Chapter 296-849 WAC
BENZENE

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WAC

DISPOSITION OF SECTIONS FORMERLY CODIFIED IN THIS CHAPTER

296-849-190 Definitions. [Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, 49.17.060 and 29 C.F.R. 1910 Subpart Z. WSR 14-07-086, § 296-849-190, filed 3/18/14, effective 5/1/14. Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, and 49.17.060. WSR 05-01-172, § 296-849-190, filed 12/21/04, effective 3/1/05.] Repealed by WSR 18-22-116, filed 11/6/18, effective 12/7/18. Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, and 49.17.060.

WAC 296-849-030 Definitions. Action level. An airborne concentration of benzene of 0.5 parts per million (ppm) calculated as an eight-hour time-weighted average.

Authorized personnel. Individuals specifically permitted by the employer to enter the exposure control area to perform necessary duties, or to observe employee exposure evaluations as a designated representative.

Benzene. Liquid benzene, benzene vapor, and benzene in liquid mixtures and the vapors released by these liquids.

The chemical abstract service (CAS) registry number for benzene is 71-43-2. CAS numbers are internationally recognized and used on safety data sheets (SDSs) and other documents to identify substances. For more information, see http://www.cas.org/about.

Breathing zone. The space around and in front of an employee's nose and mouth, forming a hemisphere with a 6- to 9-inch radius.

Bulk wholesale storage facility. Any bulk terminal or bulk plant where fuel is stored before its delivery to wholesale customers.

Container. Any container, except for pipes or piping systems, that contains benzene. It can be any of the following:

- Barrel;
- Bottle;
- Can;
- Cylinder;
- Drum;
- Reaction vessel;
- Storage tank.

Day. Any part of a calendar day.

Designated representative. Any of the following:

• Any individual or organization to which an employee gives written authorization;

• A recognized or certified collective bargaining agent without regard to written employee authorization; **OR**

• The legal representative of a deceased or legally incapacitated employee.

Emergency. Any event that could or does result in the unexpected significant release of benzene. Examples of emergencies include equipment failure, container rupture, or control equipment failure.

Exposure. The contact an employee has with benzene, whether or not protection is provided by respirators or other personal protective equipment (PPE). Contact can occur through various routes of entry such as inhalation, ingestion, skin contact, or skin absorption.

Licensed health care professional (LHCP). An individual whose legally permitted scope of practice allows him or her to provide some or all of the health care services required for medical evaluations.

Permissible exposure limits (PELs). PELs are employee exposures to toxic substances or harmful physical agents that must not be exceeded. PELs are also specified in various WISHA rules found in other chapters. The PELs for benzene are the:

• Eight-hour time-weighted average (TWA_8) of 1 part per million (ppm); **AND**

• Fifteen-minute short-term exposure limit (STEL) of 5 ppm.

Short-term exposure limit (STEL). An exposure limit averaged over a fifteen-minute period that must not be exceeded during any part of an employee's workday.

Time-weighted average (TWA_8). An exposure limit averaged over an eight-hour period that must not be exceeded during an employee's workday.

Vapor control systems. Equipment that controls the vapor displaced when chemicals are loaded and unloaded from truck or storage tanks. It also processes or balances the vapor back into the truck or storage tanks.

[Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, and 49.17.060. WSR 18-22-116, § 296-849-030, filed 11/6/18, effective 12/7/18.]

WAC 296-849-100 Scope. This chapter applies to **all** occupational exposure to benzene.

Definition:

Exposure. The contact an employee has with benzene, whether or not protection is provided by respirators or other personal protective equipment (PPE). Exposure can occur through various routes of entry such as inhalation, ingestion, skin contact, or skin absorption.

Exemptions: This chapter does not apply to any of the following:
- Liquids, vapors, mixtures in containers or pipelines, and gas in natural gas processing plants when benzene content is 0.1% or less.
- Gasoline and other fuels containing benzene once they leave the final bulk wholesale facility and are being:
  - Transported;
  - Sold;
  - Distributed;
  - Stored;
  - Dispensed either:
    - Outdoors; or
    - Indoors four hours or less a day.
  - Used as a fuel.
- Oil and gas drilling, production, and servicing operations.
- Solid materials that contain only trace amounts of benzene.
- Coke ovens.

All requirements in this chapter will not apply to every workplace with an occupational exposure. The following will show you which requirements apply to your workplace.

Step 1: If any of your work tasks are listed in Table 1, follow Table 1.

• Go to Step 2a if you have additional work tasks or other exposures that are not covered in Table 1.

Table 1
Requirements That Apply to Specific Tasks

If employees do any of the following:	Then the only requirements in this chapter that apply to those tasks are:
Load and unload benzene at bulk storage facilities that use vapor control systems for all loading and unloading operations.	• The labeling requirement found in Preventive practices, WAC 296-849-11010.
Perform tasks around sealed transport pipelines carrying gasoline, crude oil, or other liquids containing more than 0.1% benzene.	• This requirement found in Training, WAC 296-849-11050: – Make sure training and information includes specific information on benzene for each hazard communication training topic. For the list of hazard communication training topics, go to WAC 296-901-14016, Employee information and training.
Work with, or around, sealed containers of liquids containing more than 0.1% benzene.	• Emergency requirements found in Medical evaluations, WAC 296-849-12030. • Requirements found in Medical records, WAC 296-849-12080. • Respirator requirements found in Respirators, WAC 296-849-13045.

Step 2a: Follow requirements in the basic rules sections, WAC 296-849-11010 through 296-849-11090, for tasks **not** listed in Table 1.

• This includes completing an exposure evaluation, as specified in Exposure evaluations, WAC 296-849-11030, to:

– Obtain employee fifteen-minute and eight-hour exposure monitoring results of airborne benzene;

AND

– Determine if employee exposure monitoring results are above, at, or below these values:

■ Eight-hour time-weighted average **(TWA_8)** . . . . . 1 parts per million (ppm).

■ Fifteen-minute short-term exposure limit **(STEL)** . . . . 5 ppm.

■ Eight-hour action level **(AL)** . . . . . 0.5 ppm.

Step 2b: Use employee exposure monitoring results from Step 2a and follow Table 2 to find out which additional sections of this chapter apply to your workplace.

Table 2
Section Application

If employee exposure monitoring results are:	Then continue to follow the basic rules, and these additional requirements:
• **Above** the TWA_8 or STEL	• Exposure and medical monitoring, WAC 296-849-12010 through 296-849-12080; and • Exposure control areas, WAC 296-849-13005 through 296-849-13045.
• **At or below** the TWA_8 or STEL; **AND** • **At or above** AL	• Exposure and medical monitoring, WAC 296-849-12005 through 296-849-12080.
• **Below** the AL and STEL	• No additional requirements apply.

[Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, and 49.17.060. WSR 18-22-116, § 296-849-100, filed 11/6/18, effective 12/7/18. Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, 49.17.060 and 29 C.F.R. 1910 Subpart Z. WSR 14-07-086, § 296-849-100, filed 3/18/14, effective 5/1/14. Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, 49.17.060. WSR 07-03-163, § 296-849-100, filed 1/24/07, effective 4/1/07; WSR 05-13-152, § 296-849-100, filed 6/21/05, effective 8/1/05; WSR 05-01-172, § 296-849-100, filed 12/21/04, effective 3/1/05.]

WAC 296-849-110 Basic rules.

Summary:

Your responsibility:

To measure and minimize employee exposure to benzene.

IMPORTANT:

To determine which requirements to follow for your work tasks, go to Table 1 in the scope of this chapter, WAC 296-849-100.

You must meet the requirements…	in this section:
Communication of hazards	WAC 296-849-11010
Exposure control areas	WAC 296-849-11020
Exposure evaluations	WAC 296-849-11030
Personal protective equipment (PPE)	WAC 296-849-11040
Training	WAC 296-849-11050
Exposure monitoring observation	WAC 296-849-11065
Notification	WAC 296-849-11070
Exposure records	WAC 296-849-11090

[Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, and 49.17.060. WSR 18-22-116, § 296-849-110, filed 11/6/18, effective 12/7/18. Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050,

49.17.060 and 29 C.F.R. 1910 Subpart Z. WSR 14-07-086, § 296-849-110, filed 3/18/14, effective 5/1/14. Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, 49.17.060. WSR 05-01-172, § 296-849-110, filed 12/21/04, effective 3/1/05.]

WAC 296-849-11010 Communication of hazards.

Hazard communication—General.

(1) Chemical manufacturers, importers, distributors and employers must comply with all requirements of the Hazard Communication Standard (HCS, WAC 296-901-140 for benzene).

(2) In classifying the hazards of benzene at least the following hazards are to be addressed: Cancer; central nervous system effects; blood effects; aspiration; skin, eye, and respiratory tract irritation; and flammability.

(3) Employers must include benzene in the hazard communication program established to comply with the HCS, WAC 296-901-140. Employers must ensure that each employee has access to labels on containers of benzene and to safety data sheets, and is trained in accordance with the requirements of HCS and WAC 296-849-11050.

Note: You should keep containers tightly covered when not in use to prevent unnecessary exposure and accidental spills.

References: Additional requirements are found in other chapters as follows:
- For spills, leaks, or other releases of benzene, go to Emergency response, chapter 296-824 WAC.
- For labeling go to:
  - WAC 296-901-14012, Labels and other forms of warning; **AND**
  - WAC 296-901-14014, Safety data sheets.

[Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, and 49.17.060. WSR 18-22-116, § 296-849-11010, filed 11/6/18, effective 12/7/18. Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, 49.17.060 and 29 C.F.R. 1910 Subpart Z. WSR 14-07-086, § 296-849-11010, filed 3/18/14, effective 5/1/14. Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, 49.17.060. WSR 05-01-172, § 296-849-11010, filed 12/21/04, effective 3/1/05.]

WAC 296-849-11020 Exposure control areas. You must establish temporary or permanent exposure control areas where airborne concentrations of benzene are above, or can be reasonably expected to be above, the permissible exposure limits (PELs) for benzene by doing all the following:

(1) Post signs in accordance with WAC 296-849-11010.

(2) Distinguish the boundaries of exposure control areas from the rest of the workplace in any way that minimizes employee access.

(3) Allow only authorized personnel to enter exposure control areas.

Note:
- You may use permanent or temporary enclosures, caution tape, ropes, painted lines on surfaces, or other materials to visibly distinguish exposure control areas or separate them from the rest of the workplace.
- When distinguishing exposure control areas you should consider factors such as:
  - The level and duration of airborne exposure.
  - Whether the area is permanent or temporary.
  - The number of employees in adjacent areas.

Reference: If exposure control areas are established, go to Respirators, WAC 296-849-13045.

[Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, and 49.17.060. WSR 18-22-116, § 296-849-11020, filed 11/6/18, effective 12/7/18. Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, 49.17.060 and 29 C.F.R. 1910 Subpart Z. WSR 14-07-086, § 296-849-11020, filed 3/18/14, effective 5/1/14. Statutory Authority:

RCW 49.17.010, 49.17.040, 49.17.050, 49.17.060. WSR 05-01-172, § 296-849-11020, filed 12/21/04, effective 3/1/05.]

WAC 296-849-11030 Exposure evaluations.

IMPORTANT:

• When you conduct an exposure evaluation in a workplace where an employee uses a respirator, the protection provided by the respirator is not considered.

• Following this section will fulfill the requirements to identify and evaluate respiratory hazards found in chapter 296-841 WAC, Airborne contaminants.

You must conduct an employee exposure evaluation to accurately determine airborne concentrations of benzene by completing Steps 1 through 7 of the exposure evaluation process, each time any of the following apply:

(1) No evaluation has been conducted.

You have up to thirty days to complete an evaluation once benzene is introduced into your workplace.

(2) Changes have occurred in any of the following areas that may result in new or increased exposures:

(a) Production.

(b) Processes.

(c) Exposure controls such as ventilation systems or work practices.

(d) Personnel.

(3) You have any reason to suspect new or increased exposure may occur.

(4) Spills, leaks, or other releases have been cleaned up.

Note: As part of your exposure evaluation after cleanup, you will make sure exposure monitoring results have returned to prerelease levels.

Exposure evaluation process.

IMPORTANT:

• If you are evaluating employee exposures during cleaning and repair of barges and tankers that contained benzene:

– Collect samples that effectively measure benzene concentrations that employees may be exposed to;

AND

– Skip to Step 7.

Following the exposure evaluation process is not necessary when you have documentation conclusively demonstrating benzene exposures for a particular operation and material cannot exceed the action level (AL) during any conditions reasonably anticipated.

(a) Documentation can be based on data or qualitative information, such as information about:

(i) The material.

(ii) How the material is handled.

(iii) The work conditions.

(b) Retain this documentation for as long as you rely on it.

Step 1: Identify all employees who have potential airborne exposure to benzene in your workplace.

Step 2: Identify operations where fifteen-minute exposures could exceed benzene's short-term exposure limit (STEL) of 5 parts per million (ppm).

• Include operations where it is reasonable to expect high, fifteen-minute exposures, such as operations where:

– Tanks are opened, filled, unloaded, or gauged.

– Containers or process equipment are opened.
– Benzene is used as a solvent for cleaning.

Note: You may use monitoring devices such as colorimetric indicator tubes or real-time monitors to screen for activities where employee exposure monitoring results could be high.

Step 3: Select employees from those working in the operations you identified in Step 2 who will have their fifteen-minute exposures measured.

Step 4: Select employees from those identified in Step 1 who will have their eight-hour exposures monitored.

• Make sure the exposures of the employees selected represent eight-hour exposures for **all** employees identified at Step 1, including each job classification, work area, and shift.

Note: A written description of the procedure used for obtaining representative employee exposure monitoring results needs to be kept as part of your exposure records required by this chapter in Exposure records, WAC 296-849-11090. This description can be created while completing Steps 3 through 6 of this exposure evaluation process.

Step 5: Determine how you will obtain employee monitoring results.

• Select and use a method that is accurate to ±25%, with a confidence level of 95%.

Note:
• Here are examples of methods that meet this accuracy requirement:
– OSHA Method 12 for air samples, found by going to http://www.osha.gov/dts/sltc/methods/toc.html.
– NIOSH Method 1500, found by going to http://www.cdc.gov/niosh/homepage.html and link to the *NIOSH Manual of Analytical Methods*.

Step 6: Obtain employee exposure monitoring results by collecting air samples representing employees identified at Step 1.

• Collect fifteen-minute samples from employees selected at Step 3.

• Sample at least one shift representative of the eight-hour exposure for each employee selected at Step 4.

• Make sure samples are collected from each selected employee's breathing zone.

• Collecting area samples is permitted after emergency releases.

Note:
• You may use any sampling method that meets the accuracy specified in Step 5. Examples of these methods include:
– Real-time monitors that provide immediate exposure monitoring results.
– Equipment that collects samples that are sent to a laboratory for analysis.
• The following are examples of methods of monitoring representative of eight-hour exposures:
– Collect one or more continuous samples, for example, a single eight-hour sample or four two-hour samples.
– Take a minimum of five brief samples, such as fifteen-minute samples, during the work shift and at times selected randomly.
• For work shifts longer than eight hours, monitor the continuous eight-hour portion of the shift expected to have the highest average exposure concentration.

Step 7: Have the samples you collected analyzed to obtain monitoring results representing eight-hour and fifteen-minute exposures.

• Go to the scope of this chapter, WAC 296-849-100, and compare employee exposure monitoring results to the **values** found in Step 2a and follow Step 2b to determine if additional sections of this chapter apply.

Note:
• You may contact your local WISHA consultant for help:
– Interpreting data or other information.
– Obtaining eight-hour or fifteen-minute employee exposure monitoring results.
• To contact a WISHA consultant:
– Go to another chapter, the Safety and health core rules, chapter 296-800 WAC, and find the resources section, and under "other resources," find service location for labor and industries.

[Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, and 49.17.060. WSR 18-22-116, § 296-849-11030, filed 11/6/18, effective 12/7/18; WSR 07-05-062, § 296-849-11030, filed 2/20/07, effective 4/1/07; WSR 05-13-152, § 296-849-11030, filed 6/21/05, effective 8/1/05; WSR 05-01-172, § 296-849-11030, filed 12/21/04, effective 3/1/05.]

WAC 296-849-11040 Personal protective equipment (PPE). You must make sure employees use appropriate PPE as protection from skin or eye contact with liquid benzene.

Note: Harmful amounts of benzene can enter the body through skin and eye contact.

Reference: To see additional personal protective equipment requirements, go to the Safety and health core rules, chapter 296-800 WAC.

[Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, and 49.17.060. WSR 18-22-116, § 296-849-11040, filed 11/6/18, effective 12/7/18; WSR 05-01-172, § 296-849-11040, filed 12/21/04, effective 3/1/05.]

WAC 296-849-11050 Training. (1) You must provide training and information to employees:

(a) At the time of initial assignment to a work area where benzene is present;

AND

(b) At least every twelve months after initial training for employees exposed to airborne concentrations at or above the action level (AL) of 0.5 parts per million (ppm).

(2) You must make sure training and information includes all of the following:

(a) Specific information on benzene for each hazard communication training topic. For the list of hazard communication training topics, go to WAC 296-901-14016, Employee information and training;

AND

(b) An explanation of the contents of this chapter and guidance about where to find a copy of it;

AND

(c) A description of the medical evaluation requirements of this chapter found in:

■ Medical evaluations, WAC 296-849-12030;

AND

■ Medical removal, WAC 296-849-12050.

Reference: To see additional training and information requirements in other chapters, go to the:
• Respirators rule, chapter 296-842 WAC, and find the Training section, WAC 296-842-16005.
• WAC 296-901-14016, Employee information and training.

[Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, and 49.17.060. WSR 18-22-116, § 296-849-11050, filed 11/6/18, effective 12/7/18. Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, 49.17.060 and 29 C.F.R. 1910 Subpart Z. WSR 14-07-086, § 296-849-11050, filed 3/18/14, effective 5/1/14. Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, 49.17.060. WSR 07-03-153, § 296-849-11050, filed 1/23/07, effective 6/1/07; WSR 05-01-172, § 296-849-11050, filed 12/21/04, effective 3/1/05.]

WAC 296-849-11065 Exposure monitoring observation. (1) You must provide affected employees and their designated representatives an opportunity to observe exposure monitoring during Step 6 of the exposure evaluation process found in Exposure evaluations, WAC 296-849-11030.

(2) You must make sure observers who enter areas with benzene exposure:

(a) Are provided with and use the same protective clothing, respirators, and other personal protective equipment (PPE) that employees working in the area are required to use;

AND

(b) Follow safety and health requirements that apply.

[Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, and 49.17.060. WSR 18-22-116, § 296-849-11065, filed 11/6/18, effective 12/7/18; WSR 05-01-172, § 296-849-11065, filed 12/21/04, effective 3/1/05.]

WAC 296-849-11070 Notification. (1) You must provide written notification of exposure monitoring results to the employees represented by your exposure evaluation within five business days after the monitoring results become known to you.

(2) In addition, when employee exposure monitoring results are above a permissible exposure limit (PEL), provide written notification of all of the following within fifteen business days after these exposure monitoring results become known to you:

(a) Corrective actions being taken and a schedule for completion;

AND

(b) Any reason why exposures cannot be lowered to below the PELs for benzene.

Note:
- You can notify employees either individually or post the notifications in areas readily accessible to affected employees.
- Posted notification may need specific information that allows affected employees to determine which monitoring results apply to them.
- Notification may be in any written form, such as handwritten or email.
- Notification may be limited to the required information, such as exposure monitoring results.
- When notifying employees about corrective actions, your notification may refer them to a separate document that's available and provides the required information.

[Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, and 49.17.060. WSR 18-22-116, § 296-849-11070, filed 11/6/18, effective 12/7/18; WSR 05-01-172, § 296-849-11070, filed 12/21/04, effective 3/1/05.]

WAC 296-849-11090 Exposure records. (1) You must establish and keep complete and accurate records for all exposure monitoring conducted under this chapter. Make sure the record includes at least:

(a) The name, Social Security number, or other unique identifier, and job classification of the employee sampled and all other employees represented by the sampled employee.

(b) The type of respirator worn, if any.

(c) A description of the methods used to obtain exposure monitoring results.

(d) A description of the procedure used to obtain representative employee exposure monitoring results.

(e) The date, number, duration, and the result of each sample taken.

Note: It is useful to record any personal protective equipment worn by the employee, in addition to the type of respirator worn.

(2) You must keep exposure monitoring records for at least thirty years.

Reference:
- To see additional requirements for employee exposure records including access, and transfer requirements, go to another chapter, Employee medical and exposure records, chapter 296-802 WAC.
- Exposure monitoring records need to be kept longer than thirty years for employees participating in medical monitoring, go to Medical records, WAC 296-849-30080, found within this chapter.

[Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, and 49.17.060. WSR 18-22-116, § 296-849-11090, filed 11/6/18, effective

12/7/18; WSR 05-01-172, § 296-849-11090, filed 12/21/04, effective 3/1/05.]

WAC 296-849-120 Exposure and medical monitoring.

Summary:

Your responsibility:

To detect any significant changes in employee health and exposure monitoring results.

IMPORTANT:

These sections apply when employee exposure monitoring results are either:

- At or above the action level (AL) of 0.5 parts per million (ppm) for benzene;

OR

- Above either of the permissible exposure limits for benzene.

You must meet the requirements…	in this section:
Periodic exposure evaluations	WAC 296-849-12010
Medical evaluations	WAC 296-849-12030
Medical removal	WAC 296-849-12050
Medical records	WAC 296-849-12080

[Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, and 49.17.060. WSR 18-22-116, § 296-849-120, filed 11/6/18, effective 12/7/18; WSR 05-01-172, § 296-849-120, filed 12/21/04, effective 3/1/05.]

WAC 296-849-12010 Periodic exposure evaluations.

Exemption: Periodic exposure evaluations aren't required if exposure monitoring results conducted to fulfill requirements in Exposure evaluation, WAC 296-849-11030, are below the action level (AL) and short-term exposure limit (STEL).

You must obtain employee exposure monitoring results as specified in Table 3, by repeating Steps 3, 4, 6, and 7 of the exposure evaluation process found within this chapter, in Exposure evaluations, WAC 296-849-11030.

Note: If you document that one work shift consistently has higher exposure monitoring results than another for a particular operation, then you can limit sample collection to the work shift with higher exposures and use results to represent all employees performing the operation on other shifts.

Table 3
Periodic Exposure Evaluation Frequencies

If exposure monitoring results	Then
Are between the: – AL of 0.5 ppm **AND** – Eight-hour time-weighted average (TWA_8) of 1 ppm	Conduct additional exposure evaluations at least every twelve months for the employees represented by the monitoring results.
Are above the TWA_8	Conduct additional exposure evaluations at least every six months for the employees represented by the monitoring results.

If exposure monitoring results	Then
Have decreased to a concentration between the AL and TWA_8; **AND** The decrease is demonstrated by two consecutive exposure evaluations, made at least seven days apart.	You may **decrease** your evaluation frequency to every twelve months for employees represented by the monitoring results.
Are above the short-term exposure limit **(STEL)** of 5 ppm	Repeat as often as necessary to evaluate employee exposure.
Have decreased to below the AL and the STEL **AND** The decrease is demonstrated by two consecutive evaluations, made at least seven days apart.	You may **stop** periodic exposure evaluations for employees represented by the monitoring results.

[Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, and 49.17.060. WSR 18-22-116, § 296-849-12010, filed 11/6/18, effective 12/7/18; WSR 05-13-152, § 296-849-12010, filed 6/21/05, effective 8/1/05; WSR 05-01-172, § 296-849-12010, filed 12/21/04, effective 3/1/05.]

WAC 296-849-12030 Medical evaluations.

IMPORTANT:

Medical evaluations conducted under this section will satisfy the medical evaluation requirement found in Respirators, chapter 296-842 WAC.

(1) You must provide the relevant medical follow-up specified in Tables 4 and 5 to any employee exposed to benzene during an emergency.

(2) You must make medical evaluations available to current employees who meet the following criteria:

(a) Potential or actual exposure to benzene at or above the action level (AL) for at least thirty days in any twelve-month period.

(b) Potential or actual exposure to benzene at or above either permissible exposure limit (PEL) for at least ten days in a twelve-month period.

(c) Past exposure to concentrations above 10 ppm benzene for at least thirty days in a twelve-month period before November 11, 1988.

(d) Current or past work as a tire building machine operator using solvents containing more than 0.1% benzene during tire building operations.

(3) You must make medical evaluations available at no cost to employees; paying all costs, including travel costs and wages associated with any time spent outside of the employee's normal work hours;

(4) You must make medical evaluations available at reasonable times and places;

(5) You must make medical evaluations available by completing Steps 1 through 6 of the medical evaluation process for each employee covered.

Note:
- Employees who wear respirators need to be medically evaluated to make sure the respirator will not harm them, before they are assigned work in areas requiring respirators. Employees who decline to receive medical examination and testing to monitor for health effects caused by benzene are not excluded from receiving a separate medical evaluation for a respirator use.
- If employers discourage participation in medical monitoring for health effects caused by benzene, or in any way interfere with an employee's decision to continue with this program, this interference may represent unlawful discrimination under RCW 49.17.160, Discrimination against employee filing, instituting proceeding, or testifying prohibited—Procedure—Remedy.

Helpful tool:

Declination form for nonemergency related medical evaluations.

• You may use this optional form to document employee decisions to decline participation in the medical evaluation process for exposure to benzene.

Medical evaluation process:

Step 1: Identify employees who qualify, as stated above, for medical evaluations.

Step 2: Make medical evaluations available for employees identified in Step 1 at the following times:

• Initially, before the employee starts a job or task assignment where benzene exposure will occur.

• Every twelve months from the initial medical evaluation.

• Whenever the employee develops signs or symptoms commonly associated with toxic benzene exposure.

• After benzene exposure from an emergency.

Step 3: Select a licensed health care professional (LHCP) who will conduct or supervise medical evaluations and make sure:

• Individuals who conduct pulmonary function tests have completed a training course in spirometry sponsored by an appropriate governmental, academic, or professional institution, if they are not licensed physicians;

AND

• Your LHCP uses an accredited laboratory, such as one accredited by a nationally or state-recognized organization, to conduct laboratory tests.

Step 4: Make sure the LHCP receives all of the following before the medical evaluation is performed:

• A copy of this chapter.

• A description of the duties of the employee being evaluated and how these duties relate to benzene exposure.

• The anticipated or representative exposure monitoring results for the employee being evaluated.

• A description of the personal protective equipment (PPE) each employee being evaluated uses or will use.

• Information from previous employment-related examinations when this information is not available to the examining LHCP.

• Instructions that the written opinions the LHCP provides, be **limited to** the following information:

– Specific records, findings, or diagnosis relevant to the employee's ability to work around benzene.

– The occupationally relevant results from examinations and tests.

– A statement about whether or not medical conditions were found that would increase the employee's risk for impairment from exposure to benzene.

– Any recommended limitations for benzene exposure.

– Whether or not the employee can use respirators and any recommended limitations for respirator or other PPE use.

– A statement that the employee has been informed of medical results and medical conditions caused by benzene exposure requiring further explanation or treatment.

Step 5: Provide the medical evaluation to the employee. Make sure it includes the content listed in Table 4, Content of medical evaluations, and Table 5, Medical follow-up requirements.

Step 6: Obtain the LHCP's written opinion for each employee's medical evaluation and give a copy to the employee within fifteen days of the evaluation date.

• Make sure the written opinion is limited to the information specified for written opinions in Step 4.

Note: If the written opinion contains specific findings or diagnoses unrelated to occupational exposure, send it back and obtain a revised version without the additional information.

IMPORTANT:

These tables apply when conducting medical evaluations, including medical follow-up for employees exposed to benzene during emergencies.

Table 4
Content of Medical Evaluations

When conducting	Include
An initial evaluation	• A detailed history including: – Past work exposure to benzene or other hematological toxins; – Exposure to marrow toxins outside of current employment; – Exposure to ionizing radiation; – Family history of blood dyscrasias including hematological neoplasms; – History of blood dyscrasias including genetic hemoglobin abnormalities, bleeding abnormalities, and abnormal function of formed blood elements; – History of renal or liver dysfunction; – History of medications routinely taken. • A complete physical examination: – Include a pulmonary function test and specific evaluation of the cardiopulmonary system **if** the employee is required to use a respirator for at least thirty days a year. • A complete blood count including a: – Leukocyte count with differential; – Quantitative thrombocyte count;

When conducting	Include
	– Hematocrit; – Hemoglobin; – Erythrocyte count and indices (MCV, MCH, MCHC). • Additional tests the examining LHCP determines are necessary based on alterations in the components of the blood or other signs that may be related to benzene exposure. • **Medical follow-up as required in Table 5.**
Annual evaluations	• An updated medical history covering: – Any new exposure to potential marrow toxins; – Changes in medication use; – Any physical signs associated with blood disorders. • A complete blood count including a: – Leukocyte count with differential; – Quantitative thrombocyte count; – Hematocrit; – Hemoglobin; – Erythrocyte count and indices (MCV, MCH, MCHC). • Additional tests that the examining LHCP determines necessary, based on alterations in the components of the blood or other signs that may be related to benzene exposure. • A pulmonary function test and specific evaluation of the cardiopulmonary system every three years if the employee is required to use a respirator for at least thirty days a year. • **Medical follow-up as required in Table 5.**
Evaluations triggered by employee signs and symptoms commonly associated with the toxic effects of benzene exposure	• An additional medical examination that addresses elements the examining LHCP considers appropriate.

When conducting	Include
Evaluations triggered by employee exposure during an emergency	• A urinary phenol test performed on the exposed employee's urine sample within seventy-two hours of sample collection. – The urine sample must be collected at the end of the work shift associated with the emergency; – The urine specific gravity must be corrected to 1.024. • **Medical follow-up as required in Table 5.** **Reference:** Employees who are not covered by medical evaluation requirements in this chapter may be covered by medical evaluation requirements in other chapters such as Emergency response, chapter 296-824 WAC.

Table 5
Medical Follow-up Requirements

If	Then
• The **complete blood count test** result is normal.	• No further evaluation is required.
• The **complete blood count test** shows any of the following abnormal conditions: – A leukocyte count less than 4,000 per mm^3 or an abnormal differential count; **OR** – A thrombocyte (platelet) count that is either: ■ More than 20% below the employee's most recent values; **OR** ■ Outside the normal limit (95% C.I.) according to the laboratory;	• Repeat the complete blood count within two weeks: – If the abnormal condition persists, refer the employee to a hematologist or an internist for follow-up medical examination and evaluation, unless the LHCP has good reason to believe it is unnecessary; – The hematologist or internist will determine what follow-up tests are necessary; and • Follow the requirements found in Medical removal, WAC 296-849-12050.

If	Then
OR – The hematocrit or hemoglobin level is either of the following, and can not be explained by other medical reasons: ■ Below the normal limit (outside the 95% C.I.), as determined by the laboratory for the particular geographical area; **OR** ■ Persistently decreasing compared to the employee's preexposure levels.	
Results from the **urinary phenol test** conducted during an emergency evaluation show phenol levels less than 75 mg/L.	• No further evaluation is required.

If	Then
Results from the **urinary phenol test** conducted during an emergency evaluation show phenol levels equal or more than 75 mg/L.	• Provide a complete blood count monthly for three months. Include a: – Leukocyte count with differential; – Thrombocyte count; – Erythrocyte count; and • If any of the abnormal conditions previously listed in this table for complete blood count results are found: – Provide the employee with periodic examinations, if directed by the LHCP; and – **Refer the employee** to a hematologist or an internist for follow-up medical examination and evaluation unless the LHCP has good reason to believe a referral is unnecessary; and – Follow the requirements found in Medical removal, WAC 296-849-12050; and – The hematologist or internist will determine what follow-up tests are necessary.

[Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, and 49.17.060. WSR 18-22-116, § 296-849-12030, filed 11/6/18, effective 12/7/18; WSR 07-03-153, § 296-849-12030, filed 1/23/07, effective 6/1/07; WSR 05-13-152, § 296-849-12030, filed 6/21/05, effective 8/1/05; WSR 05-01-172, § 296-849-12030, filed 12/21/04, effective 3/1/05.]

WAC 296-849-12050 Medical removal.

IMPORTANT:

This section applies when an employee is referred to a hematologist or an internist for follow-up medical examination and evaluation required in Table 5, Medical follow-up requirements found in Medical evaluations, WAC 296-849-12030.

(1) You must remove the employee from areas where benzene exposure is above the action level (AL) by doing either of the following:

(a) Transfer the employee to a job currently available that:

(i) The employee qualifies for, or could be trained for in a short period of time;

AND

(ii) Will keep the employee's exposure to benzene as low as possible and never above the AL;

OR

(b) Remove the employee from the workplace until either:

(i) A job becomes available that:

■ The employee qualifies for, or could be trained for in a short period of time;

AND

■ Will keep the employee's exposure to benzene as low as possible and never above the AL;

OR

(ii) The employee is returned to work or permanently removed from benzene exposure as determined by completing the medical evaluation process for removed employees.

(2) You must maintain the employee's current pay rate, seniority, and other benefits.

Note: If you must provide medical removal benefits and the employee will receive compensation for lost pay from other sources, you may reduce your medical removal benefit obligation to offset the amount provided by these sources. Examples of other sources are:
• Public or employer-funded compensation programs;
• Employment by another employer, made possible by the employee's removal.

(3) You must complete Steps 1 through 4 of the medical evaluation process for removed employees, **within six months** of the date the licensed health care professional (LHCP) refers an employee to a hematologist or internist for follow-up.

(a) Make sure all examinations and evaluations are provided at no cost to the employee.

(b) Make examinations and evaluations available at reasonable times and places;

AND

(c) Pay for travel costs and wages, including any time spent outside of the employee's normal work hours.

Medical evaluation process for removed employees:

Step 1: Make sure the following is provided to the hematologist or internist:

• The information you provided to the LHCP in Step 4 of Medical evaluations, WAC 296-849-12030;

• The employee's medical record as described in Medical records, WAC 296-849-12080.

Note: The examining LHCP may provide this information for you.

Step 2: Provide the employee an examination and evaluation by a hematologist or internist.

• When the examination and evaluation is completed, you and the employee must be informed, in writing, of the referring LHCP's decision to continue **or** end the employee's removal from benzene exposure.

• Include the following in the LHCP's decision if removal of the employee continues:

– The expected time period for removal to continue;

AND

– Requirements for future medical examinations to review the decision.

• If the LHCP recommends the employee **end removal** and return to the usual job with benzene exposure, **skip Steps 3 and 4.**

Step 3: Provide further medical examination and evaluation to the employee when the LHCP's decision from Step 2 informs you that medical removal must continue.

Note: • During this step the LHCP, in consultation with the hematologist or internist, decides whether the employee:
– May return to their usual job;
OR
– Should be permanently removed from exposures that exceed the AL.
• If the LHCP recommends the employee return to their usual job, skip Step 4.

Step 4: When the LHCP recommends permanent removal for the employee, make sure all the following conditions are met:

• The employee has an opportunity to transfer to another job that is currently available (or will become available);

• The job is one the employee qualifies for, or could be trained for in a short period of time;

• There is no reduction in the employee's current pay rate, seniority, and other benefits;

• The employee's benzene exposures will be as low as possible, but never more than the AL.

[Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, and 49.17.060. WSR 18-22-116, § 296-849-12050, filed 11/6/18, effective 12/7/18; WSR 05-01-172, § 296-849-12050, filed 12/21/04, effective 3/1/05.]

WAC 296-849-12080 Medical records.

IMPORTANT:

This section applies when a medical evaluation is performed, or any time a medical record is created for an employee exposed to benzene.

(1) You must establish and maintain complete and accurate medical records for each employee receiving a medical evaluation and make sure the records include **all** the following:

(a) The employee's name and Social Security number, or other unique identifier;

(b) A copy of the licensed health care professional's (LHCP's) written opinions including written decisions and recommendations for the employee removed from exposure;

(c) A copy of the information required in Step 4 of the medical evaluation process, found in WAC 296-849-12030, **except** for the copy of this chapter and the appendices listed.

(2) You must maintain medical evaluation records for the duration of employment plus thirty years.

Note: Your medical provider may keep these records for you. Other medical records such as an employee's medical history, need to be kept as a confidential record by the medical provider and accessed only with the employee's consent.

Reference: To see additional employee medical record requirements, including access and transfer requirements, go to another chapter, Employee medical and exposure records, chapter 296-802 WAC.

[Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, and 49.17.060. WSR 18-22-116, § 296-849-12080, filed 11/6/18, effective 12/7/18; WSR 05-01-172, § 296-849-12080, filed 12/21/04, effective 3/1/05.]

WAC 296-849-130 Rules for exposure control areas.

Summary:

Your responsibility:

To protect employees from exposure to benzene by using feasible exposure controls and appropriate respirators.

IMPORTANT:

These sections apply when existing or potential employee exposure monitoring results are above either of the following permissible exposure limits (PELs):

• The eight-hour time-weighted average (TWA_8) of 1 part per million (ppm);

OR

• The fifteen-minute short-term exposure limit (STEL) of 5 ppm.

You must meet the requirements…	in this section:
Exposure control plan	WAC 296-849-13005
Exposure controls	WAC 296-849-13020
Respirators	WAC 296-849-13045

[Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, and 49.17.060. WSR 18-22-116, § 296-849-130, filed 11/6/18, effective 12/7/18; WSR 05-01-172, § 296-849-130, filed 12/21/04, effective 3/1/05.]

WAC 296-849-13005 Exposure control plan.

Exemption: This section does not apply to the cleaning and repair of barges and tankers that contained benzene.

(1) You must establish and implement a written exposure control plan for exposure control areas that include a schedule for developing and implementing feasible exposure controls to reduce benzene exposure to, or below, the PELs.

Note: Respirators and other personal protective equipment (PPE) help protect employees from exposures, but are **not** substitutes for feasible exposure controls.

(2) You must review and update your exposure control plan as needed, based on the most recent exposure evaluation results.

(3) You must provide a copy of your exposure control plan to affected employees and their designated representatives when they ask to review or copy it.

[Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, and 49.17.060. WSR 18-22-116, § 296-849-13005, filed 11/6/18, effective 12/7/18; WSR 07-05-062, § 296-849-13005, filed 2/20/07, effective 4/1/07; WSR 05-01-172, § 296-849-13005, filed 12/21/04, effective 3/1/05.]

WAC 296-849-13020 Exposure controls.

IMPORTANT:

Respirators and other personal protective equipment (PPE) do **not** substitute for feasible exposure controls.

You must use feasible exposure controls to reduce exposures, as specified in Table 6.

Table 6
Exposure Control Requirements

If:	Then you must use feasible controls to:
You have operations where employees clean and repair barges or tankers which have contained benzene	Keep all employee exposure concentrations below 10 parts per million (ppm).
You can document that benzene is used for less than thirty days a year in the workplace	Reduce eight-hour employee exposure monitoring results to a time-weighted average of 10 ppm or less. **Note:** If employee exposure monitoring results are between 1 and 10 ppm, you are permitted to use respirators or a combination of respirators and feasible controls to protect employees.
Employees are exposed to benzene above a PEL for at least thirty days a year	Reduce eight-hour employee exposure concentrations to the TWA_8 of 1 ppm or less; **AND** Reduce fifteen-minute employee exposure concentrations to the STEL of 5 ppm or less.

[Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, and 49.17.060. WSR 18-22-116, § 296-849-13020, filed 11/6/18, effective 12/7/18; WSR 07-05-062, § 296-849-13020, filed 2/20/07, effective 4/1/07; WSR 05-01-172, § 296-849-13020, filed 12/21/04, effective 3/1/05.]

WAC 296-849-13045 Respirators.

IMPORTANT:

These requirements are in addition to the requirements found in other chapters:

- Airborne contaminants, chapter 296-841 WAC;
- Respirators, chapter 296-842 WAC.

(1) You must provide each employee with an appropriate respirator that complies with the requirements of this section, and require that employees use them in circumstances where exposure is above either permissible exposure limit (PEL) for benzene, including any of the following circumstances:

(a) Employees are in an exposure control area;

(b) Feasible exposure controls are being put in place;

(c) Where you determine that exposure controls are not feasible;

(d) Feasible exposure controls do not reduce exposures to, or below, a PEL;

(e) Emergencies.

(2) You must provide employees, for escape, either:

(a) Any full-facepiece organic vapor gas mask;

OR

(b) Any full-facepiece self-contained breathing apparatus (SCBA);

OR

(c) A hood-style SCBA that operates in positive-pressure mode.

(3) You must use organic vapor cartridges or canisters on powered air-purifying respirators (PAPRs) and negative-pressure air-purifying respirators.

(4) You must use only chin-style canisters on full-facepiece gas masks.

Note: When other contaminants present a hazard, then you will need to use a filter or other combination sorbent cartridge that removes the additional contaminants.

(5) You must make sure respirator cartridges or canisters are replaced at the beginning of each work shift, or sooner if their service life has expired.

(6) You must make sure canisters on air-purifying respirators have a minimum service life of four hours when tested under these conditions:

(a) A benzene concentration of 150 ppm;

(b) A temperature of 25°C;

(c) A relative humidity of 85%;

(d) A flow rate of one of the following:

(i) 64 liters per minute (lpm) for nonpowered air-purifying respirators;

(ii) 115 lpm for **tight-**fitting PAPRs;

(iii) 170 lpm for **loose-**fitting PAPRs.

(7) You must provide an employee a respirator with low breathing resistance, such as a PAPR or an air-line respirator when the:

(a) Employee cannot use a negative-pressure respirator;

OR

(b) A licensed health care professional's (LHCP's) written opinion allows this type of respirator.

[Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, and 49.17.060. WSR 18-22-116, § 296-849-13045, filed 11/6/18, effective 12/7/18; WSR 09-15-145, § 296-849-13045, filed 7/21/09, effective 9/1/09; WSR 07-05-072, § 296-849-13045, filed 2/20/07, effective 4/1/07; WSR 05-13-152, § 296-849-13045, filed 6/21/05, effective 8/1/05; WSR 05-01-172, § 296-849-13045, filed 12/21/04, effective 3/1/05.]

WAC 296-849-60010 Health information about benzene. (1) You must include an explanation of the contents of this section to employees as required in Training, WAC 296-849-11050.

(2) You must provide a copy of this section to the licensed health care professional (LHCP) as required in Step 4 of the medical evaluation process found in Medical evaluations, WAC 296-849-12030.

Table 7
General Health Information About Benzene

What is benzene?
Benzene is a clear, colorless liquid with a pleasant, sweet odor. It evaporates into air very quickly. The odor of benzene does not provide adequate warning of its hazard. In this chapter, "benzene " means:

- Liquid benzene, benzene vapor, and benzene in liquid mixtures and the vapor released by these liquids. The CAS Registry Number that identifies benzene is 71-43-2.

Synonyms for benzene include: Benzol, benzole, coal naphtha, cyclohexatriene, phenyl hydride, pyrobenzol.

Benzin, petroleum benzin, and benzine are chemicals that do **not** contain benzene.

How am I exposed to benzene?

Benzene exposure occurs when you:

- Breath in **(inhale)** vapor or liquid particles (from actions such as spraying or splashing) containing benzene;
- Have skin or eye contact with liquid or vapor containing benzene. Benzene is absorbed through the skin. Absorption occurs more rapidly with abraded skin or when benzene is present in solvents (as an ingredient or contaminant) which are readily absorbed;
- Swallow **(ingest)** benzene.

What happens after I'm exposed to benzene?

Some benzene that enters your body will be absorbed into the bloodstream. Once in the bloodstream, benzene travels throughout your body and can be temporarily stored in the bone marrow and fat.

Benzene is converted to products, called metabolites, in the liver and bone marrow. Some of the harmful effects of benzene exposure are caused by these metabolites.

Most of the metabolites of benzene leave the body in the urine within 48 hours after exposure.

Why is medical monitoring necessary?

Medical monitoring is necessary to detect changes in your body's blood-forming system, including the bone marrow. These changes can occur due to repeated or prolonged, unprotected exposure to benzene, even at relatively low concentrations. Such changes can lead to various blood disorders, ranging from anemia to **leukemia,** an irreversible, fatal disease. Many of these disorders may occur without symptoms.

Benzene is classified as a confirmed **human carcinogen** (Group 1) by the International Agency for Research on Cancer (IARC).

To learn more about the medical monitoring process, see Medical evaluation, WAC 296-849-12030.

What health effects are linked to benzene exposure?

Unprotected exposure to benzene is associated with various health effects including symptoms and diseases associated with either short-term **(acute)** exposure or long-term exposure **(chronic).**

Acute effects from inhaling high vapor concentrations:

An **initial** stimulatory effect on the central nervous system (brain and spinal cord) can occur, characterized by exhilaration, nervous excitation (irritability), and/or giddiness. This may be followed by a period of depression, drowsiness, or fatigue.

Headache, dizziness, nausea, or a feeling of intoxication may develop.

A sensation of tightness in the chest may occur, accompanied by breathlessness. Ultimately the victim may lose consciousness.

In severe inhalation cases, tremors, convulsions, and death may follow due to respiratory paralysis or circulatory collapse in a few minutes to several hours.

Acute effects from inhaling liquid benzene:

Aspiration of small amounts of liquid benzene immediately causes pulmonary edema (excessive accumulation of fluid in lung tissues) and hemorrhage of pulmonary tissue.

Skin contact:

Direct contact may cause redness (erythema).

Benzene has a defatting action on skin. Repeated or prolonged contact may result in any of the following:

- Primary irritation;
- Dry skin;
- Scaling dermatitis (inflammation);
- Development of secondary skin infections.

Effects on the eyes and mucous membranes:

Localized effects from vapor or liquid contact on the eye are slight. High concentrations of benzene are irritating to eyes (causing a stinging sensation) and mucous membranes of the nose and respiratory tract.

Effects due to prolonged exposure:

The blood forming (hematopoietic) system is the main target for benzene's toxic effects. These effects can vary from anemia to **leukemia,** an irreversible, fatal disease. Many of the toxic effects may occur without symptoms.

Most importantly, prolonged exposure to **small** quantities of benzene vapor is damaging to the blood forming system. This damage has occurred at concentrations of benzene that may not cause irritation of mucous membranes or unpleasant sensory effects.

Early signs and symptoms are varied and often not readily noticed and nonspecific. These include:

- Subjective complaints of headache, dizziness, and loss of appetite may precede or follow clinical signs;
- Rapid pulse and low blood pressure, in addition to a physical appearance of anemia, may accompany a subjective complaint of shortness of breath and excessive tiredness.

Other symptoms may occur as the condition progresses:

- Bleeding from the nose, gums, or mucous membranes;

  AND

- Development of purpuric spots (small bruises).

[Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, and 49.17.060. WSR 18-22-116, § 296-849-60010, filed 11/6/18, effective 12/7/18; WSR 07-03-153, § 296-849-60010, filed 1/23/07, effective 6/1/07.]

WAC 296-849-60020 Medical guidelines for benzene. (1) You must include an explanation of the contents of this section to employees as required in Training, WAC 296-849-11050.

(2) You must provide a copy of this section to the licensed health care professional (LHCP) as required in Step 4 of the medical evaluation process found in Medical evaluations, WAC 296-849-12030.

Table 8
Medical Guidelines For Evaluating Employees Exposed to Benzene

Part 1: Becoming familiar with medical requirements in this chapter
In addition to requiring employers to train employees and protect them from exposure to benzene, this chapter (the Benzene rule) requires employers to monitor their employees' health with assistance from licensed health care professionals (LHCPs). • For employees who will use respirators, the LHCP will also need to provide the employer with a written medical opinion clearing the employee for workplace respirator use. These guidelines were designed to support an informed partnership between the LHCP and the employer when monitoring the health of employees exposed to benzene. The employer initiates this partnership by providing the LHCP with a copy of the chapter and other supporting information about the employee and job conditions. The LHCP can then become familiar with the medical monitoring requirements found in WAC 296-849-12030 through 296-849-12080, which address: • Frequency and content for routine (initial and periodic) medical examinations and consultations; • Emergency and other unplanned medical follow-up; • Medical opinions; • Employee medical removal; • Medical records retention and content.
Part 2: Benzene toxicology
Benzene is primarily an inhalation hazard. Systematic absorption may cause depression of the hematopoietic system, pancytopenia, aplastic anemia, and leukemia. Clinical evidence of leukopenia, anemia, and thrombocytopenia, singly or in combination, has been frequently reported among the first signs. **Health information about benzene, WAC 296-848-50010,** provides **basic information** about the health effects and symptoms associated with benzene exposure. **Reference:** • Other sources for toxicology information include: – ToxFAQs™ and the Toxicological Profile for Benzene. This free document is available from the Agency for Toxic Substances and Disease Registry (ATSDR) and can be obtained by: ■ Visiting http://www.atsdr.cdc.gov/toxprofiles OR ■ Calling 1-888-422-8737

- A variety of technical resources on benzene from the National Institutes for Occupational Safety and Health (NIOSH) by visiting http://www.cdc.niosh/topics/chemicals.html

Part 3: Treatment of acute toxic effects

When providing assistance to someone contaminated with benzene, make sure **you** are adequately protected and do not risk being overcome by benzene vapor.

Remove the patient from exposure immediately.

Give oxygen or artificial resuscitation, if indicated.

Flush eyes, wash skin if contaminated and remove all contaminated clothing.

Recovery from mild exposures is usually rapid and complete. Symptoms of intoxication may persist following severe exposures.

Part 4: Preventive considerations

The principal effects of benzene exposure which form the basis for the requirements in this chapter are pathological changes in the hematopoietic system, reflected by changes in the peripheral blood and manifesting clinically as pancytopenia, aplastic anemia, and leukemia.

Consequently, the medical monitoring program is designed to observe, on a regular basis, blood indices for early signs of these effects, and although early signs of leukemia are not usually available, emerging diagnostic technology and innovative regimes make consistent surveillance for leukemia, as well as other hematopoietic effects, essential.

Symptoms and signs of benzene toxicity can be nonspecific. Only a detailed history and appropriate investigative procedure will enable a physician to rule out or confirm conditions that place the employee at increased risk.

Bone marrow may appear normal, aplastic, or hyperplastic, and may not, in all situations, correlate with peripheral blood forming tissues. Because of variations in the susceptibility to benzene morbidity, there is no "typical" blood picture.

The onset of effects of prolonged benzene exposure may be delayed for many months or years after the actual exposure has ceased and identification or correlation with benzene exposure must be sought out in the occupational history.

There are special provisions for medical tests in the event of hematologic abnormalities or for emergency situations.

- This chapter specifies that blood abnormalities that persist must be referred "unless the physician has good reason to believe such referral is unnecessary." Examples of conditions that could make a referral unnecessary despite abnormal blood limits are iron or folate deficiency, menorrhagia, or blood loss due to some unrelated medical abnormality.
- Blood values that require referral to a hematologist or internist are noted under Part 5: Hematology guidelines.

Part 5: Hematology guidelines

The following guidelines are established to assist the examining LHCP with regard to which laboratory tests are necessary and when to refer an employee to the specialist. A minimum battery of tests is to be performed using strictly standardized methods.

Basic tests

- The following must be determined by an accredited laboratory:
  - Red and white cell counts;
  - Platelet counts;
  - White blood cell differential;
  - Hematocrit;
  - Red cell indices.
- The normal ranges for the red cell and white cell counts are influenced by altitude, race, and sex, and therefore should be determined by the accredited laboratory in the specific area where the tests are performed.
- Either a decline from an absolute normal or an individual's baseline to a subnormal value or a rise to a supra-normal value, are indicative of potential toxicity, particularly if all blood parameters decline.
  - The normal total white blood count is approximately 7,200/mm^3 plus or minus 3,000;
  - For cigarette smokers the white count may be higher and the upper range may be 2,000 cells higher than normal for the laboratory;
  - In addition, infection, allergies and some drugs may raise the white cell count;
  - The normal platelet count is approximately 250,000 with a range of 140,000 to 400,000. Counts outside this range should be regarded as possible evidence of benzene toxicity.
- Certain abnormalities found through routine screening are of greater significance in the benzene-exposed worker and **require prompt consultation with a specialist,** namely:
  - Thrombocytopenia;
  - A trend of decreasing white cell, red cell, or platelet indices in an individual over time is more worrisome than an isolated abnormal finding at one test time. The importance of trend highlights the need to compare an individual's test results to baseline and/or previous periodic tests;
  - A constellation or pattern of abnormalities in the different blood indices is of more significance than a single abnormality. A low white count not associated with any abnormalities in other cell indices may be a normal statistical variation, whereas if the low white count is accompanied by decreases in the platelet and/or red cell indices, such a pattern is more likely to be associated with benzene toxicity and merits thorough investigation;

- Anemia, leukopenia, macrocytosis or an abnormal differential white blood cell count should alert the physician to further investigate and/or refer the patient if repeat tests confirm the abnormalities. If routine screening detects an abnormality, follow-up tests which may be helpful in establishing the etiology of the abnormality are the peripheral blood smear and the reticulocyte count;
- The extreme range of normal for reticulocytes is 0.4 to 2.5 percent of the red cells, the usual range being 0.5 to 1.2 percent of the red cells, but the typical value is in the range of 0.8 to 1.0 percent;
- A decline in reticulocytes to levels of less than 0.4 percent is to be regarded as possible evidence (unless another specific cause is found) of benzene toxicity requiring accelerated surveillance. An increase in reticulocyte levels to about 2.5 percent may also be consistent with (but is not as characteristic of) benzene toxicity.

Additional tests

1. Peripheral blood smears:

- Collecting the sample: As with reticulocyte count, the smear should be with fresh uncoagulated blood obtained from a needle tip following venipuncture or from a drop of earlobe blood (capillary blood). If necessary, the smear may, under certain limited conditions, be made from a blood sample anticoagulated with EDTA (but never with oxalate or heparin).
- Prepping the smear: When the smear is to be prepared from a specimen of venous blood which has been collected by a commercial Vacutainer type tube containing neutral EDTA, the smear should be made as soon as possible after the venesection. A delay of up to twelve hours is permissible between the drawing of the blood specimen into EDTA and the preparation of the smear if the blood is stored at refrigerator (not freezing) temperature.
- Minimum mandatory observations:
  - The differential white blood cell count;
  - Description of abnormalities in the appearance of red cells;
  - Description of any abnormalities in the platelets;
  - A careful search must be made throughout of every blood smear for immature white cells such as band forms (in more than normal proportion, i.e., over 10 percent of the total differential count), any number of metamyelocytes, myelocytes, or myeloblasts. Any nucleate or multinucleated red blood cells should be reported. Large "giant" platelets or fragments of megakaryocytes must be recognized;

- An increase in the proportion of band forms among the neutrophilic granulocytes is an abnormality deserving special mention, for it may represent a change which should be considered as an early warning of benzene toxicity in the absence of other causative factors (most commonly infection). Likewise, the appearance of metamyelocytes, in the absence of another probable cause, is to be considered a possible indication of benzene-induced toxicity;
- An upward trend in the number of basophils, which normally do not exceed about 2.0 percent of the total white cells, is to be regarded as possible evidence of benzene toxicity. A rise in the eosinophil count is less specific but also may be suspicious of toxicity if it rises above 6.0 percent of the total white count;
- The normal range of monocytes is from 2.0 to 8.0 percent of the total white count with an average of about 5.0 percent. About 20 percent of individuals reported to have mild but persisting abnormalities caused by exposure to benzene show a persistent monocytosis. The findings of a monocyte count which persists at more than 10 to 12 percent of the normal white cell count (when the total count is normal) or persistence of an absolute monocyte count in excess of 800/mm^3 should be regarded as a possible sign of benzene-induced toxicity;
- A less frequent but more serious indication of benzene toxicity is the finding in the peripheral blood of the so-called "pseudo" (or acquired) Pelger-Huet anomaly. In this anomaly many, or sometimes the majority, of the neutrophilic granulocytes possess two round nuclear segments - less often one or three round segments - rather than three normally elongated segments. When this anomaly is not hereditary, it is often but not invariably predictive of subsequent leukemia. However, only about two percent of patients who ultimately develop acute myelogenous leukemia show the acquired Pelger-Huet anomaly. Other tests that can be administered to investigate blood abnormalities are discussed below; however, such procedures should be undertaken by the hematologist.

2. Sucrose water test and Ham test:

- An uncommon sign, which cannot be detected from the smear, but can be elicited by a "sucrose water test" of peripheral blood, is transient paroxysmal nocturnal hemoglobinuria (PNH), which may first occur insidiously during a period of established aplastic anemia, and may be followed within one to a few years by the appearance of rapidly fatal acute myelogenous leukemia. Clinical detection of PNH, which occurs in only one or two percent of those destined to have acute myelogenous leukemia, may be difficult; if the "sucrose water test" is positive, the somewhat more definitive Ham test, also known as the acid-serum hemolysis test, may provide confirmation.

Important clinical findings

1. Individuals documented to have developed acute myelogenous leukemia years after initial exposure to benzene may have progressed through a preliminary phase of hematologic abnormality. In some instances pancytopenia (i.e., a lowering in the counts of all circulating blood cells of bone marrow origin, but not to the extent implied by the term "aplastic anemia") preceded leukemia for many years.

- Depression of a single blood cell type or platelets may represent a harbinger of aplasia or leukemia. The finding of two or more cytopenias, or pancytopenia in a benzene-exposed individual, must be regarded as highly suspicious of more advanced although still reversible, toxicity.
- "Pancytopenia" coupled with the appearance of immature cells (myelocytes, myeloblasts, erythroblasts, etc.), with abnormal cells (pseudo Pelger-Huet anomaly, atypical nuclear heterochromatin, etc.), or unexplained elevations of white blood cells must be regarded as evidence of benzene overexposure unless proved otherwise.
- Many severely aplastic patients manifested the ominous findings of:
  - 5 to 10 % myeloblasts in the marrow;
  - Occasional myeloblasts and myelocytes in the blood;
  - 20 to 30 monocytes.
- It is evident that isolated cytopenias, pancytopenias, and even aplastic anemias induced by benzene may be reversible and complete recovery has been reported on cessation of exposure. However, since any of these abnormalities is serious, the employee must immediately be removed from any possible exposure to benzene vapor.
  - Certain tests may substantiate the employee's prospects for progression or regression. One such test would be an examination of the bone marrow, but the decision to perform a bone marrow aspiration or needle biopsy is made by the hematologist.

2. The findings of basophilic stippling in circulating red blood cells (usually found in one to five percent of red cells following marrow injury), and detection in the bone marrow of what are termed "ringed sideroblasts" must be taken seriously, as they have been noted in recent years to be premonitory signs of subsequent leukemia.

3. Recently peroxidase-staining of circulating or marrow neutrophil granulocytes, employing benzidine dihydrochloride, have revealed the disappearance of, or diminution in, peroxidase in a sizable proportion of the granulocytes, and this has been reported as an early sign of leukemia. However, relatively few patients have been studied to date. Granulocyte granules are normally strongly peroxidase positive. A steady decline in leukocyte alkaline phosphatase has also been reported as suggestive of early acute leukemia.

- Peroxidase and alkaline phosphatase staining are usually undertaken when the index of suspicion for leukemia is high.

4. Exposure to benzene may cause an early rise in serum iron, often but not always associated with a fall in the reticulocyte count. Thus, serial measurements of serum iron levels may provide a means of determining whether or not there is a trend representing sustained suppression of erythropoiesis.

5. Measurement of serum iron, determination of peroxidase and of alkaline phosphatase activity in peripheral granulocytes can be performed in most pathology laboratories.

[Statutory Authority: RCW 49.17.010, 49.17.040, 49.17.050, and 49.17.060. WSR 18-22-116, § 296-849-60020, filed 11/6/18, effective 12/7/18; WSR 07-03-153, § 296-849-60020, filed 1/23/07, effective 6/1/07.]