personnel in an easily accessible and usable form.

The primary differences between the safety and industrial hygiene missions are that:

- occupational safety personnel are mainly concerned with the prevention and control of traumatic injury to personnel, and with accidents that result in loss of material, and

- industrial hygienists are mainly concerned with factors at the worksite that cause chronic or acute illness, disease, or injury to personnel.

The programs are most effective when staff of both work together to execute their responsibilities. For example, if acid bubbles out of a lead acid battery on high charge and burns a worker’s unprotected hands, it is an occupational safety issue; however, if the worker inhales the resulting acid mist, and consequently sustains respiratory illness, these are industrial hygiene and occupational healthcare issues.

Personal protective equipment (PPE) also involves dual medical and safety responsibilities. For example, the issue and use of respiratory protective equipment has traditionally been the domain of supervisors and occupational safety personnel. However, selecting the proper respirator requires a detailed industrial hygiene exposure evaluation, and the potential user must be medically evaluated before being required to wear a respirator.

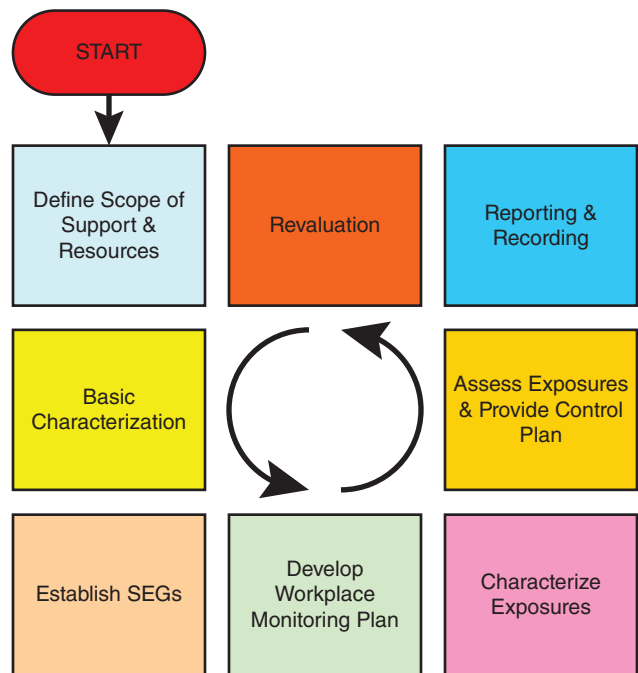
### PRACTICING ARMY INDUSTRIAL HYGIENE

#### The Department of Defense Exposure Assessment Model

Army industrial hygienists provide information on the mission and health impact of health risks to commanders, who can then make decisions that minimize risk. Industrial hygienists collect information on potential hazard sources; exposure pathways; and magnitude, frequency, and duration of worker exposures. They analyze this information to identify the risk of negative health effects from these exposures; determine options for controlling the sources, pathways, and exposures; and quantify the risk. Industrial hygienists also provide exposure information to occupational medicine staff and other healthcare professionals to support medical surveillance. This exposure information contributes to the longitudinal medical record.

In 2000, the Army collaborated with the military services and other DoD components to create a common industrial hygiene business practice that incorporated the best practices of industry and professional associations. The result was the DoD industrial hygiene exposure assessment model (Figure 14-1).<sup>8</sup> This model describes the industrial hygiene exposure assessment process to collect and evaluate exposure data, including exposures at any workplace where Army personnel are employed. Workplaces vary from fixed installations during peacetime operations to wartime deployments.

The elements of the exposure assessment in Figure 14-1 outline the sequence used by industrial hygienists. The process is sequential, with information from earlier steps essential to completing later steps, as follows:



**Figure 14-1.** Department of Defense industrial hygiene exposure assessment model. SEG: similar exposure group

**Step 1. Define scope of support and resources.**

- Through data collection, research, and interviews, identify organizations to be served and the scope of the industrial hygiene services needed. Develop a schedule with required resources for providing services.

**Step 2. Perform basic characterization.**

- Anticipate and identify potential exposures. Identify the types of operations performed and exposure situations, and the types of hazards that require assessment at each exposure location, by reviewing results of previous workplace assessments, reviewing medical surveillance and injury/illness events and summaries, and meeting with the supervisor and employee representative. Identify the hazard sources using Material Safety Data Sheets or equipment inventories.
- Assess the hazard sources. Describe their operating characteristics (eg, power settings used for an electrical generator) and existing controls (eg, engineering, PPE, administrative). Then qualitatively assess whether or not there are significant personnel exposures to toxic chemicals and/or harmful physical agents based on all available information.

**Step 3: Establish similar exposure groups.**

- A similar exposure group (SEG) is a tool to effectively and accurately use limited industrial hygiene resources. The industrial hygienist groups similarly exposed workers into an SEG, performs a risk assessment of all hazards and exposures for the SEG, and administratively assigns the exposures and controls to all members of the SEG. A worker may belong to more than one SEG (eg, one SEG for exposures from arc welding, and another SEG for exposure to kerosene-fueled heaters from living in a tent). This allows the industrial hygienist to leverage scarce resources and still collect, analyze, and archive quality information.
- The industrial hygienist establishes SEGs at a level of detail needed to separately identify and evaluate exposures. The hygienist may choose to group more workers together into a single SEG to save time, or separate workers into smaller groups to more accurately identify workers needing training, protective equipment, and medical surveillance. The hygienist may establish SEGs by:
  - unit organizational structure, treating an organization or sub-unit as one SEG;

- geographic location or event (eg, space with heat stress, base camp on an old fuel spill, downwind of an uncontrolled chemical release); or
- individual work operation and task (eg, paint removal, sanding, solvent cleaning).

**Step 4: Develop a workplace monitoring plan.**

- The industrial hygienist develops a workplace monitoring plan with the following objectives:
  - monitoring performance of the exposure controls (eg, static pressure in ventilation duct, interlocks on x-ray rooms, testing for carbon monoxide in fuel-heated spaces);
  - collecting exposure data to monitor effectiveness of controls (eg, using exposure control charts);
  - collecting additional data to improve the accuracy of exposure estimates (eg, reduced standard deviation); and
  - complying with periodic monitoring required by regulatory agencies (eg, Occupational Safety and Health Administration [OSHA] regulations on cadmium).
- The information needed in the monitoring plan includes:
  - hazard and SEG being monitored;
  - purpose of monitoring (eg, monitor controls, exposure trends, improve exposure estimate);
  - procedures for measuring exposures or controls;
  - number of measurements;
  - type of sample or measurement (eg, breathing zone, general area sample, peak noise level, full-shift, duration of task, air velocity in duct);
  - location type (eg, general area, breathing zone, source zone);
  - location description (eg, center of base camp, representative living quarters);
  - conditions required during monitoring (eg, doors open or closed);
  - standards used to compare to results (eg, ventilation baseline criteria, occupational exposure limit [OEL]); and
  - data analysis procedures (eg, pass/fail criteria, run-chart trend analysis).

**Step 5: Characterize exposures.**

- The industrial hygienist uses state-of-the-art sampling and monitoring techniques to characterize worker exposures. This may be done by what is often a sequential process:

- directly measure exposures (eg, air sampling, noise dosimetry);
- record information on person sampled (eg, name, employee identification number, job title, job series identification number);
- record sample type and location (eg, personal breathing zone, general area, dosimetry, bulk, wipe);
- record PPE worn by person sampled (eg, respirators, gloves, eye protection, face and body protection);
- record environmental conditions (eg, indoors or outdoors, doors open or closed, ambient temperature, pressure, wind speed and direction);
- submit the samples for analysis; and
- determine the time-weighted average or other exposure level and compare to OELs.

**Step 6: Assess exposures and provide control plan.**

- Industrial hygienists compare the documented exposures to appropriate OELs to determine the need for corrective actions and follow-up surveillance. They calculate and assign prioritization codes to all potential exposures in an SEG. They evaluate effectiveness of controls for each potential route of exposure (eg, breathing zone levels with local ventilation operations, noise attenuation of hearing protection, chemical permeation of gloves). They develop options for controlling exposures, considering inherent effectiveness and reliability of the controls. Control options include:
  - eliminating or modifying the process;
  - material substitution within the existing process;
  - engineering controls (isolation, interception);
  - PPE; and
  - administrative controls (including training, physical security of hazard source).
- And finally, the industrial hygienist determines if periodic monitoring of the hazardous agent or the controls is required.

**Step 7: Report and record.**

- Army industrial hygienists use DOEHRS to collect, analyze, and archive all information relevant to occupational exposures. The industrial hygienist uses many means of communication (eg, memoranda, email, meetings) to convey information to decision-makers, workers, supervisors, safety managers, and occupational medicine providers.

**Step 8: Reevaluate.**

- The exposure assessment process is cyclical. It is often necessary to repeat the exposure assessment process with the goal of improving previous assessments, and thereby continuing to reduce risk.

**Army-Specific Requirements**

The Army implements the DoD policy to reduce, to as low as reasonably achievable, health risks to each employee from recognized chemical, physical, or biological hazards that cause or are likely to cause death, illness, injury, or reduced mission effectiveness. The lowest OEL for the vast majority of occupational health hazards are listed by the American Conference of Governmental Industrial Hygienists (ACGIH) in *TLVs and BEIs* (threshold limit values and biological exposure indices).<sup>9</sup> This reference is updated annually based on current science, and the guidelines are developed to assist in the control of health hazards. They are not developed for use as legal standards.

The permissible exposure levels (PELs) developed by OSHA are legally binding. Because the standard promulgation process is so lengthy and new standards are subject to administration stays and legal actions, the OSHA PELs are often less stringent than ACGIH TLVs. The Army believes that its soldiers and civilians are best served by the most stringent standards, affording them the best protection in the workplace, so it is Army policy to use the most stringent OEL available.<sup>7</sup>

Within the Army, there are many military-unique workplaces, operations, types of equipment, and systems. Army personnel are engaged in testing and maintenance of military-unique equipment and systems such as military weapons, military-unique aircraft, military-unique ships, missiles, early warning systems, military space systems, ordnance, and tactical vehicles. They also perform operations such as peace-keeping missions; field maneuvers; combat training; military flight and missile operations; military-unique research, development, test, and evaluation activities; and actions required under national defense contingency conditions. Often the Army must develop a military-unique OEL because an appropriate level does not exist, as well as accompanying sampling and analysis protocols.

For example, after elevated concentrations of ortho-chlorobenzylidene malononitrile (commonly referred to as CS or tear gas) were found during mask confidence training (MCT) at a basic training site, the Army developed procedures for capsule dispersal to establish an initial CS training concentration in the chamber and maintain that concentration. Also, a new requirement

was established for industrial hygienists to conduct semiannual monitoring and hazard assessments for all sites that conduct MCT using CS in test chambers. The organization responsible for the chamber had to implement a periodic cleaning schedule using wet methods to reduce the residual CS build-up in the chamber. Personnel tasked with cleaning the CS chambers were required to wear full-face respirators approved by the National Institute of Occupational Safety and Health for CS exposure, water-resistant disposable coveralls with a hood, water-resistant protective footwear, and gloves. Industrial hygienists assist with respirator fit-testing and selection of appropriate protective equipment.

### Defense Occupational and Environmental Readiness System

The Army and all DoD components must collect and analyze health information to support the risk management process during all phases of military operations.<sup>10,11</sup> They must also maintain and control access to personnel exposure and medical surveillance records for the duration of employment plus 30 years.<sup>12</sup> DOEHRS is used to carry out this directive. The data collection modules in DOEHRS follow the steps in the exposure assessment model, including a method for establishing SEGs and assessing the statistical validity of exposure monitoring.

DOEHRS data collected at the garrison level, in the field, or on deployments is routinely added to an Army corporate database. This database not

only provides a longitudinal exposure record for workers, it also allows for data analysis. Analytical review of the data can answer questions about the prevalence of hazards (eg, how many soldiers are exposed to beryllium); prevalence of risk (eg, how many workplaces have high risk assessment codes); and the accomplishments of local industrial hygiene programs.

### Industrial Hygiene Metrics

To ensure timely delivery of quality industrial hygiene services, the Army conducts frequent reviews of their programs by assessing program workload, health outcomes, management effectiveness, and resource utilization. Reviews include program assistance visits and self-reported metrics. A program review involves an organization such as APHC assessing a local program, noting deficiencies, and making recommendations for improvement.

DoD Instruction (DoDI) 6055.5, *Occupational and Environmental Health*,<sup>8</sup> lists several metric measurements that provide insight into the effectiveness of the local industrial hygiene program. The reduction of work-related occupational and environmental exposures is a real measure of success. The metrics include:

- percentage of shop hazard characterizations completed,
- index of unacceptable exposures,
- percentage of hazards by risk level, and
- percentage completion of the monitoring plan.

### SUMMARY

The fundamental goal of Army industrial hygiene is to ensure the health and welfare of the soldier and civilian in an increasingly complex and fast-paced world. Army industrial hygienists must not only

maintain a scientific edge, they must also embrace new technologies, effectively communicate risk and risk remediation, and leverage scarce resources to accomplish the mission.

### REFERENCES

1. American Industrial Hygiene Association website. <http://www.aiha.org>. Accessed October 27, 2016.
2. American Conference of Governmental Industrial Hygienists website. <http://www.acgih.org>. Accessed October 27, 2016.
3. Bayne-Jones S. *The Evolution of Preventive Medicine in the United States Army, 1607–1939*. Washington, DC: US Department of the Army, Office of The Surgeon General; 1968.
4. Heaton LD, Anderson RS, Hoff EC, eds. *Preventive Medicine in World War II*. Vol 9, Special fields. Washington, DC: US Department of the Army, Office of The Surgeon General; 1969.
5. US Department of the Army. *The Army Safety Program*. Washington, DC: DA; 2010. Army Regulation 385-10.

6. US Department of the Army. *Preventive Medicine*. Washington, DC: DA; 2007, Army Regulation 40-5.
7. US Department of the Army. *The Army Industrial Hygiene Program*. Washington, DC: DA; 2013. DA Pamphlet 40-503.
8. US Department of Defense. *Occupational and Environmental Health*. Washington, DC: DoD; 2008. DoD Instruction 6055.05.
9. American Conference of Governmental Industrial Hygienists. *TLVs and BEIs: Threshold Limit Values for Chemical Substances and Physical Agents*. Cincinnati, OH: ACGIH; 2016.
10. US Department of Defense. *DoD Safety and Occupational Health (SOH) Program*. Washington, DC: DoD; 1998. DoD Instruction 6055.1.
11. National Science and Technology Council. *Improving the Health of Our Military, Veterans, and Their Families*. Washington, DC: Executive Office of the President, Office of Science and Technology Policy; August 1998. Presidential Review Directive 5.
12. 29 CFR, Part 1910.1020. Access to employee exposure and medical records.

