

DEPARTMENT OF LICENSING AND REGULATORY AFFAIRS

DIRECTOR'S OFFICE

OCCUPATIONAL HEALTH STANDARDS

(By authority conferred on the director of the department of licensing and regulatory affairs by sections 14 and 24 of 1974 PA 154, MCL 408.1014 and 408.1024; and Executive Reorganization Orders Nos. 1996-1, 1996-2, 2003-1, 2008-4, AND 2011-4, MCL 330.3101, 445.2001, 445.2011, 445.2025 AND 445.2030)

PART 309. CADMIUM

R 325.51851 Scope and application.

Rule 1. (1) These rules apply to all occupational exposures to cadmium and cadmium compounds in all forms and in all industries and employment situations, including the construction industry, except as provided in subrule (2) of this rule.

(2) Some of these rules and subrules of these rules apply only to the construction industry or to general industry and agricultural operations, as indicated in the rules and subrules. If a specific application is not indicated in a rule or subrule, then the rule or subrule applies to general industry, agricultural operations, and the construction industry.

(3) The rule replaces all references to cadmium contained in Occupational Health Standards Part 301 "Air Contaminants for General Industry" and Part 601 "Air Contaminants for Construction," as referenced in R 325.51851a.

History: 1993 AACCS; 1998 AACCS; 2013 AACCS.

R 325.51851a MIOSHA standards by reference.

Rule 1a. (1) The following Michigan occupational safety and health administration (MIOSHA) standards are referenced in these rules. Up to 5 copies of these standards may be obtained at no charge from the Michigan Department of licensing and regulatory affairs, MIOSHA standards section, 7150 Harris Drive, P.O. Box 30643, Lansing, MI, 48909-8143 or via the internet at website: www.michigan.gov/mioshastandards. For quantities greater than 5, the cost, at the time of adoption of these rules, is 4 cents per page.

(a) Administrative Part 11 "Recording and Reporting of Occupational Injuries and Illnesses," R 408.22101 to R 408.22162.

(b) Construction Safety Standard Part 1 "General Rules," R 408.40101 to R 408.40134.

(c) General Industry Safety Standard Part 1 "General Provisions," R 408.10001 to R 408.10098.

(d) General Industry Safety Standard Part 33 "Personal Protective Equipment," R 408.13301 to R 408.13398.

(e) Occupational Health Standard Part 301 "Air Contaminants for General Industry," R 325.51101 to R 325.51108.

(f) Occupational Health Part 430 “Hazard Communication,” R 325.77001 to R 325.77003.

(g) Occupational Health Part 451 “Respiratory Protection,” R 325.60051 to R 325.60052.

(h) Occupational Health Part 470 “Employee Medical Records and Trade Secrets,” R 325.3451 to R 325.3476.

(i) Occupational Health Part 520 “Ventilation Control,” R 325.52001 to R 325.52012.

(j) Occupational Health Part 601 “Air Contaminants for Construction,” R 325.60151 to R 325.60161.

(k) Occupational Health Part 621 “Health Hazard Control for Specific Equipment and Operations for Construction,” R 325.62102 to R 325.62126.

(2) Appendices, except where portions of Appendices A, B, D, E, and F to this rule are expressly incorporated in requirements of this rule, are purely informational and are not intended to create any additional obligations not otherwise imposed or to detract from any existing obligations.

History: 2013 AACCS.

R 325.51852 Definitions.

Rule 2. As used in these rules:

(a) “Action level” (AL) means an airborne concentration of cadmium of 2.5 micrograms per cubic meter of air (2.5 µg/ m³), calculated as an 8-hour, time-weighted average (TWA).

(b) “Authorized person” means a person who is authorized by an employer, and who is required by work duties, to be present in a regulated area, or a person who is authorized under 1974 PA 154, MCL 408.1001 to 408.1094, and regulations issued under 1974 PA 154 to be in a regulated area for the purpose of conducting an authorized investigation.

(c) “Competent person” means a person who is designated by an employer to act on the employer’s behalf, who is capable of identifying existing and potential cadmium hazards in the workplace and the proper methods to control the hazards to protect workers, and who has the authority necessary to take prompt corrective measures to eliminate or control such hazards. See R 325.51884 for the duties of a competent person.

(d) “Construction industry” means employers whose operations involve the construction, alteration, maintenance, repair, and demolition of a facility. Construction work includes any of the following:

(i) The wrecking, demolition, or salvage of structures where cadmium or materials that contain cadmium are present.

(ii) The use of cadmium-containing paints and cutting, brazing, burning, grinding, or welding on surfaces that are painted with cadmium-containing paints.

(iii) The construction, alteration, repair, maintenance, or renovation of structures, substrates, or portions thereof that contain cadmium or materials that contain cadmium.

(iv) Cadmium welding or cutting of cadmium-plated steel and brazing or welding with cadmium alloys.

(v) The installation of products that contain cadmium.

(vi) Electrical grounding with cadmium welding and electrical work using cadmium-coated conduit.

(vii) Maintaining or retrofitting cadmium-coated equipment.

(viii) Cadmium contamination cleanup and emergency operations that involve cadmium.

(ix) The transportation, disposal, storage, or containment of cadmium or materials, that contain cadmium on the site or location at which construction activities are performed.

(e) “Director” means the director of the Michigan department of licensing and regulatory affairs or his or her designee.

(f) “Employee exposure” means the exposure to airborne cadmium that would occur if the employee were not using respiratory protective equipment.

(g) “Final medical determination” means the written medical opinion of the employee’s health status by the examining physician under R 325.51870 to R 325.51876, and R 325.51877 if the review is by more than 1 physician, or R 325.51877(5) if the alternative physician determination is invoked. It is the final, written medical finding, recommendation, or determination that emerges from the medical surveillance process.

(h) “High-efficiency particulate air (HEPA) filter” means a filter that is capable of trapping and retaining not less than 99.97% of mono-dispersed particles that are 0.3 micrometers in diameter.

(i) “Regulated area” means an area which is demarcated by an employer and in which an employee’s exposure to airborne concentrations of cadmium exceeds, or can reasonably be expected to exceed, the permissible exposure limit (PEL).

History: 1993 AACS; 1998 AACS; 2013 AACS.

R 325.51853 Permissible exposure limit (PEL).

Rule 3. An employer shall ensure that an employee is not exposed to an airborne concentration of cadmium in excess of 5 micrograms per cubic meter of air (5 ug/m³), calculated as an 8-hour, time-weighted average (TWA) exposure.

History: 1993 AACS.

R 325.51854 Exposure monitoring generally.

Rule 4. (1) This subrule applies only to construction. Before performing of any construction work where employees may potentially be exposed to cadmium, an employer shall establish the applicability of these rules by determining whether cadmium is present in the workplace and whether there is the possibility that employee exposures will be at or above the action level. An employer shall designate a competent person to make this determination. The employers shall use appropriate investigation and material testing techniques in making the determination. An investigation shall include all of the following:

(a) A review of relevant plans.

(b) A review of past reports relative to cadmium.

(c) Safety data sheets.

(d) Other available records.

(e) Consultations with the property owner.

(f) Discussions with appropriate individuals and agencies.

(2) An employer whose workplace or work operation involves cadmium in any way shall determine if any employee may be exposed to cadmium at or above the action level. An employer shall identify which employees potentially are exposed to cadmium at or above the action level and shall conduct exposure monitoring to determine what the exposure levels are.

(3) Determinations of employee exposure shall be made from breathing zone air samples that reflect the monitored employee's regular, daily 8-hour TWA exposure to cadmium.

(4) Eight-hour TWA exposures shall be determined for each employee on the basis of 1 or more personal breathing zone air samples that reflect a full shift of exposure on each shift, for each job classification, in each work area. Where several employees perform the same job tasks, in the same job classification, on the same shift, and in the same work area and the length, duration, and level of cadmium exposures are similar, an employer may sample a representative fraction of the employees instead of all of the employees to meet this requirement. In representative sampling, an employer shall sample the employee who is expected to have the highest cadmium exposures.

(5) An employer shall use a method of monitoring and analysis that has an accuracy of not less than plus or minus 25%, with a confidence level of 95%, for airborne concentrations of cadmium at or above the action level, the permissible exposure limit (PEL), and the separate engineering control air limit (SECAL).

History: 1993 AACCS; 2013 AACCS.

R 325.51855 Exposure monitoring; applicability of subrules (1), (2), (4), and (6).

Rule 5. (1) This subrule applies only to general industry and agricultural operations. Except as provided for in this subrule and subrule (3) of this rule, an employer shall monitor employee exposures and shall base initial determinations on the monitoring results. If an employer has monitored after

September 14, 1991, under workplace conditions that, in all important aspects, closely resemble currently prevailing workplace conditions and If the monitoring satisfies all other requirements of R 325.51854, including the accuracy and confidence levels specified in subrule (5) of this rule, then an employer may rely on the earlier monitoring results to satisfy the requirements of this subrule.

(2) This subrule applies only to the construction industry. Except as provided for in subrule (3) of this rule, if a determination that is made in compliance with the provisions of R 325.51854(1) shows the possibility of employee exposure to cadmium at or above the action level, then an employer shall conduct exposure monitoring as soon as practicable that is representative of the exposure for each employee in the workplace who is or may be exposed to cadmium at or above the action level. In addition, if an employee periodically performs tasks that may expose the employee to a higher concentration of airborne cadmium, then the employee shall be monitored while performing the tasks.

(3) If an employer has objective data, as specified in R 325.51881(2), which demonstrate that employee exposure to cadmium will not exceed the action level under the expected conditions of processing, use, or handling, then an employer may

rely upon the data instead of implementing the initial monitoring required by subrules (1) and (2) of this rule.

(4) This subrule applies only to The construction industry. If, pursuant to the provisions of R 325.51854(1) or R 325.51855(2), a determination of exposure is made that a potentially exposed employee is not exposed to airborne concentrations of cadmium at or above the action level, an employer shall make a written record of the determination. The record shall include at least the monitoring data that is developed pursuant to the provisions of subrules (2) and (3) of this rule, if applicable, and shall also include the name and social security number of each employee and the date of the determination.

(5) If the initial monitoring or periodic monitoring reveals employee exposures to be at or above the action level, then an employer shall monitor at a frequency and pattern needed to ensure that the monitoring results reflect, with reasonable accuracy, an employee's typical exposure levels given the variability in the tasks performed, work practices, and environmental conditions on the jobsite and to ensure the adequacy of respiratory protection selection and the effectiveness of engineering and work practice controls.

(6) This subrule applies only to general industry and agricultural operations. An employer shall perform the periodic monitoring that is described in subrule (5) of this rule at least once every 6 months until the conditions specified in subrule (7) of this rule are met.

(7) If the initial monitoring or the periodic monitoring indicates that an employee exposure is below the action level and that exposure is confirmed by the results of other monitoring that is performed not less than 7 days later, then an employer may discontinue the monitoring for employees whose exposures are represented by initial or periodic and other monitoring.

(8) An employer shall conduct exposure monitoring that is required by the provision of subrules (2) and (5) of this rule if any of the following situations occur:

(a) There has been a change in the raw materials, equipment, personnel, work practices, or finished products that may result in additional employees being exposed to cadmium at or above the action level.

(b) An employee who is presently exposed to cadmium at or above the action level becomes exposed above the PEL.

(c) An employer or competent person has any reason to suspect that any other change might result in an additional exposure.

History: 1993 AACCS; 1998 AACCS.

R 325.51856 Employee notification of monitoring results.

Rule 6. (1) Not later than 15 working days for general industry and agricultural operations and not later than 5 working days for the construction industry, after an employer receives the results of any exposure monitoring that is performed pursuant to the provisions of these rules, an employer shall notify each affected employee individually in writing, or by posting the results, in an appropriate location that is accessible to all affected employees.

(2) If monitoring results indicate that employee exposure exceeds the PEL, then an employer shall include, in the written notice, a statement that the PEL has been exceeded and a description of the corrective action that is being taken by the employer to reduce employee exposure to or below the PEL.

History: 1993 AACCS; 1998 AACCS; 2013 AACCS.

R 325.51857 Regulated areas.

Rule 7. (1) An employer shall establish a regulated area if an employee's exposure to airborne concentrations of cadmium is, or can reasonably be expected to be, in excess of the permissible exposure limit (PEL).

(2) Regulated areas shall be demarcated from the rest of the workplace in any manner that adequately establishes, and alerts employees to, the boundaries of the regulated area.

(3) Access to regulated areas shall be limited to authorized persons.

(4) Each person who enters a regulated area shall be supplied with, and required to use, a respirator that is selected in accordance with the provisions of R 325.51862(2).

(5) An employer shall ensure that employees do not eat, drink, smoke, chew tobacco or gum, or apply cosmetics in a regulated area; carry the products associated with these activities into a regulated area; or store such products in a regulated area.

History: 1993 AACCS.

R 325.51858 Engineering and work practice controls; written compliance program; applicability of rule to general industry and agricultural operations.

Rule 8. (1) This rule applies only to general industry and agricultural operations. Except as specified in subrules (2), (4), and (5) of this rule, an employer shall implement engineering and work practice controls to reduce and maintain employee exposure to cadmium at or below the PEL, unless, and to the extent that, the employer can demonstrate that the controls are not feasible.

(2) Except as specified in subrules (4) and (5) of this rule, for industries where a separate engineering control air limit (SECAL) is specified for the particular processes set forth in table 1, an employer shall implement engineering and work practice controls to reduce and maintain employee exposure at or below the specified SECAL, unless, and to the extent that, the employer can demonstrate that the controls are not feasible. (3) Table 1 reads as follows:

Table 1
SEPARATE ENGINEERING CONTROL AIRBORNE LIMITS (SECAL)

SECAL

Industry Process (microgram Cd/m³ air)

Nickel cadmium battery Platemaking, plate preparation. 50

All other processes. 15

Zinc/cadmium refining* Cadmium refining, casting, 50 melting, oxide production, sinter plant.

Pigment manufacture Calcine, crushing, milling, blending. 50
All other processes. 15

Stabilizers* Cadmium oxide charging, crushing, drying, blending. 50

Lead smelting* Sinter plant, blast furnace, baghouse, yard area. 50

Plating* Mechanical plating. 15

*Processes in these industries that are not specified in this table shall achieve the PEL using engineering controls and work practices as required in subrule (2) of this rule.

(4) The requirement to implement engineering and work practice controls to achieve the PEL or SECAL, where applicable, does not apply if an employer can demonstrate both of the following:

(a) An employee is only intermittently exposed.

(b) An employee is not exposed above the PEL on 30 or more days per 12-consecutive-month period.

(5) If engineering and work practice controls are required and are not sufficient to reduce employee exposure to or below the PEL or SECAL, then an employer shall implement the controls to reduce exposures to the lowest levels achievable. The employer shall supplement the controls with respiratory protection that is in compliance with the provisions of R 325.51862 and R 325.51863 and the PEL.

(6) An employer shall not use employee rotation as a method of compliance.

(7) All of the following provisions apply to a written compliance program:

(a) If the PEL is exceeded, then an employer shall establish and implement a written compliance program to reduce employee exposure to or below the PEL by means of engineering and work practice controls, as required by subrules (1) and (2) of this rule.

(b) If engineering and work practice controls cannot reduce exposures to or below the PEL, then an employer shall include, in the written compliance program, the use of appropriate respiratory protection to achieve compliance with the PEL.

(c) A written compliance program shall include all of the following information:

(i) A description of each operation in which cadmium is emitted, including all of the following information, as appropriate:

(A) The machinery used.

(B) The material processed.

(C) The controls in place.

(D) The crew size.

(E) Employee job responsibilities.

(F) Operating procedures.

(G) Maintenance practices.

(ii) A description of the specific means that will be employed to achieve compliance, including engineering plans and studies that are used to determine the methods that are selected for controlling exposure to cadmium and, where necessary, the use of appropriate respiratory protection to achieve the PEL.

(iii) A report of the technology applicable to meeting the PEL.

(iv) Air monitoring data that document the levels and sources of cadmium emissions.

(v) A detailed schedule for implementation of the program, including documentation such as copies of purchase orders for equipment and copies of construction contracts.

(vi) A work practice program that includes items required by the provisions of R 325.51864 to R 325.51866.

(vii) A written plan for emergency situations, as specified in R325.51864.

(viii) Other relevant information.

(d) A written compliance program shall be reviewed and updated at least annually, or more often if necessary, to reflect significant changes in the employer's compliance status.

(e) Upon request, a written compliance program shall be provided to affected employees, designated employee representatives, and the director for examination and copying.

History: 1993 AACCS; 1998 AACCS.

R 325.51859 Engineering and work practice controls; applicability of rule to construction industry.

Rule 9. (1) This rule applies only to the construction industry. Except as specified in subrule (2) of this rule, an employer shall implement engineering and work practice controls to reduce and maintain employee exposure to cadmium at or below the PEL, unless, and to the extent that, the employer can demonstrate that the controls are not feasible.

(2) The requirement to implement engineering controls to achieve the PEL does not apply if an employer can demonstrate both of the following:

(a) The employee is only intermittently exposed.

(b) The employee is not exposed above the PEL on 30 or more days per 12-consecutive-month period.

(3) If engineering and work practice controls are not sufficient to reduce employee exposure at or below the PEL, an employer nonetheless shall implement the controls to reduce exposures to the lowest levels achievable. The employer shall supplement the controls with respiratory protection that is in compliance with R 325.51862 and the PEL.

(4) An employer shall not use employee rotation as a method of compliance.

(5) All of the following provisions apply to the specific operations indicated:

(a) Abrasive blasting of cadmium or cadmium-containing materials shall be conducted in a manner that will provide adequate protection for employees.

(b) Welding, cutting, and other forms of heating cadmium or cadmium-containing materials shall be conducted in accordance with Occupational Health Standard Part 621

“Health Hazard Control for Specific Equipment and Operations for Construction,” as referenced in R 325.51851a, where applicable.

(c) High-speed abrasive disc saws and similar abrasive power equipment that are is used for work on cadmium or cadmium-containing materials shall be equipped with appropriate engineering controls to minimize emissions to levels below the PEL.

(d) Materials that contain cadmium shall not be applied by spray methods if resulting exposures are above the PEL, unless employees are protected with supplied-air respirators which have full facepieces, hoods, helmets, and suits and which are operated in a positive pressure mode and, in addition, measures are instituted to limit overspray to prevent contamination of adjacent areas.

History: 1993 AACCS; 2013 AACCS.

R 325.51860 Use of mechanical ventilation to control exposure to cadmium.

Rule 10. (1) If ventilation is used to control cadmium exposure, measurements that demonstrate the effectiveness of the system in controlling exposure, such as capture velocity, duct velocity, or static pressure, shall be made as necessary to ensure the ventilation system’s effectiveness.

(2) Measurements of the system’s effectiveness in controlling exposure shall be made as necessary within 5 working days of any change in production, process, or control that might result in a significant increase in employee exposure to cadmium.

(3) If air from exhaust ventilation is recirculated into the workplace, the system shall have a high-efficiency filter and be monitored to ensure effectiveness. Recirculation of local exhaust air shall be in compliance with Occupational Health Standard Part 520 “Ventilation Control,” as referenced in R 325.51851a.

(4) Procedures shall be developed and implemented to minimize employee exposure to cadmium when maintenance is performed on the ventilation systems and when filters are changed.

History: 1993 AACCS; 2013 AACCS.

R 325.51861 Written compliance program; applicability of rule.

Rule 11. This rule applies only to the construction industry.

(a) Where employee exposure to cadmium exceeds the PEL and an employer is required by the provisions of R 325.51859(1) to implement controls to comply with the PEL, prior to beginning the job an employer shall establish and implement a written compliance program to reduce employee

exposure to or below the PEL. To the extent that engineering and work practice controls cannot reduce exposures to or below the PEL, the employer shall include, in the written compliance program, the use of appropriate respiratory protection to achieve compliance with the PEL.

(b) A written compliance program shall be reviewed and updated as often and as promptly as necessary to reflect significant changes in an employer's compliance status or significant changes in the lowest air cadmium level that is technologically feasible.

(c) A competent person shall review the comprehensive compliance program initially and after each change.

(d) Upon request, a written compliance program shall be provided to the director, affected employees, and designated employee representatives for examination and copying.

History: 1993 AACCS.

R 325.51862 Respiratory protection; circumstances for use; selection.

Rule 12. (1) For employees who use respirators required by this rule, the employer shall provide each employee an appropriate respirator that complies with the requirements of this rule. Respirators must be used during all of the following:

(a) Periods necessary to install or implement feasible engineering and work practice controls when employee exposures exceeds the PEL.

(b) Maintenance and repair activities and brief or intermittent work operations for which employee exposures exceed the PEL and engineering and work practice controls are not feasible or are not required.

(c) Work operations in the regulated areas specified in R 325.51857.

(d) Work operations for which the employer has implemented all feasible engineering and work practice controls and such controls are not sufficient to reduce exposures to or below the PEL.

(e) Emergencies.

(f) Work operations for which an employee who is exposed to cadmium at or above the action level requests a respirator.

(g) Work operations for which engineering controls are not required by R 325.51859(2) to reduce employee exposures that exceed the PEL.

(2) The employer shall do all of the following:

(a) Select, and provide to employees, the appropriate respirators specified in paragraph (d)(3)(i)(A) of Occupational Health Standard Part 451 "Respiratory Protection," as referenced in R 325.51851a.

(b) Provide employees with full facepiece respirators when they experience eye irritation.

(c) Provide HEPA filters for powered and non-powered air-purifying respirators.

(3) An employer shall provide a powered, air-purifying respirator (PAPR) in place of a negative pressure respirator if an employee who is entitled to a respirator chooses to use this type of respirator and if a PAPR respirator will provide adequate protection to the employee.

History: 1993 AACCS; 1999 AACCS; 2013 AACCS.

R 325.51863 Respiratory protection program; fit testing.

Rule 13. (1) The employer shall implement a respiratory protection program in accordance with Occupational Health Standard Part 451 "Respiratory Protection," Rules 1910.134(b) to (d) and (f) to (m), except for (d)(1)(iii), as

referenced in R 325.51851a, which covers each employee required by this rule to use a respirator.

(2) If an employee exhibits breathing difficulty during fit testing or respirator use, then the employer shall provide the employee with a medical examination under R 325.51868(2)(d) to determine if the employee can use a respirator while performing the required duties.

(3) An employee shall not use a respirator when, based on his or her most recent medical examination, the examining physician determines that the employee will be unable to continue to function normally while using a respirator. If the physician determines the employee must be limited in, or removed from, the employee's current job because of the employee's inability to use a respirator, then the employer shall conduct the job limitation or removal under R 325.51875 and R 325.51876.

History: 1993 AACCS; 1998-2000 AACCS; 2013 AACCS.

R 325.51864 Emergency plan.

Rule 14. An employer shall develop and be prepared to implement a written plan for dealing with emergency situations that involve substantial releases of airborne cadmium. The plan shall include provisions for the use of appropriate respirators and personal protective equipment. In addition, employees who are not essential to correcting the emergency situation shall be restricted from the emergency area and normal operations halted in that area until the emergency is abated.

History: 1993 AACCS.

R 325.51865 Protective work clothing and equipment.

Rule 15. (1) If an employee is exposed to airborne cadmium above the PEL or if skin or eye irritation is associated with cadmium exposure at any level, then an employer shall provide, at no cost to the employee, and ensure that the employee uses, appropriate protective work clothing and equipment that prevents contamination of the employee and the employee's garments. Protective work clothing and equipment includes all of the following:

(a) Coveralls or similar full-body work clothing.

(b) Gloves, head coverings, and boots or foot coverings.

(c) Face shields, vented goggles, or other appropriate protective equipment that is in compliance with General Industry Standard Part 33 "Personal Protective Equipment," as referenced in R 325.51851a.

(2) All of the following provisions pertain to the removal and storage of protective work clothing and equipment:

(a) An employer shall ensure that employees remove all protective clothing and equipment that is contaminated with cadmium at the completion of the work shift and that employees do so only in change rooms that are provided in accordance with R 325.51866(2).

(b) An employer shall ensure that an employee does not take cadmium-contaminated protective clothing or equipment from the workplace, except for employees who are authorized to do so for purposes of laundering, cleaning, maintaining, or disposing of cadmium-contaminated protective clothing and equipment at an appropriate location or facility away from the workplace.

(c) An employer shall ensure that contaminated protective clothing and equipment, when removed for laundering, cleaning, maintenance, or disposal, is placed and stored in sealed, impermeable bags or other closed, impermeable containers that are designed to prevent the dispersion of cadmium dust.

(d) An employer shall assure that bags or containers of contaminated protective clothing and equipment that are to be taken out of the change rooms or the workplace for laundering, cleaning, maintenance, or disposal bear labels in accordance with R 325.51879.

(3) All of the following provisions pertain to the cleaning, replacement, and disposal of protective clothing and equipment:

(a) An employer shall provide the protective clothing and equipment required by subrule (1) of this rule in a clean and dry condition as often as necessary to maintain its effectiveness, but at least weekly. An employer is responsible for cleaning and laundering the protective clothing and equipment required by this rule to maintain its effectiveness and is also responsible for disposing of the clothing and equipment.

(b) An employer is responsible for repairing or replacing required protective clothing and equipment as needed to maintain its effectiveness. An employer shall ensure that rips or tears, which are detected while an employee is working are immediately mended or the worksuit shall be immediately replaced.

(c) An employer shall prohibit the removal of cadmium from protective clothing and equipment by blowing, shaking, or any other means that disperses cadmium into the air.

(d) An employer shall ensure that any laundering of contaminated clothing or cleaning of contaminated equipment in the workplace is done in a manner that prevents the release of airborne cadmium in excess of the PEL.

(e) An employer shall inform any person who launders or cleans protective clothing or equipment contaminated with cadmium of the potentially harmful effects of exposure to cadmium and that the clothing and equipment should be laundered or cleaned in a manner to effectively prevent the release of airborne cadmium in excess of the PEL.

History: 1993 AACCS; 1998 AACCS; 2013 AACCS.

R 325.51866 Hygiene areas and practices.

Rule 16. (1) An employer shall provide clean change rooms, handwashing facilities, showers, and lunchroom facilities that are in compliance with General Industry Standard Part 1 “General Provisions,” or Construction Safety Standard Part 1 “General Rules,” as referenced in R 325.51851a, for employees whose airborne exposure to cadmium is above the PEL.

(2) An employer shall ensure that change rooms are equipped with separate storage facilities for street clothes and for protective clothing and equipment which are designed to prevent the dispersion of cadmium and contamination of the employee’s street clothes.

(3) Both of the following provisions pertain to showers and handwashing facilities:

(a) An employer shall ensure that employees who are exposed to cadmium above the PEL shower during the end of the work shift.

(b) An employer shall ensure that employees whose airborne exposure to cadmium is above the PEL wash their hands and faces before eating, drinking, smoking, chewing tobacco or gum, or applying cosmetics.

(4) Both of the following provisions pertain to lunchroom facilities:

(a) An employer shall ensure that lunchroom facilities are readily accessible to employees, that tables for eating are maintained free of cadmium, and that no employee in a lunchroom facility is exposed at any time to cadmium at or above a concentration of 2.5 µg/m³.

(b) An employer shall ensure that employees do not enter lunchroom facilities with protective work clothing or equipment unless surface cadmium has been removed from the clothing and equipment by HEPA filter vacuuming or some other method that removes cadmium dust without dispersing it.

History: 1993 AACS; 2013 AACS.

R 325.51867 Housekeeping.

Rule 17. An employer shall comply with all of the appropriate following requirements pertaining to housekeeping:

(a) All surfaces shall be maintained as free as practical of the accumulation of cadmium.

(b) All spills and sudden releases of material that contains cadmium shall be cleaned up as soon as possible.

(c) Surfaces that are contaminated with cadmium shall, where possible, be cleaned by vacuuming or other method that minimizes the likelihood of cadmium becoming airborne.

(d) HEPA filter vacuuming equipment or equally effective filtration methods shall be used for vacuuming. The equipment shall be used and emptied in a manner that minimizes the reentry of cadmium into the workplace.

(e) Shoveling or dry or wet sweeping and brushing may be used only if vacuuming or other methods that minimize the likelihood of cadmium becoming airborne have been tried and found to be ineffective.

(f) Compressed air shall not be used to remove cadmium from any surface unless the compressed air is used in conjunction with a ventilation system that is designed to capture the dust cloud created by the compressed air.

(g) Waste scrap, debris, bags, containers, personal protective equipment, and clothing which are contaminated with cadmium and which are consigned for disposal shall be collected and disposed of in sealed impermeable bags or other closed, impermeable containers. The bags and containers shall be labeled in accordance with R 325.51878a and R 325.51879.

History: 1993 AACS; 2013 AACS.

R 325.51868 Medical surveillance generally; applicability of subrules (1) and (2)

Rule 18. (1) This subrule applies only to general industry and agricultural operations. An employer shall institute a medical surveillance program as follows:

(a) For all employees who are or may be exposed to cadmium at or above the action level, unless the employer can demonstrate that the employee is not, and will not be, exposed at or above the action level on 30 or more days during a 12-consecutive-month period.

(b) For all employees who, before September 16, 1993, might previously have been exposed to cadmium at or above the action level by the employer, unless the employer can demonstrate that the employee, before September 16, 1993, did not work for the employer in jobs with exposure to cadmium for an aggregated total of more than 60 months.

(c) To determine an employee's fitness for wearing a respirator, an employer shall provide the limited medical examination specified by R 325.51873(1) and (2).

(2) This subrule applies only to the construction industry. An employer shall institute a medical surveillance program as follows:

(a) For all employees who are or may be exposed at or above the action level.

(b) For all employees who perform any of the following tasks, operations, or jobs:

(i) Electrical grounding with cadmium welding.

(ii) Cutting, brazing, burning, grinding, or welding on surfaces that are painted with cadmium containing paints.

(iii) Electrical work using cadmium-coated conduit.

(iv) Use of cadmium-containing paints.

(v) Cutting and welding cadmium-plated steel.

(vi) Brazing or welding with cadmium alloys.

(vii) Fusing of reinforced steel by cadmium welding.

(viii) Maintaining or retrofitting cadmium-coated equipment.

(ix) Wrecking and demolition where cadmium is present.

(c) For all employees who previously might have been exposed to cadmium by the employer before September 16, 1993, in tasks listed in subdivision (b) of this subrule, unless the employer can demonstrate that the employee, in the years before September 16, 1993, did not work in those tasks for the employer with exposure to cadmium for an aggregated total of more than 12 months.

(d) To determine an employee's fitness for wearing a respirator, an employer shall provide the limited medical examination specified by R 325.51873(1) and (2).

(e) A medical surveillance program is not required if an employer can demonstrate that both of the following provisions apply:

(i) An employee is not currently exposed by the employer to airborne concentrations of cadmium at or above the action level on 30 or more days during a 12-consecutive-month period.

(ii) An employee is not currently exposed by the employer in those tasks listed in subdivision (b) of this subrule on 30 or more days during a 12-consecutive-month period.

(3) An employer shall ensure that all medical examinations and procedures that are required by these rules are performed by or under the supervision of a licensed physician who has read, and is familiar with, all of the following:

(a) The health effects section of appendix A.

(b) The regulatory text of these rules.

(c) The protocol for sample handling and laboratory selection in appendix F.

(d) The questionnaire in appendix D. All medical surveillance, examinations, tests, and procedures shall be provided without cost to the employee and at a time and place that is reasonable and convenient for employees.

(4) An employer shall ensure that the collection and handling of biological samples of cadmium in urine (CdU), cadmium in blood (CdB), and beta-2 microglobulin in urine (β_2 -M) taken from employees is done in a manner that ensures the integrity and reliability of the samples and that analysis of the samples is performed in laboratories that have a demonstrated proficiency for the particular analyte. See appendix F.

History: 1993 AACCS; 1998 AACCS; 2013 AACCS.

R 325.51869 Initial medical examination.

Rule 19. (1) An employer shall provide an initial medical examination to all employees who are covered by the medical surveillance program required pursuant to R 325.51868(1) or (2). The examination shall be provided to covered employees within 30 days after initial assignment to a job with exposure to cadmium or not later than 90 days after September 16, 1993, whichever date is later.

(2) The initial medical examination shall include both of the following elements:

(a) A detailed medical and work history, with an emphasis on all of the following:

(i) Past, present, and anticipated future exposure to cadmium.

(ii) Any history of renal, cardiovascular, respiratory, hematopoietic, reproductive, or musculoskeletal system dysfunction.

(iii) Current use of medication that has potential nephrotoxic side effects.

(iv) Smoking history and current status.

(b) Biological monitoring that includes all of the following tests:

(i) Cadmium in urine (CdU), standardized to grams of creatinine (g Cr).

(ii) Beta-2 microglobulin in urine (B2-M), standardized to grams of creatinine (g Cr) with Ph specified, as described in appendix F.

(iii) Cadmium in blood (CdB), standardized to liters of whole blood (lwb).

(3) An initial medical examination is not required to be provided if adequate records show that an employee has been examined in accordance with the requirements of subrule (2) of this rule within the past 12 months. If an employee has been examined in accordance with the requirements of subrule (2) of this rule within the past 12 months, the records shall be maintained as part of the employee's medical record and the exam shall be treated as if it were an initial medical examination for the purposes of R 325.51870 and R 325.51871.

History: 1993 AACCS; 2013 AACCS.

R 325.51870 Initial biological monitoring; medical removal; applicability of subrules (4) and (5).

Rule 20. (1) If the results of the initial biological monitoring tests specified in R 325.51869(2)(b) show the employee's CdU level to be at or below 3 g/g Cr, the 2-M

level to be at or below 300 g/g Cr, and the CdB level to be at or below 5 g/lwb, then the employer shall comply with the following provisions, as applicable:

(a) For currently exposed employees who are subject to medical surveillance pursuant to the provisions of R 325.51868(1)(a) or (2)(a) and (b), an employer shall provide the minimum level of periodic medical surveillance in accordance with the requirements in R 325.51871.

(b) For previously exposed employees who are subject to medical surveillance pursuant to the provisions of R 325.51868(1)(b) or (2)(c), an employer shall provide biological monitoring for CdU, 2-M, and CdB 1 year after the initial biological monitoring and then the employer shall comply with the requirements of R 325.51871(4).

(2) For all employees who are subject to medical surveillance pursuant to the provisions of R 325.51868(1) or (2), if the results of the initial biological monitoring tests show the level of CdU to be more than 3 g/g Cr, the level of 2-M to be more than 300 g/g Cr, or the level of CdB to be more than 5 g/lwb, then an employer shall comply with all of the following provisions:

(a) Within 2 weeks after receipt of biological monitoring results, reassess the employee's occupational exposure to cadmium as follows:

(i) Reassess the employee's work practices and personal hygiene.

(ii) Reevaluate the employee's respirator use, if any, and the respirator program.

(iii) Review the hygiene facilities required pursuant to the provisions of R 325.51866.

(iv) Reevaluate the maintenance and effectiveness of the relevant engineering controls.

(v) Assess the employee's smoking history and status.

(b) Within 30 days after the exposure reassessment specified in subdivision

(a) of this subrule, take reasonable steps to correct any deficiencies found in the reassessment that may be responsible for the employee's excess exposure to cadmium.

(c) Within 90 days after receipt of biological monitoring results, provide a full medical examination to the employee in accordance with the requirements of R 325.51871(2). After completing the medical examination, the examining physician shall determine, in a written medical opinion, whether to medically remove the employee. If the physician determines that medical removal is not necessary, then until the employee's CdU level falls to or below 3 g/g Cr, the 2-M level falls to or below 300 g/gCr, and the CdB level falls to or below 5 g/lwb, an employer shall do both of the following:

(i) Provide biological monitoring in accordance with the provisions of R 325.51869(2)(b) on a semiannual basis.

(ii) Provide annual medical examinations in accordance with the provisions of R 325.51871(2).

(3) For all employees who are subject to medical surveillance pursuant to the provisions of R 325.51868(1) or (2), if the results of the initial biological monitoring tests show the level of CdU to be more than 15 g/g Cr, or the level of CdB to be more than 15 g/lwb, or the level of 2-M to be more than 1,500 g/g Cr, then an employer shall comply with the requirements of subrule (2)(a) and (b) of this rule. Within 90 days

after receipt of biological monitoring results, the employer shall provide a full medical examination to the employee in accordance with the requirements of R 325.51871(2). After completing the medical examination, the examining physician shall determine, in a written medical opinion, whether to medically remove the employee. However, if the initial biological monitoring results and the biological monitoring results obtained during the medical examination both show the level of CdU to be more than 15 g/g Cr, the level of CdB to be more than 15 g/lwb, or the level of 2-M to be more than 1500g/gCr and, in addition, the level of CdU is more than 3 g/g Cr or CdB is more than 5g/lwb, then the physician shall medically remove the employee from exposure to cadmium at or above the action level. If the second set of biological monitoring results obtained during the medical examination does not show that a mandatory removal trigger level has been exceeded, then the employee is not required to be removed by the mandatory provisions of this subrule. If the employee is not required to be removed by the mandatory provision of this subrule or by the physician's determination, then until the employee's CdU level falls to or below 3 g/g Cr, the 2-M level falls to or below 300 g/g Cr,

and the CdB level falls to or below 5 g/lwb, an employer shall do all of the following:

(a) Periodically reassess the employee's occupational exposure to cadmium.

(b) Provide biological monitoring in accordance with the provisions of R 325.51869(2)(b) on a quarterly basis.

(c) Provide semiannual medical examinations in accordance with the provisions of R325.51871(2).

(4) This subrule applies only to general industry and agricultural operations. Beginning on January 1, 1999, for all employees to whom medical surveillance is provided, an employer shall comply with all of the following provisions rather than subrules (1) to (3) of this rule:

(a) If the results of the initial biological monitoring tests show the employee's CdU level to be at or below 3 g/g Cr, the 2-M level to be at or below 300 g/g Cr, and the CdB level to be at or below 5 g/lwb, then, for currently exposed employees, an employer shall comply with the requirements of subrule (1)(a) of this rule, and, for previously exposed employees, the employer shall comply with the requirements of subrule(1)(b) of this rule.

(b) If the results of the initial biological monitoring tests show the level of CdU to be more than 3 g/g Cr, the level of 2-M to be more than 300g/g Cr, or the level of CdB to be more than 5 g/lwb, then an employer shall comply with the requirements of subrule (2) of this rule.

(c) If the results of the initial biological monitoring tests show the level of CdU to be more than 7 g/g Cr, or the level of CdB to be more than 10 g/lwb, or the level of 2-M to be more than 750g/gCr, then an employer shall do all of the following, if applicable:

(i) Comply with the requirements of subrule (2)(a) and (b) of this rule and, within 90 days after receipt of biological monitoring results, provide a full medical examination for the employee in accordance with the requirements of R 325.51871(2).

(ii) After completing the medical examination, the examining physician shall determine, in a written medical opinion, whether to medically remove the employee.

(iii) If the initial biological monitoring results and the biological monitoring results obtained during the medical examination both show that the level of CdU is more than 7 g/g Cr, the level of CdB is more than 10 g/lwb, or the level of 2-M is more than 750g/g Cr and, in addition, the level of CdU

is more than 3 g/g Cr or the level of CdB is more than 5 g/lwb, then the physician shall medically remove the employee from exposure to cadmium at or above the action level.

(iv) If the second set of biological monitoring results obtained during the medical examination does not show that a mandatory removal trigger level has been exceeded, then the employee is not required to be removed by the mandatory provisions of this subrule.

(v) If the employee is not required to be removed by the mandatory provisions of this subrule or by the physician's determination, then until the employee's CdU level falls to or below 3 g/g Cr, the 2-M level falls to or below 300g/g Cr, and the CdB level falls to or below 5 g/lwb, an employer shall do all of the following:

(A) Periodically reassess the employees's occupational exposure to cadmium.

(B) Provide biological monitoring in accordance with the provisions of R 325.51869(2) every 3 months.

(C) Provide semiannual medical examinations in accordance with the provisions of R325.51871(2).

(5) This subrule applies only to the construction industry. Beginning on January 1, 1999, for all employees to whom medical surveillance is provided, an employer shall comply with all of the following provisions rather than the provisions of subrules (1) to (3) of this rule:

(a) If the results of initial biological monitoring tests show the employee's CdU level to be more than 7 g/g Cr, or the 2-M level to be more than 750g/g Cr, or the CdB level to be more than 10 g/lwb, an employer shall comply with the requirements of subrule (2) of this rule.

(b) Within 90 days after receipt of biological monitoring results, an employer shall provide a full medical examination to the employee in accordance with the requirements of R 325.51871(2).

(c) After completing the medical examination, the examining physician shall determine, in a written medical opinion, whether to medically remove the employee.

(d) If the initial biological monitoring results and the biological monitoring results obtained during the medical examination both show that the level of CdU is more than 7 g/g Cr, the level of CdB is more than 10 g/lwb, or the level of 2-M is more than 750g/g Cr and, in addition, the level of CdU

is more than 3 g/g Cr or the level of CdB is more than 5g/lwb, then the physician shall medically remove the employee from exposure to cadmium at or above the action level.

(e) If the second set of biological monitoring results obtained during the medical examination does not show that a mandatory removal trigger level has been exceeded, then the employee is not required to be removed by the mandatory provisions of this subrule.

(f) If the employee is not required to be removed by the mandatory provisions of this subrule or by the physician's determination, then until the employee's CdU level

falls to or below 3 g/g Cr, the 2-M level falls to or below 300 g/g Cr, and the CdB level falls to or below 5 g/lwb, an employer shall do all of the following:

- (i) Periodically reassess the employee's occupational exposure to cadmium.
- (ii) Provide biological monitoring in accordance with the provisions of R 325.51869(2) every 3 months.
- (iii) Provide semiannual medical examinations in accordance with the provisions of R325.51871(2).

History: 1993 AACCS; 1998 AACCS.

R 325.51871 Periodic medical examinations.

Rule 21. (1) For each employee who is covered by the provisions of R 325.51868(1)(a) or (2)(a) and (b) because of current or anticipated exposure to cadmium, an employer shall provide at least a minimum level of periodic medical surveillance that consists of periodic medical examinations and periodic biological monitoring. A periodic medical examination shall be provided within 12 months after the initial examination that is required pursuant to the provisions of R 325.51869 and not more than once every 24 months thereafter. Biological sampling shall be provided every 12 months either as part of a periodic medical examination or separately as periodic biological monitoring.

(2) A periodic medical examination shall include all of the following:

(a) A detailed medical and work history, or update thereof, with an emphasis on all of the following:

- (i) Past, present, and anticipated future exposure to cadmium.
- (ii) Smoking history and current status.
- (iii) Reproductive history.
- (iv) Current use of medications with potential nephrotoxic side effects.
- (v) Any history of renal, cardiovascular, respiratory, hematopoietic, or musculoskeletal system dysfunction.
- (vi) For employees who wear respirators, answers to questions 3 to 11 and 25 to 32 in appendix D to these rules.

(b) A complete physical examination with an emphasis on blood pressure, the respiratory system, and the urinary system.

(c) A posterior-anterior chest X ray. After the initial X ray, the frequency of chest X rays shall be determined by the examining physician.

(d) Pulmonary function tests, including forced vital capacity (FVC) and forced expiratory volume at 1 second (FEV1).

(e) Biological monitoring, as required by the provisions of R 325.51869(2).

(f) Additional blood analyses, including blood urea nitrogen, complete blood count, and serum creatinine.

(g) Additional urinalysis, including the determination of albumin, glucose, and total and low molecular weight proteins.

(h) For males over 40 years of age, prostate palpation or other diagnostic test that is at least as effective.

(i) Any additional tests that are deemed appropriate by the examining physician.

(3) Periodic biological monitoring shall be performed in accordance with the provisions of R 325.51869(2)(b). If the results of periodic biological monitoring or the results of biological monitoring performed as part of the periodic medical examination show the level of the employee's CdU, B2-M, or CdB to be more than the levels specified in R 325.51870(2) or (3) or, beginning on January 1, 1999, more than the levels specified in R 325.51870(2), (4), or (5), an employer shall take the appropriate actions specified in R 325.51870(2) to (5).

(4) For previously exposed employees as specified by the provisions of R 325.51868(1)(b) or (2)(c), all of the following provisions apply:

(a) If the employee's level of CdU was not more than 3 ug/g Cr, CdB was not more than 5 ug/lwb, and B2-M was not more than 300 ug/g Cr in the initial biological monitoring tests, and if the results of the follow-up biological monitoring required by R 325.51870(1)(b) 1 year after the initial examination confirms the previous results, an employer may discontinue all periodic medical surveillance for that employee.

(b) If the initial biological monitoring results for CdU, CdB, or B2-M were more than the levels specified in subdivision (a) of this subrule, but subsequent biological monitoring results required by the provisions of R 325.51870(2) to (5) show that the employee's CdU level is not more than 3 ug/g Cr, the CdB level is not more than 5 ug/lwb, and B2-M level is not more than 300 ug/g Cr, an employer shall provide follow-up biological monitoring for CdU, CdB, and B2-M 1 year after the most recent biological monitoring results. If the results of this follow-up biological monitoring confirm the previous results, an employer may discontinue all periodic medical surveillance for that employee.

(c) If the results of the follow-up tests specified in subdivision (a) or (b) of this subrule indicate that the level of the employee's CdU, B2-M, or CdB is more than the levels specified in subdivision (b) of this subrule, an employer is required to provide annual medical examinations in accordance with the provisions of subrule (2) of this rule until the results of biological monitoring are consistently below the levels specified in subdivision (b) of this subrule or until the examining physician determines, in a written medical opinion, that further medical surveillance is not required to protect the employee's health.

(5) A routine, once every 24 months, medical examination is not required to be provided in accordance with the provisions of R 325.51870(1) and subrule (1) of this rule if adequate medical records show that the employee has been examined in accordance with the requirements of subrule

(2) of this rule within the past 12 months. In that case, the records shall be maintained by the employer as part of the employee's medical record and the next routine, periodic medical examination shall be made available to the employee within 2 years of the previous examination.

History: 1993 AACCS.

R 325.51872 Actions triggered by medical examinations; applicability of subrules (1) and (2).

Rule 22. (1) This subrule applies only to general industry and agricultural operations. If the results of a medical examination carried out in accordance with these rules indicate any laboratory or clinical finding consistent with cadmium toxicity that does not require employer action required by R325.51869 to R 325.51871, then an employer shall, within 30 days, reassess the employee's occupational exposure to cadmium and take all of the following corrective actions until the physician determines they are no longer necessary:

(a) Periodically reassess all of the following:

(i) The employee's work practices and personal hygiene.

(ii) The employee's respirator use.

(iii) The employee's smoking history and status.

(iv) The respiratory protection program.

(v) The hygiene facilities.

(vi) The maintenance and effectiveness of the relevant engineering controls.

(b) Within 30 days after the reassessment, take all reasonable steps to correct the deficiencies found that may be responsible for the employee's excess exposure to cadmium.

(c) Provide medical reexaminations every 6 months to evaluate the abnormal clinical signs of cadmium toxicity until the results are normal or the employee is medically removed.

(d) If the results of tests for total proteins in urine are abnormal, provide a more detailed medical evaluation of the toxic effects of cadmium on the employee's renal system.

(2) This subrule applies only to the construction industry. If the results of a medical examination carried out in accordance with these rules indicate any laboratory or clinical finding consistent with cadmium toxicity that does not require employer action required by R325.51869 to R 325.51871, an employer shall take all of the following actions and continue to take them until the physician determines that they are no longer necessary:

(a) Periodically reassess all of the following:

(i) The employee's work practices and personal hygiene.

(ii) The employee's respirator use.

(iii) The employee's smoking history and status.

(iv) The respiratory protection program.

(v) The hygiene facilities.

(vi) The maintenance and effectiveness of the relevant engineering controls. The employer shall take all reasonable steps to correct the deficiencies discovered by this reassessment that may be responsible for the employee's excess exposure to cadmium.

(b) Provide medical reexaminations every 6 months to evaluate the abnormal clinical signs of cadmium toxicity until the results are normal or the employee is medically removed.

(c) If the results of tests for total proteins in urine are abnormal, provide a more detailed medical evaluation of the toxic effects of cadmium on the employee's renal system.

History: 1993 AACCS; 1998 AACCS.

R 325.51873 Medical exams for fitness to use respirators, for exposure due to emergency, and at termination.

Rule 23. (1) To determine an employee's fitness for respirator use, an employer shall provide a medical examination that includes the elements specified in this subrule. The examination shall be provided before an employee is assigned to a job that requires the use of a respirator or not more than 90 days after September 16, 1993, whichever date is later, to any employee who has not had a medical examination within the preceding 12 months that satisfies the requirements of this subrule. The medical exam shall include all of the following:

(a) A detailed medical and work history, or update thereof, with an emphasis on all of the following:

(i) Past exposure to cadmium.

(ii) Smoking history and current status.

(iii) Any history of renal, cardiovascular, respiratory, hematopoietic, or musculo-skeletal system dysfunction.

(iv) A description of the job for which the respirator is required.

(v) Answers to questions 3-11 and 25-32 in appendix D to these rules.

(b) A blood pressure test.

(c) Biological monitoring of the employee's levels of CdU, CdB, and β 2-M in accordance with the requirements of R 325.51869(2)(b), unless the results have been obtained within the previous 12 months.

(d) Any other test or procedure that the examining physician deems appropriate.

(2) All of the following provisions pertain to the medical examination for respirator use:

(a) After reviewing all of the information obtained from the medical examination required in subrule (1) of this rule, the physician shall determine whether the employee is fit to wear a respirator.

(b) If an employee has exhibited difficulty in breathing during a respirator fit test or during use of a respirator, an employer shall provide the employee, as soon as possible, with a periodic medical examination in accordance with R 325.51871(2) to determine the employee's fitness to wear a respirator.

(c) If the results of the examination required by subrule (1) of this rule or subdivision (a) or (b) of this subrule are abnormal, the medical limitation or prohibition of respirator use shall be considered. If the employee is allowed to wear a respirator, the employee's ability to continue to do so shall be periodically evaluated by a physician.

(3) In addition to the medical surveillance required by R 325.51869 to R 325.51873(2), an employer shall provide a medical examination, as soon as possible, to any employee who may have been acutely exposed to cadmium because of an emergency. The examination shall include the information required pursuant to R 325.51871(2), with an emphasis on the respiratory system, other organ systems considered appropriate by the examining physician, and symptoms of acute overexposure, as reviewed in appendix A to these rules.

(4) At termination of employment, an employer shall provide a medical examination in accordance with R 325.51871(2), including a chest X ray where necessary, to any employee to whom, at any prior time, an employer was required to provide medical surveillance pursuant to R 325.51868(1) or subrule (3) of this rule. However, if the last

examination satisfied the requirements of R 325.51871(2) and was less than 6 months before the date of termination, then another examination is not required unless otherwise specified by R 325.51870 or R 325.51872(1) or (2). If the employer has discontinued all periodic medical surveillance as provided by the provisions of R 325.51871(4), the termination of employment medical examination is not required.

History: 1993 AACCS; 2013 AACCS.

R 325.51874 Providing of information to physician by employer; employer required to obtain medical opinion; employer required to obtain results of biological monitoring; findings unrelated to cadmium exposure.

Rule 24. (1) An employer shall provide all of the following information to an examining physician:

- (a) A copy of these rules and appendices.
 - (b) A description of an affected employee's former, current, and anticipated duties as they relate to the employee's occupational exposure to cadmium.
 - (c) An employee's former, current, and anticipated future levels of occupational exposure to cadmium.
 - (d) A description of any personal protective equipment, including respirators, that were used or are to be used by the employee, including the date of use and the length of time that the employee has used that equipment.
 - (e) The results of previous biological monitoring and medical examinations that are relevant to the employee.
- (2) An employer shall promptly obtain a written medical opinion from the examining physician for each medical examination performed on each employee. The written opinion shall contain all of the following information:
- (a) The physician's diagnosis for the employee.
 - (b) The physician's opinion as to whether the employee has any detected medical condition that would place the employee at an increased risk of material impairment to health from further exposure to cadmium, including any indications of potential cadmium toxicity.
 - (c) The results of any biological or other testing or related evaluations that directly assess the employee's absorption of cadmium.
 - (d) Any recommended removal from, or limitation on, the activities or duties of the employee or on the employee's use of personal protective equipment including respirators.
 - (e) A statement that the physician has clearly and carefully explained to the employee the results of the medical examination, including all biological monitoring results and any medical conditions related to cadmium exposure that require further evaluation or treatment, and any limitation on the employee's diet or use of medications.
- (3) An employer promptly shall obtain a copy of the results of any biological monitoring that is provided to an employee by requirements other than those of a medical examination required by R 325.51869 and R 325.51871 and, if there is no written medical opinion, shall obtain an explanation sheet explaining the results.

(4) An employer shall instruct the physician not to reveal orally or in the written medical opinion that is given to the employer specific findings or diagnoses unrelated to an occupational exposure to cadmium.

History: 1993 AACCS; 2013 AACCS.

R 325.51875 Medical removal protection (MRP); applicability of subrule (1) (d) and (e).

Rule 25. (1) All of the following provisions pertain to the removal of an employee from work that exposes the employee to cadmium:

(a) An employer shall temporarily remove an employee from work if the exposure level exceeds the action level on each occasion that medical removal is required by the provisions of R 325.51870, R325.51871, or R 325.51873(1) and (2) and on each occasion that a physician determines, in a written medical opinion, that the employee should be removed from such exposure. The physician's determination may be based on any of the following factors:

- (i) Biological monitoring results.
- (ii) Inability to wear a respirator.
- (iii) Evidence of illness.
- (iv) Other signs or symptoms of cadmium-related dysfunction or disease.
- (v) Any other reason deemed medically sufficient by the physician.

(b) An employer shall medically remove an employee in accordance with the provisions of subdivision (a) of this subrule regardless of whether or not a job is available into which the removed employee may be transferred.

(c) If an employee is medically removed pursuant to the provisions of this subrule, then an employer shall transfer the removed employee to a job where the exposure to cadmium is at or below the permissible levels specified in this subrule as soon as a job becomes available.

(d) This subdivision applies only to general industry and agricultural operations. For an employee who is medically removed pursuant to the provisions of subdivision (a) of this subrule, an employer shall provide follow-up biological monitoring in accordance with the provisions of R325.51869(2)(b) at least once every 3 months and follow-up medical examinations at least once every 6 months until, in a written medical opinion, the examining physician determines that either the employee may be returned to his or her former job status as specified pursuant to the provisions of subrules (3) and (4) of this rule or the employee must be permanently removed from excess cadmium exposure.

(e) This subdivision applies only to the construction industry. For any employee who is medically removed pursuant to the provisions of subdivision (a) of this subrule, an employer shall provide follow-up medical examinations once every 6 months until, in a written medical opinion, the examining physician determines that either the employee may be returned to his or her former job status or the employee must be permanently removed from excess cadmium exposure.

(f) An employer shall not return an employee who has been medically removed for any reason to his or her former job status until a physician determines, in a written

medical opinion, that continued medical removal is no longer necessary to protect the employee's health.

(2) If an employee is found to be unfit to wear a respirator pursuant to the provisions of R 325.51873(2)(a), then an employer shall remove the employee from work if exposure to cadmium is above the PEL. If removal is based on any reason other than the employee's inability to wear a respirator, then an employer shall remove the employee from work if exposure to cadmium is at or above the action level.

(3) Except as specified in subrule (4) of this rule, an employee who was removed because his or her level of CdU, CdB, or 2-M exceeded the medical removal trigger levels in R 325.51870 and R 325.51871 shall not be returned to work if there is an exposure to cadmium at or above the action level until the employee's level of CdU falls to or below 3g/g Cr, the level of CdB falls to or below 5 g/lwb, and the level of 2-M falls to or below 300 g/g Cr.

(4) If in the examining physician's opinion continued exposure to cadmium will not pose an increased risk to the employee's health and there are special circumstances that make continued medical removal an inappropriate remedy, the physician shall fully discuss these matters with the employee and

then, in a written determination, may return a worker to his or her former job status despite what would otherwise be unacceptably high biological monitoring results. Thereafter, the returned employee shall continue to be provided with medical surveillance as if he or she was still on medical removal until the employee's level of CdU falls to or below 3 g/g Cr, the level of CdB falls to or below 5 g/lwb, and the level of 2-M falls to or below 300 g/g Cr. Until these biological monitoring levels are achieved, the employee is not subject to mandatory medical removal. Subsequent questions regarding the employee's medical removal shall be decided solely by a final medical determination.

(5) If an employer, although not required by the provisions of subrules (1) and (2) of this rule to do so, removes an employee from exposure to cadmium or otherwise places limitations on an employee due to the effects of cadmium exposure on the employee's medical condition, then the employer shall provide the same medical removal protection benefits to that employee, as required by R 325.51876, as would have been provided had the removal been required by the provisions of this rule.

History: 1993 AACCS; 1998 AACCS.

R 325.51876 Medical removal protection benefits (MRPB).

Rule 26. (1) An employer shall provide MRPB for up to a maximum of 18 months to an employee each time and while the employee is temporarily medically removed pursuant to the provisions of R 325.51875.

(2) For the purposes of these rules, the requirement that an employer provide MRPB means that the employer shall maintain the total normal earnings, seniority, and all other employee rights and benefits of the removed employee, including the employee's right to his or her former job status, as if the employee had not been removed from the employee's job or otherwise medically limited.

(3) If, after 18 months on medical removal because of elevated biological monitoring results, the employee's monitoring results have not declined to a low

enough level to permit the employee to be returned to his or her former job status, both of the following provisions shall apply:

(a) An employer shall make available to the employee a medical examination pursuant to these rules in order to obtain a final medical determination as to whether the employee may be returned to his or her former job status or must be permanently removed from excess cadmium exposure.

(b) An employer shall ensure that the final medical determination indicates whether the employee may be returned to his or her former job status and what steps, if any, should be taken to protect the employee's health.

(4) An employer may condition the provision of MRPB upon the employee's participation in medical surveillance provided in accordance with these rules.

History: 1993 AACCS.

R 325.51877 Employee right to second medical opinion; resolution of differing opinions; alternate form of physician determination.

Rule 27. (1) If an employer selects the initial physician to conduct a medical examination or consultation provided to an employee pursuant to these rules, the employee may designate a second physician to do both of the following:

(a) Review any findings, determinations, or recommendations of the initial physician.

(b) Conduct such examinations, consultations, and laboratory tests as the second physician deems necessary to facilitate this review.

(2) An employer shall promptly notify an employee of the right to seek a second medical opinion after each occasion that an initial physician provided by the employer conducts a medical examination or consultation pursuant to these rules. The employer may condition its participation in, and payment for, multiple physician review upon the employee doing both of the following within 15 days after receipt of this notice, or receipt of the initial physician's written opinion, whichever occurs later:

(a) Informing the employer that he or she intends to seek a medical opinion.

(b) Initiating steps to make an appointment with a second physician.

(3) If the findings, determinations, or recommendations of the second physician differ from those of the initial physician, then the employer and the employee shall ensure that efforts are made for the 2 physicians to resolve any disagreement. If the 2 physicians are unable to quickly

resolve their disagreement, then the employer and the employee, through their respective physicians, shall designate a third physician to do both of the following:

(a) Review any findings, determinations, or recommendations of the other 2 physicians.

(b) Conduct such examinations, consultations, laboratory tests, and discussions with the other 2 physicians as the third physician deems necessary to resolve the disagreement among them.

(4) An employer shall act consistently with the findings, determinations, and recommendations of the third physician, unless the employer and the employee

reach an agreement that is consistent with the recommendations of at least 1 of the other 2 physicians.

(5) An employer and an employee, or designated employee representative, may agree upon the use of any alternate form of physician determination in place of the multiple physician review provided pursuant to the provisions of subrules (1) to (4) of this rule if the alternative is expeditious and at least as protective of the employee.

History: 1993 AACCS.

R 325.51878 Employer provision of medical information to employee.

Rule 28. (1) An employer shall provide a copy of the physician's written medical opinion to the examined employee within 2 weeks after receipt of the opinion.

(2) An employer shall provide the employee with a copy of the employee's biological monitoring results and an explanation sheet explaining the results within 2 weeks after receipt of the results if the employee is employed in general industry or within 5 working days if the employee is employed in the construction industry.

(3) Within 30 days after a request by an employee, an employer shall provide the employee with the information the employer is required to provide to the examining physician pursuant to the provisions of R 325.51874.

History: 1993 AACCS.

R 325.51878a Hazard communication--general.

Rule 28a. (1) Chemical manufacturers, importers, distributors and employers shall comply with all requirements of the Occupational Health Standard Part 430 "Hazard Communication," as referenced in R 325.51851a, for cadmium.

(2) In classifying the hazards of cadmium, at least the following hazards are to be addressed:

- (a) Cancer.
- (b) Lung effects.
- (c) Kidney effects.
- (d) Acute toxicity effects.

(3) Employers shall include cadmium in the hazard communication program established to comply with the requirements of the Occupational Health Standard Part 430 "Hazard Communication." Employers shall ensure that each employee has access to labels on containers of cadmium and to safety data sheets, and is trained in accordance with R 325.51880 and Occupational Health Standard Part 430 "Hazard Communication," as referenced in R 325.51851a.

History: 2013MR 10, Eff. June 5, 2013.

R 325.51879 Communication of cadmium hazards to employees.

Rule 29. (1) An employer shall provide warning signs and display them in regulated areas. In addition, warning signs shall be posted at all approaches to regulated areas so

that an employee may read the signs and take the necessary protective steps before entering the regulated area.

(2) Warning signs required by subrule (1) of this rule, shall bear the following legend:

DANGER
CADMIUM
MAY CAUSE CANCER
CAUSES DAMAGE TO LUNGS AND KIDNEYS
WEAR RESPIRATORY PROTECTION IN THIS
AREA
AUTHORIZED PERSONNEL ONLY

(3) Prior to June 1, 2016, employers may use the following legend in lieu of that specified in subrule (2) of this rule.

DANGER
CADMIUM
CANCER HAZARD
CAN CAUSE LUNG AND KIDNEY DISEASE
AUTHORIZED PERSONNEL ONLY
RESPIRATORS REQUIRED IN THIS AREA

(4) An employer shall ensure that warning signs that are required by this subrule are illuminated, cleaned, and maintained as necessary so that the legend is readily visible.

(5) An employer shall ensure that all shipping and storage containers that contain cadmium, or cadmium compounds, shall bear appropriate warning labels as specified in R 408.51878a.

(6) The warning labels for containers of cadmium-contaminated protective clothing, equipment, waste, scrap, or debris shall include at least the following information:

DANGER
CONTAINS CADMIUM
MAY CAUSE CANCER
CAUSES DAMAGE TO LUNGS AND KIDNEYS
AVOID CREATING DUST

(7) Prior to June 1, 2015, employers may include the following information on shipping and storage containers containing cadmium, cadmium compounds, or cadmium contaminated clothing, equipment, waste, scrap, or debris in lieu of the labeling requirements specified in R 408.51878a and subrule (2) of this rule:

DANGER
CONTAINS CADMIUM
CANCER HAZARD
AVOID CREATING DUST
CAN CAUSE LUNG AND KIDNEY DISEASE

(8) Where feasible, installed cadmium products shall have a visible label or other indication that cadmium is present.

History: 1993 AACCS; 1998 AACCS; 2013 AACCS.

Editor's Note: An obvious error in R 325.51880 was corrected at the request of the promulgating agency, pursuant to Section 56 of 1969 PA 306, as amended by 2000 PA 262, MCL 24.256. The rule containing the error was published in *Michigan Register*, 2013 MR 10. The memorandum requesting the correction was published in *Michigan Register*, 2013 MR 21.

R 325.51880 Employee information and training.

Rule 30. (1) An employer shall train each employee who is potentially exposed to cadmium in accordance with this rule. The employer shall institute a training program, ensure employee participation in the program, and maintain a record of the contents of the program. Employee training shall be provided before or at the time of initial assignment to a job that involves potential exposure to cadmium and at least annually thereafter.

(2) An employer shall make the training program understandable to the employee and shall ensure that each employee is informed of all of the following:

(a) The health hazards associated with cadmium exposure, with special attention to the type of information provided in appendix A.

(b) The quantity, location, manner of use, release, and storage of cadmium in the workplace and the specific nature of operations that could result in exposure to cadmium, especially exposure above the PEL.

(c) The engineering controls and work practices associated with the employee's job assignment.

(d) The measures employees can take to protect themselves from exposure to cadmium, including modification of smoking and personal hygiene habits, and the specific procedures the employer has implemented to protect employees from exposure to cadmium, such as appropriate work practices, emergency procedures, and the provision of personal protective equipment.

(e) The purpose, proper selection, fitting, proper use, and limitations of respirators and protective clothing.

(f) The purpose and a description of the medical surveillance program required pursuant to R 325.51868 to R 325.51878.

(g) The contents of these rules and the appendices to these rules.

(h) The employee's right of access to records as provided by Occupational Health Standard Part 470 "Employee Medical Records and Trade Secrets," as referenced in R 325.51851a.

(3) An employer shall make a copy of these rules and the appendices to these rules readily available without cost to all affected employees and shall provide a copy if requested. Also, an employer shall provide to the director, upon request, all materials relating to the employee information and training program.

(4) This subrule applies only to the construction industry. In a multiemployer workplace, an employer who produces, uses, or stores cadmium in a manner that may

expose employees of other employers to cadmium shall notify the other employers of the potential hazards in accordance with –Occupational Health Standard Part 430 “Hazard Communication,” for general industry or the construction industry, as referenced in R 325.51851a.

History: 1993 AACCS; 1998 AACCS; 2013 AACCS.

Editor's Note: An obvious error in R 325.51880 was corrected at the request of the promulgating agency, pursuant to Section 56 of 1969 PA 306, as amended by 2000 PA 262, MCL 24.256. The rule containing the error was published in *Michigan Register*, 2013 MR 10. The memorandum requesting the correction was published in *Michigan Register*, 2013 MR 21.

R 325.51881 Recordkeeping.

Rule 31. (1) All of the following provisions pertain to records of exposure monitoring:

(a) An employer shall establish and keep accurate records of all air monitoring for cadmium in the workplace.

(b) Air monitoring records shall include, at a minimum, all of the following information:

(i) The monitoring date, shift, duration, and results in terms of an 8-hour TWA of each sample taken and, if cadmium is not detected, the detection level.

(ii) The name, social security number, and job classification of all employees who are monitored and of all other employees whose exposures the monitoring result is intended to represent, including, if applicable, a description of the justification that monitoring results of 1 employee can represent other employees' exposures.

(iii) A description of the sampling and analytical methods used and evidence of their accuracy.

(iv) The type of respiratory protective device, if any, worn by the monitored employee and by any other employee whose exposure the monitoring result is intended to represent.

(v) A notation of any other conditions that might have affected the monitoring results.

(vi) Any exposure monitoring or objective data that were used and the exposure levels obtained. The provisions of this paragraph apply only to the construction industry.

(c) An employer shall maintain these records for not less than 30 years as set in accordance with Occupational Health Standard Part 470 “Employee Medical Records and Trade Secrets,” as referenced in R 325.51851a.

(d) This subdivision applies only to the construction industry. An employer shall provide a copy of the results of an employee's air monitoring prescribed in R 325.51854 and R 325.51855 to an industry trade association and to the employee's union, if any. If neither the association nor the union exists, monitoring results shall be furnished to another comparable organization which is competent to maintain such records and which is reasonably accessible to employers and employees in the industry.

(2) This subrule applies to objective data used to exempt an employer from the requirements to perform initial monitoring as provided in R 325.51855(3). For the purposes of these rules, “objective data” means information which demonstrates that a particular product or material that contains cadmium, or a specific process, operation, or activity that involves cadmium, cannot release dust or fumes in concentrations at or above the action level even under the worst-case release conditions. Objective data can be obtained from an industry-wide study or from laboratory product testing results for

manufacturers of cadmium containing products or materials. The data the employer uses from an industry-wide survey shall be obtained under workplace conditions closely resembling the processes, types of material, control methods, work practices, and environmental conditions in the employer's current operations. An employer shall establish and maintain a record of the objective data for not less than 30 years.

(3) All of the following provisions pertain to medical surveillance records:

(a) An employer shall establish and maintain an accurate record for each employee covered by the medical surveillance requirements of R 325.51868(1) or (2).

(b) The medical surveillance records shall include, at a minimum, all of the following information about the employee:

(i) Name, social security number, and description of duties.

(ii) A copy of the physician's written opinions and an explanation sheet for biological monitoring results.

(iii) A copy of the medical history, the results of any physical examination, and all test results that are required to be provided by these rules, including biological tests, X-rays, pulmonary function tests, and tests that have been obtained to further evaluate any condition that might be related to cadmium exposure.

(iv) The employee's medical symptoms that might be related to exposure to cadmium.

(v) A copy of the information that is provided to the physician as required by R 325.51874(1)(b) to (e).

(c) An employer shall ensure that medical records are maintained for the duration of employment plus 30 years as specified by Occupational Health Standard Part 470 "Employee Medical Records and Trade Secrets," as referenced in R 325.51851a.

(4) All of the following provisions pertain to the availability and transfer of records:

(a) Except as otherwise provided for in these rules, access to all records that are required to be maintained by this rule shall be in compliance with Occupational Health Standard Part 470 "Employee Medical Records and Trade Secrets," as referenced in R 325.51851a.

(b) Within 15 days after a request, an employer shall make an employee's medical records that are required to be kept pursuant to subrule (3) of this rule available for examination and copying to the subject employee, to a designated representative, or to anyone who has the specific written consent of the subject employee and, after the employee's death or incapacitation, to the employee's family members.

(c) When an employer ceases to do business and there is no successor employer to receive and retain records for the prescribed period or the employer intends to dispose of any records that are required to be preserved for not less than 30 years, then the employer shall comply with the requirements concerning the transfer of records set forth in Occupational Health Standard Part 470 "Employee Medical Records and Trade Secrets," as referenced in R 325.51851a.

(5) An employer shall ensure that any abnormal condition or disorder that is caused by occupational exposure to cadmium in the workplace is properly recorded in injury and illness records pursuant to Administrative Standard Part 11 "Recording and Reporting of Occupational Injuries and Illnesses," as referenced in R 325.51851a.

History: 1993 AACCS; 2013 AACCS.

Editor's Note: An obvious error in R 325.51880 was corrected at the request of the promulgating agency, pursuant to Section 56 of 1969 PA 306, as amended by 2000 PA 262, MCL 24.256. The rule

containing the error was published in *Michigan Register*, 2013 MR 10. The memorandum requesting the correction was published in *Michigan Register*, 2013 MR 21.

R 325.51882 Employee observation of monitoring.

Rule 32. An employer shall provide affected employees or their designated representatives an opportunity to observe any monitoring of employee exposure to cadmium. When observation of monitoring requires entry into an area where the use of protective clothing or equipment is required, an employer shall provide the observer with that clothing and equipment and shall ensure that the observer uses the clothing and equipment and complies with all other applicable safety and health procedures.

History: 1993 AACCS.

R 325.51883. Compliance dates.

Rule 33. The rules that apply to general industry and agricultural operations shall commence on September 16, 1993, except as follows:

(a) Except for small businesses that have 19 or fewer employees, initial monitoring that is required by R 325.51855 shall be completed as soon as possible, but not later than 60 days after September 16, 1993. For small businesses, initial monitoring shall be completed as soon as possible, but not later than 120 days after September 16, 1993.

(b) Except for small businesses that have 19 or fewer employees, regulated areas that are required by R 325.51857 shall be established as soon as possible after the results of exposure monitoring are known, but not later than 90 days after September 16, 1993. For small businesses, required regulated areas shall be established as soon as possible after the results of exposure monitoring are known, but not later than September 16, 1993.

(c) Except for small businesses that have 19 or fewer employees, respiratory protection that is required by R 325.51862 and R 325.51863 shall be provided as soon as possible, but not later than 90 days after September 16, 1993. For small businesses, respiratory protection shall be provided as soon as possible, but not later than 150 days after September 16, 1993.

(d) Written compliance programs that are required by R 325.51858(7) shall be completed and available for inspection and copying as soon as possible, but not later than 1 year after September 16, 1993.

(e) The engineering controls that are required by R 325.51858(1) to (6) shall be implemented as soon as possible, but not later than 2 years after September 16, 1993. Work practice controls shall be implemented as soon as possible. Work practice controls that are directly related to engineering controls to be implemented in accordance with the compliance plan shall be implemented as soon as possible after the engineering controls are implemented.

(f) Permanent or temporary hand-washing facilities shall be provided as soon as possible, but not later than 60 days after September 16, 1993.

(g) Change rooms, showers, and lunchroom facilities shall be provided as soon as possible, but not later than 1 year after September 16, 1993.

(h) Except for small businesses that have 19 or fewer employees, the employee information and training that is required by R 325.51880 shall be provided as soon as possible, but not later than 90 days after September 16, 1993. For small businesses, employee information and training shall be provided as soon as possible, but not later than 180 days after September 16, 1993.

(i) Except for small businesses that have 19 or fewer employees, initial medical examinations that are required by R 325.51869 shall be provided as soon as possible, but not later than 90 days after September 16, 1993. For small businesses, initial medical examinations shall be provided as soon as possible, but not later than 180 days after September 16, 1993.

History: 1993 AACCS; 1998 AACCS; 2013 AACCS.

R 325.51884 Competent person for construction.

Rule 34. This rule applies only to construction. The duties of a competent person include all of the following:

(a) Determine before the performance of work whether cadmium is present in the workplace.

(b) Establish regulated areas where necessary and assure that access to and from those areas is limited to authorized employees.

(c) Ensure the adequacy of employee exposure monitoring required by these rules.

(d) Ensure that all employees who are exposed to cadmium levels above the permissible exposure limit wear appropriate personal protective equipment and are trained in the use of appropriate methods of exposure control.

(e) Ensure that proper hygiene facilities are provided and that workers are trained to use those facilities.

(f) Ensure that the engineering controls required by these rules are implemented, maintained in proper operating condition, and functioning properly.

History: 1993 AACCS.

R 325.51885 Rescinded.

History: 1993 AACCS; 1998-2000 AACCS; 2013 AACCS.

R 325.51886 Rescinded.

History: 1993 AACCS; 1998 AACCS; 2013 AACCS.