AIHA
UNIVERSITY
Frameworks

Competency Framework

Understanding How ARECC Works Within Occupational Exposure Assessment

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About AIHA®

Founded in 1939, the American Industrial Hygiene Association® (AIHA®) is one of the largest international associations serving the needs of industrial/occupational hygiene professionals practicing in industry, government, labor, academic institutions, and independent organizations. For more information, visit www.AIHA.org.

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AIHA University offers cutting-edge education and training developed for current and aspiring industrial hygiene and OEHS professionals. From face-to-face courses to online instruction to webinars and professional frameworks, AIHA University is your go-to-resource for affordable and accessible education at every step of your career.

Frameworks

AIHA® and its appointed members and volunteers worked collaboratively to develop the following guides, known as Frameworks, which outlines the knowledge and skills a competent person should possess and be able to demonstrate in a specific topic or specialty.

A **Competency Framework** is a structure that sets out and defines the core knowledge and skills required by an individual for effective performance in a specific area of expertise. These competency frameworks can be linked to either an assessment-based certificate program or an online self-study course.

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Occupational Exposure Assessment

Occupational Definition

This document provides an organized summary of the collective knowledge and skills necessary for persons conducting occupational exposure assessments. This Body of Knowledge (BoK) will be used by AIHA to establish a framework for the development of education programs and knowledge/skill assessment tools, and for the improvement of the state of professional industrial hygiene (IH) knowledge.

Total Worker Health integrates occupational safety and health protection with workplace policies, programs and practices that promote health and prevent disease to advance worker safety, health and well-being. The knowledge and skills in this BoK are one approach in assessing exposures and hazards through the identification, characterization, estimation, and evaluation of workplace hazards. This BoK establishes the core knowledge elements of the industrial hygiene process in harmony with the convention of Anticipate, Recognize, Evaluate, Control, and Confirm (ARECC). Additional elements are planned to provide supplemental details on risk evaluation and occupational exposure banding.

This BoK is not intended to define or stipulate employer hiring criteria. It is the employer's responsibility to ensure that each employee understands his or her specific job and has met the minimum criteria established by relevant regulations, standards, and best practices for the specific industry, facility, project, or exposure scenario.

Knowledge Levels

As used in this BoK, "knowledge" is the practical understanding of the subject area, while "skill" is the learned capacity to use knowledge in a practical application, to do something that comes from training, experience, or practice. Knowledge and skills, combined together, form the measurable competencies summarized in this document. From the Technical IH Level 1 to 3, the knowledge areas generally illustrate increasing professional experience and responsibility as defined below and in Table 1. The management level is considered separately, outside of the Technical IH Level 1-2-3 hierarchy.

Technical IH Level 1 - Applies the fundamentals of IH to gather, document, and report monitoring data and make exposure judgments under the supervision of a more experienced industrial hygienist, who will review the data to ensure compliance with proper data collection procedures. Technical Level 1 is expected to be met by an undergraduate degree in the STEM curricula.

Technical IH Level 2 - Has subject area expertise. Is responsible for day to day field work. Implements programs and procedures to meet goals and objectives of the exposure assessment program in order to establish and communicate the exposure estimate and evaluate the impact of proposed controls. Knowledgeable about worksite processes and agents, pertinent occupational exposure limits, sampling protocols, and hierarchy of controls. Selects appropriate monitoring instruments for purchase and use and sets exposure evaluation strategies (i.e., sampling, rules-of-thumb, etc.)

Technical IH Level 3 - Knowledgeable about corporate occupational health and safety goals and objectives. May oversee multiple exposure assessment projects. May set company-level policies and procedures. Responsible for high level data interpretation regarding program performance. Selects relevant OELs, bands, DNELs, BEIs, etc.

Management Level - May or may not have other exposure assessment responsibilities and knowledge outlined in technical IH knowledge levels. Ensures adherence to applicable corporate and regulatory requirements and maintains necessary corporate documentation. May coordinate or work with operations, human resources, medical, safety, and/or other departments in support of organization's overall occupational health and safety objectives to ensure a safe and healthy work environment. May be responsible for using exposure assessment information provided by IH professionals to develop and recommend safety and occupational health policy to higher levels of management. Ensures adequate human and financial resources are available for the IH process. Authorizes industrial hygiene decision making within the organization.

Demonstration of Competence

Performance-based training incorporates performance tasks (performance assessments) that build on content knowledge and further develop skills. These demonstrations of knowledge and skills document competence. Demonstration of personal competency in conducting occupational exposure assessments may take different forms, such as successful performance on a written or computer-based examination or a hands-on demonstration of skills regarding instrument operation and maintenance. At a minimum, competent persons at each knowledge level will be able to successfully demonstrate competence at that knowledge level as outlined in Table 1.

Knowledge Areas

Table 1 describes the knowledge that constitutes competent occupational exposure assessment within the ARECC decision-making framework.

| IH ARECC Decision-Making Framework Knowledge Area

1.0 | Anticipate

Technical IH Level 1 - Apply the fundamentals of IH, as follows:

1.1.   Investigate basic parameters of the exposure (manpower, methods, and materials of the use setting) and the application of published OELs (more identification of agents of exposure than prescriptive limits)

1.2.   Apply training and education, understand client goals, and seek preliminary information to create a baseline characterization of exposures involving recognized and identified hazards

1.3.   Understand the toxicological basis of setting an OEL; and interpretation of qualitative estimates or quantitative measures of hazard concentration when compared to those published OELs

Technical IH Level 2 - In addition to Technical IH Level 1, define goals and purpose of the exposure assessment, as follows:

1.4.   Establish the exposure acceptability from the exposure assessment and its accompanying criterion

1.5.   Clearly communicate the exposure results in terms that a lay person can understand so that they may understand whether or not the exposure is acceptable and if not, what is being done to reduce the exposure

1.6.   Document the assessment, characterizing the hazard concentration, frequency, duration, and route of exposure so that the manner of arriving at a decision is transparent to all stakeholders

1.7.   Perform a defined strategy of investigation (i.e., baseline characterizations of field conditions, examination of historical data, use of first principles of chemistry and physics to model exposures, and collection of monitoring data) based upon the alignment of client and professional goals

1.8.   Understand the fundamentals and inherent flexibility of the Hazard Banding and/or Occupational Exposure Banding processes

Technical IH Level 3 - In addition to Technical IH Level 2, determine criteria for exposure acceptability, as follows:

1.9.   Apply the hierarchy of Occupational Exposure Limits (OELs) to properly select a criterion for the assessment of exposure exceedances

1.10.   Understand the uncertainty around OELs as a function of the process used to establish them in order to properly communicate an exposure decision and its' inherent uncertainty

1.11.   Apply the fundamentals of toxicology in order to coherently discuss and research basic hazard information

1.12.   Establish high level control criteria in line with definitions of acceptable exposure (e.g. >50% OEL = need for X level of control)

1.13.   Establish exposure criteria as part of corporate or client policy statement in order to establish whether exposures are acceptable

1.14.   Understand the Hazard Banding and/or Occupational Exposure Banding processes, and their utility as screening to focus limited resources on priority objectives

Management Level - Determine criteria for exposure management, as follows:

1.15.   Communicate exposures in a timely fashion and in accordance with corporate or client management objectives, including the ability to communicate a need for increasing attention and intervention as exposures and uncertainty increases

1.16.   Define and understand the stakeholders, regulatory environment, and corporate or client values that impact management and communication of information serving exposure management

2.0 | Recognize

Technical IH Level 1 - Identify and document critical information about agents, processes, activities, and workforce, as follows

2.1.   Demonstrate an awareness and understanding of the intermediates, fugitive emissions, and highly infrequent activities that could change the exposure profile

2.2.   Record and communicate documentation of all information from the actions taken during baseline characterization so as to comply with customer/client/corporate requirements and provide evidence of prior decisions retrospectively for the benefit of future stakeholders (e.g., workers, litigators, epidemiologists, regulators)

2.3.   Demonstrate an understanding of the elements to consider for a minimally acceptable baseline characterization

2.4.   Recognize existing corporate/client/customer expectation of what is an adequate level of baseline documentation in order to provide professional IH input to ensure technical and ethical requirements are met (specifically, what is an ethically and scientifically defensible adequate level of baseline documentation from the IH)

2.5.   Inform designated corporate/client/customer representatives of the baseline characterization outcome (level of detail and quality of information) in order to meet the agreed-upon expectations of documentation

2.6.   Apply Sampling and Analytical Error (SAE) calculations to determine Confidence Limits in order to make valid assessments

Technical IH Level 2 - In addition to Technical IH Level 1, identify and document critical information about agents, processes, activities, and workforce, as follows:

2.7.   Promote and conduct field walk-throughs (in-person or virtually) in order to understand the context of worker exposures against the nature of work execution and process control status

2.8.   Identify patterns of potential cumulative exposure to multiple agents by multiple routes (e.g., inhalation, dermal, ingestion)

2.9.   Consider the observed boundaries of work (i.e., the sequence of events from start to finish for a complete process and points at which worker starts/stops involvement) in order to recognize unexpected exposures as well as obvious exposures

2.10.   Acquire workplace and process-specific information (e.g., feeds, flow rates, engineering control settings, etc.) and agent-specific information (e.g., temperature, pressure, physical form, contaminants, etc.) that can influence exposures

2.11.   Consider the relationship of worker behaviors and practices during and outside of the workplace work, to exposure potential

2.12.   Acquire toxicological information in order to understand metabolic pathways from agent to organ(s) affected

2.13.   Recognize whether or not there is a mature, formal and documented organizational management of change process (for use later in certainty ranking of judgments in the exposure assessment process)

Technical IH Level 3 - In addition to Technical IH Level 2, identify and document critical determinants of exposure, as follows:

2.14.   Understand the importance of continuing education (formal and informal, each where appropriate) to learn and expand knowledge of industry technology and processes, state of regulation, litigation, and social expectations, especially in emerging technology areas with rapidly evolving information(e.g., nanotech and fracking)

2.15.   Demonstrate an understanding of the fundamentals of workplace nomenclature and processes, including the materials used and the hazards they may pose, in order to identify hazards and alternative ways of achieving desired work outcomes with reduced exposures

2.16.   Research workplace and process-specific information (e.g., feeds, flow rates, engineering control settings, etc.) and agent-specific information (e.g., temperature, pressure, physical form, contaminants, etc.) that can influence exposures

2.17.   Influence the management of change system to accurately capture and assess changes that are pertinent to industrial hygiene and worker health

Management Level - Understand the critical determinants of exposure, as follows:

2.18. Demonstrate an understanding of the requirements and resources to perform baseline characterization

2.19. Understand the importance of continuing education (formal and informal, each where appropriate) for the management team as well as accountable supervision and staff to learn and expand knowledge of industry technology and processes, state of regulation, litigation, and social expectations, especially in emerging technology areas with rapidly evolving

3.0 | Evaluate

Technical IH Level 1 - Make accurate qualitative exposure judgments by:

3.1. Understand the limitations and biases inherent in any professional judgment, in order to follow the precautionary principle and defer to worker protections

3.2. Apply fundamental science concepts necessary for the measurement of biological, chemical and physical hazards over time in order to collect accurate measurement data

3.3. Apply knowledge of chemical and physical properties of the chemical hazards and the process parameters (e.g., process temperatures, chemical reactions during the process, physical processes that are contributing to airborne exposure/skin absorption, etc.) to collect accurate measurement data

3.4. Apply knowledge of workplace personnel, facilities, processes, materials, and controls, as well as any historical or published data to establish a profile with "like" exposure potential (i.e., initial Similar Exposure Groups (SEGs) structure)

3.5. Apply qualitative judgment tools, such as codified checklists, to determine a first approximation of the exposure in order to most efficiently and effectively apply limited IH resources to assessing and managing exposures

3.6. Consider the limits of the mathematical model(s) used and the limits of IH interpretation in order to determine ways to check for accuracy (e.g., use of "real-time" monitoring equipment to support modeling)

3.7. Select and apply appropriate mathematical models to arrive at semi-quantitative (second) approximations of exposure

Technical IH Level 2 - In addition to Technical IH Level 1, REFINE appropriate similar exposure groups (SEGs), as follows:

3.8. Verify appropriate calculation methods for exposure evaluation

3.9. Employ available OELs and their rationales according to company/corporate/ client policy, in order to select and communicate the most appropriate OEL or OEL range against which to compare exposures

3.10. Characterize data sets according to the corresponding exposure profiles for subsequent application of appropriate statistical treatment in accordance with the AIHA Exposure Assessment Strategy Book, or an equivalent international standard, to confirm all exposures belong in the same SEG

3.11. Select and apply appropriate mathematical models in the evaluation of problem solving

3.12. Apply fundamental concepts of inferential and deterministic statistics in order to select appropriate statistical tools (both parametric and non-parametric) to determine exposure outcomes

Technical IH Level 3 - In addition to Technical IH Level 2, establish Program Policy, as follows:

3.13. Apply fundamental hierarchy of controls engineering principles and mechanisms to assess their effectiveness and value to the worker/organization

3.14. Identify and ensure completion of clear exposure assessment goals that include actions resulting from conclusions drawn from data, in order that all stakeholders understand the treatment of data

3.15. Define a logically defensible and transparent OEL selection process in order to document the technical basis for its selection

3.16. Apply IH study design to best determine end goals and meet required timelines and budgets (e.g., routine vs. worst case, area sampling vs. personal sampling vs. grab sampling, etc.)

3.17. When lacking any OEL, determine whether there is sufficient information and expertise for the development of an internal OEL, or move straight to banding approach

3.18. Define fundamental concepts of inferential and deterministic statistics in order to select appropriate statistical tools (both parametric and non-parametric) to determine exposure outcomes

3.19. Utilize hazard and exposure banding processes when needed in the absence of internal working or authoritative OELs

3.20. Apply sensitivity analysis tools to assess the relative contribution of each exposure determinant so that the largest contributor may be modified first

Management Level - Manage the process of exposure assessment results, as follows:

3.21.   Support staff in effectively communicating results to all stakeholders

3.22.   Enable resource allocation to highest priorities in validating exposure controls and judgments

3.23.   Measure progress in program performance

3.24.   Ensure expectations of staff performance with respect to documentation requirements

4.0 | Control

Technical IH Level 1 - Apply the IH hierarchy of controls, as follows:

4.1.   Confirm effective (proper) use of engineering specific controls

4.2.   Communicate with employees on the application of the hierarchy of controls and their important role in use of executing administrative/work practice or related PPE controls

4.3.   Confirm behaviors are appropriate for effective PPE specific controls

4.4.   Apply knowledge of the interplay between control mechanisms so that multiple controls can effectively be used to reduce exposures

4.5.   Confirm conformance to applicable Administrative specific controls

4.6.   Apply knowledge of alternate approaches to complete the process goal that might allow elimination of the particular hazard

4.7.   Demonstrate an understanding of the critical components of donning and doffing sequences for PPE and the importance of training in this activity

4.8.   Demonstrate an understanding of the critical need to verify behaviors of the workforce in the proper donning, use, and doffing of PPE

Technical IH Level 2 - In addition to Technical IH Level 1, apply the IH hierarchy of controls,
as follows:

4.9.   Consider the impact of the proposed design control from the worker's perspective

4.10.   Demonstrate a working knowledge of engineering concepts, sufficient to talk effectively with engineers about exposure management and how their decisions (with adding a control, or redesigning a process or reconfiguring production based on a change of ingredients) will impact workers

4.11.   Apply a working knowledge sufficient to communicate with other groups (engineering/maintenance/procurement)regarding source control of hazards

4.12.   Raise awareness of IH principles to select and implement controls

4.13.   Establish policies regarding materials/methods/control technologies and to prevent substitution without taking into consideration exposure aspects

4.14.   Demonstrate an understanding of ventilation design concepts, including Q (volume) more important than V (velocity); the difference between comfort (turbulent flows) vs. control (laminar flows)

4.15.   Demonstrate an understanding of ventilation concepts and modeling, including capture velocity, face velocity and dilution ventilation, so that design outputs match the conditions of contaminant use and generation and so that the controls do not add to employee exposure

4.16.   Demonstrate an understanding of the basic physics involved in a hazard profile, (e.g. sound, lasers, musculoskeletal mechanics) and how it affects the selection and design of controls

4.17.   Demonstrate an understanding of noise control design concepts, principles of isolation, and sound absorption

4.18.   Demonstrate an understanding of limitations of personal protective equipment, as well as additional hazards introduced with use of specific garments and ensembles (e.g., heat stress introduced with vapor chemical suits)

4.19.   Apply knowledge of gloves and other barrier PPE performance characteristics and limitations

4.20.   Recognize the need for cross-disciplinary teamwork in review of control strategy alternative(s) so that a comprehensive risk management solution is selected

4.21.   Apply knowledge of the interaction between control mechanisms so that multiple controls can effectively be used to reduce exposures

4.22.   Demonstrate an understanding of the use and limitations of administrative controls so that controls are implemented and managed properly

4.23.   Troubleshoot ventilation controls in order to diagnose inefficiencies, improper uses, and failures of the system

4.24.   Analyze the proposed control to determine whether it can be used effectively by the worker in the work environment without adversely affecting the worker interface and production goals

4.25.   Integrate administrative control obligations into operational documentation

4.26.   Demonstrate an understanding of the need for easy system status indicators for the worker to verify operational status, periodic efficiency evaluations, validation and maintenance of controls

Technical IH Level 3 - In addition to Technical IH Level 2, apply the IH hierarchy of controls, as follows:

4.27. Understand the importance of communication to effectively select and implement any control within the hierarchy

4.28. Understand the need to properly implement fitting, and testing of the effectiveness of fit, for PPE

4.29. Understand NIOSH and ANSI respiratory protection selection processes and the AIHA Respiratory Protection Body of Knowledge content (or an equivalent international standard)

4.30. Understand the technical basis for the PPE policy

4.31. Demonstrate an awareness of the impact of latex allergies and other sanitary concerns with group-assigned protective garments and respiratory protection

4.31. Understand the role of the IH in the design process that allows anticipation of competing hazards during design phase

4.33. Integrate exposure management obligations into the organization's processes to effectively manage change results

4.34. Create a PPE policy that fits with corporate goals and governance of the workplace

4.35. Promote training to team members on ESH implications to design decisions by engineers

4.36. Distinguish the appropriate control that includes considerations of the process parameters

4.37. Assess and understand Change Documentation

4.38. Demonstrate an understanding of the need for proper design, review, and modeling (computational fluid dynamics or wind tunnel environment) of control systems to establish confidence in the control affecting a change prior to capital investment (purchase, installation, and training)

4.39. Apply principles of Occupational Health Psychology and cultural awareness considerations to the selection of control strategies and subsequently the design of that control

4.40. Create a Hazards Substitution Policy that fits with corporate goals and governance of the workplace

Management Level - Apply and communicate the IH hierarchy of controls to inform or support organizational policy, as follows:

4.41. Develop and ensure compliance with the procedures and guidelines for use of PPE, selection criteria for PPE, reasoning for decontamination, and reuse/replacement of PPE

4.42. Understand the organization and lead effective integration of IH into processes to ensure accountability for ESH by all elements of the organization (both line production and staff)

4.43. Communicate and understand the broader impact that occupational control strategies have to business costs and environmental compliance

5.0 | Confirm

Technical IH Level 1

5.1. Possess the ability to determine (signs and symptoms) of overexposure

5.2. Understand that all data bearing on the context of an exposure profile should be verified during reassessments

5.3. Evaluate any acquired data with appropriate statistical tools

5.4. Revise the health risk rating and exposures to be managed so activity is directed at the highest potential risk and minimal activity is directed at those risks found to be adequately controlled

Technical IH Level 2 - In addition to Technical IH Level 1, appropriately monitor and manage exposures, as follows:

5.5. Evaluate the need for ongoing related support programs (medical surveillance, controls maintenance, calibrations and verifications, capital projects, etc.) and report results to management

5.6. Establish needed Data Quality Objectives (DQOs) (some of these may be qualitative or subjective) and numbers of measurements to sufficiently (effectively and efficiently) demonstrate that exposure risks are controlled

5.7. Translate needed DQOs and measurements into resource needs (e.g., time, money, level of effort, lab contracts, etc.) that the client/customer/regulator can understand for applied risk / benefit analysis, and assign resources accordingly

5.8. Communicate the need for and the importance of a Management of Change (MOC) Process to complement the expected cycle of reassessment and be integrated into to the exposure management program

Technical IH Level 3 - In addition to Technical IH Level 2:

5.9. Define strategies for ongoing exposure monitoring to assure timely identification of deviations in exposure profiles and to ensure controls continue to be effective

5.10. Apply statistical techniques to analyze exposure trends over time, in order to improve the exposure assessment and confirm controls remain effective (control banding approach)

5.11. Define periodic monitoring policy so as to improve the understanding of exposure profiles

5.12. Acquire and assign resources in accordance with exposure management goals

5.13. Communicate the progress of the Exposure Management Program from the information provided by junior participants (where uncertainty has been adequately accounted for as well as where it remains)

Management Level - Apply Management of Change and periodic reassessment to ensure on-going exposure control, as follows:

5.14. Understand record keeping obligations under regulations versus effective data for legal and epidemiological value

5.15. Confirm, through initial assessment and reassessments, that the written assessment program has been adequately implemented to meet stated program goals

5.16. Consider the non-occupational exposure profiles (outside of work hours and assignment) that may have bearing on a total exposure to the individual, and promote their inclusion in exposure judgments in order to meet the ethical charter of industrial hygiene

5.17. Manage the implementation of the exposure assessment program to meet goals

5.18. Request periodic analysis of program metrics in order to measure performance of program elements (staffing, budgets, and exposure management goals) to ensure consistency with stated program goals

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Every single day, we work to empower those who apply scientific knowledge to protect all workers from occupational hazards.

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We are experts in what we do. We use our knowledge to better protect people and the environment.

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3141 Fairview Park Dr., Suite 777, Falls Church, VA 22042