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| Midland Engineering Co., Inc. Safety Management System | | | Doc No: | ARSENIC |
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POLICY

The purpose of this Program is to define the key elements of an Arsenic Program to minimize and/or eliminate worker exposures to inorganic arsenic during work activities. The primary goal of this Program is to implement arsenic control measures to below the action level (AL) without regard to the use of respirators, and minimize surface contamination.

SCOPE

This Program applies to all Midland Engineering Co., Inc. employees and contractors. Task-specific work instructions and Standard Operating Procedures are required for all activities that fall under the scope of this program. This includes the following:

- Preventive maintenance and service tasks on tools or equipment that are contaminated with arsenic and present the potential for employee exposures.
- Cleaning, refurbishing or recycling of parts from Ion Implanters or other tools or equipment that have used arsenic as a dopant (e.g., arsine gas or solid arsenic sources) and may be contaminated with inorganic arsenic as a by-product from the tool process.
- Collection of arsenic contaminated hazardous waste (e.g., collecting, emptying arsenic hazardous waste containers).
- Housekeeping of areas potentially contaminated with inorganic arsenic. This could include floors, fume hoods, work benches and other surfaces that are potentially contaminated with inorganic arsenic. This also includes decontaminating areas where fume hoods, bead blasters, or other arsenic-cleaning equipment are used (e.g., floors, other areas outside of equipment).
- Facility maintenance tasks that involve working with equipment that is contaminated with inorganic arsenic; such as:
 - Maintenance on point of use abatement systems for arsenic exhaust streams,
 - Maintenance of facility exhaust systems handling inorganic arsenic particulate and emissions,
 - Replacing filters in portable HEPA vacuums or exhaust ventilation systems that handle inorganic arsenic particulate and emissions.

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DEFINITIONS

Action Level (AL) - The AL for inorganic arsenic is 0.005 mg/m³ averaged over any 8 hour period.

Administrative Controls - The use of work practices, training, signs and labels, written procedures and other management-dictated work practices to prevent or reduce employee exposures to potential health hazards.

Area Air Sample - A sample that represents the level of chemical (i.e., concentration) in the air in a specific area for a specific duration of time. Area air samples can be integrated samples or direct reading measurements. Area air samples are not collected in the breathing zone of the employee and are not considered to be representative of the exposure(s) received by workers.

Arsenic (As) - The 33rd element on the periodic table. Atomic weight is 74.9.

Baseline Monitoring - The initial exposure monitoring performed for a specific potential health hazard (chemical, radiation, noise, etc.) and for a specific operation or task to establish the levels of exposure for future comparisons.

Breathing Zone - The area surrounding a worker's nose and mouth from which he or she draws breathing air over the course of a work period. This zone can be pictured by inscribing a sphere with a radius of about 10 inches centered at the worker's nose.

Control Strategies - Tools, techniques, methods and designs to reduce and control employee exposures to potential health hazards in the workplace. Examples include substitution of a less toxic agent; engineering controls such as local exhaust ventilation; administrative controls such as changes in work practices and training; and use of personal protective equipment.

Engineering Controls - Controls that reduce exposures to employees by removing the hazard from the process or placing a barrier between the hazard and the employee (e.g., protective guards, shielding, fume hood, etc.).

Exposure - The exposure of a worker to inorganic arsenic through skin contact, ingestion, and / or inhalation during work tasks.

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High Efficiency Particulate Air (HEPA) vacuum – Vacuums that contain high efficiency air filters that have particulate removal efficiency (99.97%) of 0.3 micron sized particles.

Industrial Hygiene (IH) - The recognition, evaluation and control of occupational health hazards in the work place.

Exposure Monitoring – Sampling of target contaminants to evaluate concentrations (exposures) associated with specific tasks, operations or work areas. Exposure monitoring for airborne contaminants can be performed in an employee’s personal breathing zone. Area air sampling can be performed to evaluate the concentrations of airborne contaminants in a specific location. Surface wipe sampling can be performed to observe the amount of contamination deposited on surfaces.

Inorganic Arsenic - For the purpose of this Program, inorganic arsenic includes elemental arsenic and all of its inorganic compounds, **with the exception of arsine**. For the purposes and requirements of this definition, any substance with a total inorganic arsenic content of 0.02 percent or less, by weight, is excluded.

Occupational Safety and Health Administration (OSHA) - OSHA is a federal agency created by the Occupation Safety and Health Act of December 29, 1970 and is mandated to prevent on-the-job accidents and injuries in US factories and other industries. OSHA establishes and issues safety and health regulations, and enforces compliance.

Occupational Exposure Limit (OEL) - The OEL is defined to be the lower of either the local regulatory limit or the most current ACGIH TLV. For inorganic arsenic, the TLV and the PEL (permissible exposure limit - the OSHA regulatory limit) are both 0.010 mg/m³ as an 8-hour TWA exposure.

Potential Health Hazard - The capability of an environmental agent to cause deleterious effects in an exposed worker. Whether a specific health effect actually results from an exposure is related to a variety of factors including concentration, duration of exposure, specific agent involved, physical state of the agent, route of entry and frequency of exposure.

Fit Testing - A procedure which tests for leakage of an airborne test agent into a respirator while being worn by the employee.

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Quantitative Exposure Assessment - The assessment of employee exposures to chemicals, noise or physical agents in a workplace based upon quantitative measurement of the chemical or physical agent using direct reading instruments and / or collection of integrated samples that are analyzed by a laboratory to provide the results.

Industrial Hygienist - A person who has a college or university degree in engineering, chemistry, physics or medicine or related biological sciences and who by virtue of special studies and training has acquired competence in industrial hygiene.

Restricted Access Area - An area where employee exposure to airborne inorganic arsenic, without regard to the use of respirators, can exceed the AL.

Threshold Limit Value (TLV) - TLVs refer to airborne levels of exposure and represents conditions under which it is believed that nearly all workers may be repeatedly exposed day after day, over a working lifetime without adverse health effects. TLVs established by the ACGIH are the primary basis for establishing applied OELs, except where a local regulatory limit is lower.

Time Weighted Average (TWA): The average concentration over a period of time. Employee exposures to arsenic are expressed as TWA results based upon samples collected over an exposure period (e.g., 8-hour work-shift).

Ultra Low Penetration Air (ULPA) vacuum: Vacuums that contain filters that provide very high efficiency removal of particulates (99.999% of 0.12 micron sized particles).

Wipe Sample - A sample collected on a surface to characterize the amount of accumulation over the course of time. Wipe samples can be used to indicate the adequacy of housekeeping and relate to the potential for employee exposures, but do **not** represent employee exposure levels.

INTRODUCTION

Arsenic occurs naturally in the environment as an element of the earth's crust. Arsenic is combined with other elements such as oxygen, chlorine, and sulfur to form inorganic arsenic compounds. Exposure to higher-than-average levels of arsenic occurs mainly in workplaces, near or in hazardous waste sites, and areas with high levels naturally occurring in soil, rocks, and water. Exposure to high levels of arsenic can cause death. Exposure to arsenic at low levels for extended periods of time can cause a discoloration of the skin and the appearance of small corns or warts.

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RESPONSIBILITIES

Supervisors and Managers are accountable for compliance with this Program and are responsible for:

- Implementing this Program
- Providing information needed to assess the potential for inorganic arsenic exposures.
- Establishing timelines and providing resources & funding that allow for the timely implementation of this Program
- Ensure that affected workers are trained, as required.
- Ensure medical surveillance participation by affected workers.

EHS Department:

- Communicating responsibilities of this Program to the Managers/Supervisors and any other upper management and addressing any questions.
- Developing, maintaining and (if necessary) interpreting this document.
- Maintaining this Program including re-evaluating the overall effectiveness and applicability of this Program on an annual basis.
- Providing assistance to supervisors/managers, employees, and/or contractors on mitigation of hazards through engineering, administrative and PPE controls.
- Working with Managers/Supervisors to identify employees or contractors that should be included in the medical surveillance program based upon the criteria in the Arsenic Program and tracking their participation.
- Defining the content / scope of medical surveillance for affected workers.
- Identifying the clinics, medical analytical labs, appropriate lab analysis and other resources in support of medical surveillance for affected workers.
- Reviewing the results for each employee to identify any results that require follow-up.
- Providing follow-up notification to employees and management on the steps to be taken in response to the medical surveillance results.
- Summarizing the medical surveillance results on a yearly basis in order to identify any trends or issues that need to be addressed.
- Providing training as described in this program to all employees included in this Arsenic Program.

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- Performing hazard assessments and employee exposure monitoring to document exposure levels and the effectiveness of the controls, and notifying workers and management of these results.
- Performing wipe sampling to verify the effectiveness of housekeeping procedures in accordance with the tiered approach identified in this Program
- Facilitating employee exposure assessments

Facilities Operations Group:

- Providing assistance in implementing engineering controls that require Facilities support (e.g., local exhaust ventilation),
- Ensuring that facilities employees that are involved in tasks or operations that fall under the scope of this Program are included in the Arsenic Program.

Employees and Subcontractors:

- Being familiar with the procedures and other requirements as described in this Program.
- Successfully completing the Arsenic Protection Training, and any other required specific training.
- Being familiar with the SDS for all materials containing arsenic.
- Getting a physical, fit test and training, if required, to wear a respirator.
- Participating in medical surveillance as directed by the EHS Department.
- Cleaning up the immediate work area at the end of the task or at the end of the work shift.
- Following the procedures and proper use of protective measures when performing maintenance, service or repair tasks that fall under the scope of this Program.
- Maintain respirators clean and in good working order.
- Properly dispose of arsenic contaminated waste.

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COMPLIANCE

A written compliance program shall be implemented when the PEL of 10 ug/m(3) is exceeded to reduce exposures to or below the permissible exposure limit by means of engineering and work practice controls. The written program must be reviewed and updated annually or more often to reflect status of the program. The Program shall be provided for examination and copying upon request of affected employees, their representatives, the Assistant Secretary and the Director.

ENGINEERING CONTROLS

Fume Hood: Laboratory fume hoods should be used for tasks performed away from the tool or equipment (e.g., dedicated cleaning operation). The fume hood should include a sash to allow the size of the opening to be adjusted based upon the task being performed. The exhaust ventilation for the fume hood should provide 80-125 fpm face velocity with the sash positioned at the designated working height. The optimal approach is to have two dedicated fume hoods; a "Contaminated Parts" hood for cleaning contaminated parts from the tools and a "Clean Parts" hood for handling / assembling cleaned parts prior to replacement on the tool.

- Keep the vent slots at the back of the hood clear. Any obstructions will reduce or alter the air flow at the sash opening which could compromise the airborne particle capture.
- A disposable lab coat, jumpsuit, or Tyvek suit must be worn while working in the hoods to prevent contamination of the Midland Engineering Co., Inc. supplied cleanroom garments, if applicable
- Clean gloves and wipes must not be stored in the exhaust hoods. Stow these items in storage compartment under the work surface.
- Once work is completed, wipe down internal and external surfaces of the hood with 10% IPA and pull off the top layer of the tacky mats in front of the hoods.
- Triple bag all dirty parts, if shipping offsite.
- Properly discard used wipes, tacky mats, and disposable garments after each use either in a yellow hazardous materials bag that is labeled with a red hazardous waste sticker or in the solid arsenic-dedicated hazardous waste storage bin.
- Empty the hood trash when full into the solid arsenic-dedicated hazardous waste storage bin. If none are available, contact EHS.

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Exhausted Abrasive Blast Cabinet (if used): If an abrasive blasting cabinet is used, the abrasive blasting cabinet / enclosure should be provided with exhaust ventilation and should not allow the escape of dust from the enclosure during operation. A design guideline for this type of equipment is provided in the ACGIH *Industrial Ventilation Manual*. The exhaust ventilation provided for this control should meet the following criteria:

- 20 air changes per minute
- 500 fpm inward velocity at any opening in the enclosure
- Minimum duct velocity of 4000 fpm

Dedicated Arsenic Cleaning Room/Area: Whenever possible, a remote, dedicated parts cleaning room or area should be used for parts cleaning and other tasks that involve the potential for generation of arsenic dust and particulate. This effectively limits the spread of arsenic contamination in the cleanroom. The most effective approach is to install the various engineering controls in this dedicated room or area and perform activities that could release arsenic only in this area.

Use of Dedicated Parts Clean Room - If parts-cleaning is performed in a dedicated remote area / room, a procedure should be developed to address key aspects of the use of the room / area including the following:

- **Parts transport procedures:** The procedure should describe the steps to follow when transporting arsenic contaminated parts from the tool or another area of the facility to the remote area where parts cleaning or other tasks are performed.
- **Storage of contaminated parts and cleaned parts.**
- **Use of controls to prevent exposures;** e.g., location of controls, any instructions on proper use, means of ensuring the controls are operating correctly, maintenance schedule for controls (e.g., frequency for checking exhaust on fume hood, frequency for changing out vacuum filters, etc.).
- **Gowning procedures for putting on / taking off PPE:** This procedure should describe the steps to follow when putting on protective clothing; and when and where to remove contaminated protective clothing after PM tasks, and proper disposal of contaminated PPE.

Snorkel at the tool for in-situ cleaning: Where possible, local portable exhaust ventilation should be used at the tool (e.g., snorkel exhaust) for tasks such as parts cleaning that cannot be performed remotely in a dedicated clean area. Whenever possible, tasks should be performed in a fume hood away from the tool / equipment rather than at the tool using local portable exhaust. Using a fume hood limits the locations where arsenic can be released into the facility.

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Engineering controls must be validated to ensure that they are working properly and providing effective protection against arsenic exposures each time they are used based upon the following approach:

- Controls should be tested on a periodic basis to ensure that the controls meet the criteria in this Program (e.g., face velocity measurements on fume hood). The frequency for these validation tests will depend on the type of control and manufacturer's instructions.
- Controls should be provided with a means of verifying that the control is operating at the minimum acceptable level of performance. Examples of these types of verification methods are: magnehelic gauge with minimum static pressure; alarms that are connected to a monitoring device (gauge, anemometer, etc.); velocity gauge at the duct with a readout or visual indicator to show velocity is within acceptable ranges.

If the control is found to be operating at an unacceptable level, respiratory protection must be used until control operations are at acceptable performance levels.

SAFE WORK PRACTICES

The control measures and program elements in this document are the minimum requirements at the Midland Engineering Co., Inc. facility. These must be implemented for all those involved in tasks with the potential for arsenic exposures.

Equipment/Tool specific detailed work procedures or SOPs (details steps for cleaning parts) are required and should include the following hygiene and housekeeping work practices to minimize the transfer of the toxic material to places where people are not protected (e.g., door handles, keyboards, phones, areas outside the restricted area). Good work practices also prevent self-contamination (touching own mouth, nose, etc.). These work practices apply to tasks performed at the tool, in fume hoods, or in dedicated remote parts cleaning rooms or areas.

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HYGIENE

The following good hygiene and work practices should be used by all personnel that perform tasks that involve working with arsenic contaminated parts, tools, equipment, or work surfaces. These practices should be part of the arsenic training provided to workers involved in tasks with the potential for arsenic exposures.

- Do not touch clean surfaces or unprotected skin with contaminated gloves – remove the outer gloves first.
- Always wash hands and face after changing out of arsenic contaminated PPE following the completion of tasks involving the potential for arsenic exposures.
- Always remove PPE and wash hands and face before eating, drinking or smoking.
- No storage or consumption of food or beverages in the work area.
- No smoking or chewing of tobacco products in the work area.
- No gum chewing in the work area.
- No storage or application of cosmetics in the work area.

Hygiene Facilities

Employees working in regulated areas or subject to the possibility of skin or eye irritation from inorganic arsenic, shall have access to clean change rooms equipped with storage facilities for street clothes and separate storage facilities for protective clothing and equipment. Workers potentially exposed to arsenic should be provided with hygiene facilities as follows:

- A location with sink with running water, soap and towels where workers can wash their hands and face after tasks. This facility does not have to be dedicated to arsenic tasks or operations.
- A location for eating, drinking, and smoking that is clean and separated from the restricted work areas.

If workers are exposed to airborne arsenic levels that exceed the Arsenic OEL of 0.010 mg/m³, the following facilities must be provided for workers involved in these tasks.

- Change rooms for PPE
- Shower facilities
- Lunch facilities

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HOUSEKEEPING

Housekeeping of areas where arsenic contaminated materials are handled or worked with should be performed on a regular basis to prevent the accumulation of arsenic containing dust or particulates. A written housekeeping and maintenance plan shall be kept which shall list appropriate frequencies for carrying out housekeeping operations, and for cleaning and maintaining dust collection equipment. The plan shall be available for inspection. A tool-specific housekeeping plan should be developed in terms of location, method and frequency of cleaning.

- Each worker at Midland Engineering Co., Inc. is responsible for their immediate work area and equipment, such as hoods, glove boxes, personal work tools, and dedicated work cart.
- NEVER dry sweep and / or dry clean the work area, equipment, or materials containing arsenic. Wet techniques should be used during manual parts cleaning.
- Never use compressed air for cleaning arsenic contaminated surfaces.
- Prior to commencing work on a tool (PM, source change, repair, etc.) barriers must be erected and signs must be posted to entrances into the restricted area indicating the PM is in progress. Label should read:
 - STOP
 - PM IN PROGRESS
 - DO NOT ENTER
 - *Authorized Workers Only*
- Lay down tacky mats along/in front of areas where the work will be performed, under and around potential dust sources, and the entry/exit of the restricted area.
- If applicable, place plastic sheeting over nearby equipment and over perforated and non-perforated floor tiles.
- If contaminated items need to be taken to the exhaust hood or another area, line the walkway with a covering to prevent dust, flakes, or other contaminated material from falling into the waffle and/or subfab use either tacky mats or bag the item before transport.
- If parts must be moved outside the restricted area, the part must be bagged before transport.

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- Transport parts using a cart dedicated for moving arsenic-contaminated material only to hood, as soon as possible. Carts must be cleaned with dampened wipes after every use.
- Tyvek disposable jumpsuits and disposable over-booties, double layered gloves and a P100 full-faced cartridge respirator (or higher level of respiratory protection, if other hazards are present) are to be worn while performing any major PM. At no time shall anyone with a contaminated suit, over-booties, or dirty gloves leave the restricted area to walk in the core ballroom areas.
- After work is complete, clean all exposed surfaces and equipment with dampened wipes.
- If a vacuum is used, it must be a dedicated arsenic HEPA or ULPA vacuum (labeled with the appropriate arsenic warning labels). Do not use dedicated arsenic vacuums for general cleanup applications because all of the waste must be treated as arsenic contaminated. Conversely, do not use general vacuum cleaners for arsenic contaminated areas because of the potential for arsenic contamination of the general vacuum cleaner.

CAUTION: If arsine is present, the HEPA vacuum must be connected to an exhaust system.

- All tools and HEPA vacuums including hoses must be thoroughly cleaned with dampened wipes in the restricted area before being transported back to their storage areas.
- Filter Changes for arsenic-dedicated vacuums is the responsibility of the employees working in the arsenic-restricted area. This procedure must be performed inside of a fume hood. The vacuum filter and any contaminated cleaning materials (e.g., wet wipes) should be handled and disposed of as hazardous waste.
- Wipe down potentially contaminated surfaces, tools and equipment. When removing tacky mats, start from the edges and fold in to contain any loose debris in the mats.
- All arsenic contaminated waste is toxic and must be discarded in yellow bags or container. These bags and containers must have the red hazardous waste label on them and be labeled, 'Toxic Arsenic Contaminated Hazardous Solid Waste'. Arsenic contaminated waste should never be discarded into the general waste stream.

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NOTE: If arsenic-contaminated parts with sharp edges are to be discarded, use a hard walled container so that the edges do not pierce the plastic waste bag.

- After tacky mats, cleanup materials and contaminated PPE have been disposed of roll tacky rollers on the floor and accessible horizontal surfaces.

PERSONAL PROTECTIVE EQUIPMENT (PPE)

Where the possibility of skin or eye irritation from inorganic arsenic exists, and for all workers working in regulated areas, appropriate and clean protective work clothing and equipment shall be provided at no cost to the employee. PPE should be worn for all tasks performed by personnel that present the potential for arsenic exposure through inhalation or skin contact and to prevent exposure of street clothing or cleanroom suits to arsenic contamination.

NOTE: Do not leave restricted area in contaminated PPE.

Disposable suits/coveralls with head cover (e.g., Tyvek suits) should be worn to cover and prevent arsenic contamination of cleanroom suits. Street clothing cannot be used as protection for any tasks that present the potential for arsenic exposure through inhalation or skin contact.

Shoe covers (two layers) that completely cover the shoes. In the cleanroom, the additional pair of shoe covers should be worn before entering the restricted area and discarded immediately before leaving the restricted area to prevent arsenic contamination from spreading to other areas of the fab.

Gloves. (two layers) so that the outer contaminated layer can be removed before touching / handling non-contaminated surfaces (e.g., door knobs, handles, etc.). Depending on the nature of the task, the outer layer may be cleanroom gloves; however, a different type of glove may be required for some tasks (e.g., chemical resistant or abrasion-resistant gloves). Replace torn or damaged gloves with new gloves. Do not touch clean surfaces with contaminated gloves – remove the outer layer of gloves first, then re-double glove, if necessary.

Respiratory Protection is required for all tasks performed in-situ (at tool) with arsenic contamination or for tasks that involve work on arsenic contaminated parts that cannot be performed inside of a properly ventilated fume hood. However, respiratory protection may not be required if exposure assessments have been performed to validate the effectiveness of engineering controls. The following criteria must be met in order to determine that respiratory protection is not required:

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- Two successive personal exposure assessments (at least 7 days apart) must be performed and demonstrate that the exposures are below the AL for arsenic of 0.005 mg/m³ as an 8-hour TWA. These assessments must be based upon personal samples collected in worker's breathing zone while performing tasks that are expected to result in the realistic worst case exposure levels. This testing must be performed in accordance with OSHA regulatory requirements.
- If the controls, the tasks, or the operation change, personal monitoring must be repeated (as described above) to validate that the exposure levels have not increased. Respiratory protection must be used in the interim period while the repeat monitoring results are being collected.

Respiratory protection must be selected in accordance with the Midland Engineering Co., Inc. Respiratory Protection Program. The type of respiratory protection required will depend on the tasks performed and the level of exposure determined by employees' personal monitoring results. Respirators should be selected based on the following criteria:

- Full face-piece air purifying respirator (APR) with HEPA cartridges should be used for tasks that can result in exposures to arsenic that do not exceed 0.125 mg/m³. The North elastomeric full face-piece respirator is an example of this type of respirator.
- Air-supplied respirator in pressure demand mode should be used for tasks that present the potential for employee exposures to arsenic at concentrations above 0.125 mg/m³ or for arsine at concentrations above 0.005 ppm (5 ppb) as an 8-hour TWA exposure. Arsine can sometimes be generated as a by-product such as when arsenic contaminated surfaces are wetted with water. The Scott full face-piece Supplied Air Respirator is an example of this type of respirator.

PROCEDURE FOR REMOVING CONTAMINATED PPE

Contaminated PPE should not be cleaned by shaking or by the use of compressed air or other compressed gases. All contaminated clothing should be handled carefully to avoid the generation of airborne arsenic dust. If you observe dust on your PPE, HEPA vacuum any accumulated dust. Make sure you clean the area and wet wipe down equipment and tools before removing your PPE. All disposable PPE should be disposed of as toxic waste.

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- Remove your contaminated PPE just inside the restricted area. Have disposal bags / containers and cleaning wipes prepared.
- Dispose of each outer bootie stepping into the warm zone with each bootie removal. Booties and gloves are typically the most contaminated pieces of PPE.
- Dispose of the outer layer of nitrile gloves.
- Carefully remove the head covering and coveralls/Tyvek suit. Roll the outside of the material in as you remove to help contain any dust that may be on the outside of the suit. Try to only contact the inside of the PPE as you remove it. Dispose into the waste container before removing the respirator.
- Remove the respirator and wipe down the outside of the respirator using respirator cleaning wet wipes. Use a fresh wipe to clean the inner seal of the respirator. Discard wipes as arsenic hazardous toxic waste and store respirator in a clean, plastic bag.
- Remove remaining PPE, leave cleanroom and proceed to the hygiene facility to wash hands and face.

EMPLOYEE EXPOSURE ASSESSMENTS

Employees performing the tasks / operations that involve potential exposure to inorganic arsenic should be assessed to document the levels of exposure to arsenic and to verify that the existing controls are adequate.

Sampling should be performed to represent the realistic worst case exposures.

- Personal breathing zone air samples should be collected over the employee's work shift (i.e., at least 7 continuous hours) to evaluate exposures.
- If various tasks involving arsenic exposures are performed on different shifts, data should be collected to cover the various tasks.

Monitor at least one sample for each shift for each job classification in each work area. Employee exposure monitoring should be based upon the procedures set forth by OSHA and NIOSH. Ensure flow rate used will allow a detection limit to below the AL of 5 µg/m³.

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Baseline Monitoring: Baseline monitoring should be performed initially for each job category / task at each location where the potential for employee exposures to arsenic exist.

Follow-up Monitoring: Follow-up monitoring should be performed based on results of baseline monitoring.
Less than AL: Two rounds at least 7 days apart. Can discontinue monitoring if both sets of results are less than the AL. Follow the criteria below if either round exceeds the AL or PEL.

- Greater than or equal to AL but less than PEL. Every 6 months. Continue monitoring until two sets of results at least 7 days apart are less than the AL.
- Greater than the PEL. Every 3 months. Continue monitoring until two sets of results at least 7 days apart are less than the AL.

Additional Monitoring Whenever there has been personnel, production, process, control, or other change which may result in new or increased exposure to inorganic arsenic, additional monitoring which complies with this Program should be conducted for all potentially affected workers within 30 days of any such change. Area measurements at each location (e.g., lab, cleanroom, etc.) where these tasks are performed can supplement personal monitoring data. However, area sampling data are not acceptable as the basis for evaluating employee exposures. Midland Engineering Co., Inc. EHS should be provided with a copy of results of any sampling performed onsite.

WIPE SAMPLES

Wipe samples should be collected on a periodic basis from horizontal and other work surfaces in areas where tasks with the potential for arsenic contamination are performed to validate the effectiveness of housekeeping and clean-up activities.

- Areas sampled should be at least 100 cm² in size and should be analyzed for arsenic. The laboratory analytical method must be capable of providing a limit of detection that is less than 1 µg per sample.
- Midland Engineering Co., Inc. Surface Contamination Assessment Criterion for arsenic is 50 µg arsenic / 100 cm² of surface area. Results that exceed the 50 µg/100 cm² criterion indicate that the housekeeping / clean-up procedures are not adequate and these areas require more frequent and / or more careful cleaning of residual accumulations of arsenic.
- Midland Engineering Co., Inc. EHS should be provided with a copy of results of any sampling performed onsite.

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RESTRICTED ACCESS AREAS

EHS is responsible for identifying the need for Restricted Access Area based upon monitoring results and discuss with supervisors/managers regarding what tasks or operations are affected.

- Areas in which operations are performed that present the potential for exposures to inorganic arsenic above the AL, without regard to the use of respirators, should be identified as Restricted Access Areas.
- Access to Restricted Access Areas should be limited to personnel that have received the appropriate training and PPE, and are included in the medical surveillance program for arsenic as described in this document.
- Personnel not directly involved in tasks performed in these areas should not enter these areas.
- Restricted Access Areas should be identified to warn personnel of the potential hazard and the need for controls as follows:
 - If tasks are performed at tools that can result in levels above the AL, a temporary Restricted Access Area should be created; e.g., orange cones around the area with a posted sign. The boundary indicators should be placed at the periphery of the operation well removed from the potential source of release of airborne arsenic from the tool.
- Note that the use of a Restricted Access Area should only be necessary if controls to reduce the exposures to below the AL (outside of the respirator face-piece) are not effective or cannot be implemented for an extended time period (e.g., > 1 month).
- Signage should clearly indicate arsenic hazard. The signs format shown at the end of this Program can be used.

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SIGNS AND LABELS

Labels and signs are an effective means of notifying personnel present in the work area containing arsenic hazards. The format and content of signs and labels should comply with local regulations and requirements. Appendix A provides a standardized format and content for signs and labels which shall be used.

The following items must have hazardous warning labels and/or signs:

- Arsenic restricted access areas
- Arsenic dedicated vacuums
- Fume hoods used for cleaning arsenic contaminated parts, and other activities that may produce airborne arsenic particulates.
- FOUPs, FOSBs, or other carriers containing arsenic materials
- Bags and containers containing arsenic contaminated waste
- Snorkels used to control airborne arsenic particulates.
- Storage cabinets and other locations used for storing contaminated arsenic parts or materials.
- Tools/chambers contaminated with arsenic and any associated downstream equipment (e.g., pumps, abatement units, forelines).

EXCEPTION: Labels are not required when the inorganic arsenic is encapsulated or bound within the product in such a manner as to make unlikely the possibility of exposure to airborne inorganic arsenic. Examples include semiconductors, wafers, light emitting diodes, and glass.

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TRAINING

All workers performing tasks where they are potentially exposed to inorganic arsenic must take Midland Engineering Co., Inc. Inorganic Arsenic Training. Training materials shall be readily available to all affected employees. The training will consist of two parts:

1. Generic training on arsenic toxicology, key work practices, controls, etc. that can be used in all locations, operations. This could be a web-based training approach.
2. Task-specific training for specific locations with arsenic exposure potential, protocols for work practices, housekeeping, hygiene, PPE, disposal, etc. This will normally be an instructor led training class; however, the instructor could be a supervisor or other non-EHS personnel.

Frequency of Arsenic Training:

Training shall be provided for all employees who are potentially exposed to arsenic prior to initial assignment and at least annually thereafter. The generic section and the facility-specific training should be presented initially for all workers that fall under the Program.

Refresher training for both the generic and facility-specific training shall be conducted annually thereafter.

MEDICAL SURVEILLANCE

Employees who perform tasks where they are exposed to inorganic arsenic above the AL, without regard to the use of respirators, should be included in the Midland Engineering Co., Inc. Arsenic Medical Surveillance Program. Employees who perform these tasks are included in the program without regard to the number of times they are exposed to arsenic or whether they are wearing a respirator for these tasks. An accurate record for each employee subject to medical surveillance must be established and maintained.

The Medical Surveillance Program is administered by the Occupational Health Center and includes:

- Work and medical history
- Urine analysis for arsenic
- Standard posterior-anterior chest X-ray
- Nasal and skin examination
- Maintaining medical clearance to wear respirators

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RECORDS

Exposure monitoring records for operations involving arsenic records shall be retained for a minimum of 40 years.

Workers must be provided copies of their records as follows:

- Workers must be notified of the results from the monitoring within 15 working days of receipt of the results, either individually in writing or by posting the results in an appropriate location that is accessible to employees.
- Employee medical records: Workers must be provided with a copy of their own personal medical results. Workers may not receive copies of other workers' medical records. Consult the EHS department for assistance in responding to employee requests for medical records.