Document Number: **RHS00009**	**Benzene Standard**	**Facility:** **Base Plant, In Situ, Major Projects, Fort Hill and East Tank Farm**
Revision Date: **2023/01/23** Revision: **2** Review Cycle: **3**	Document Owner (Title): **Director RMWB EH&S Integration**	

Purpose

This standard aims to prevent adverse health effects from overexposure to benzene.

This Standard also fulfills legislative requirements:

- Alberta – Benzene Code of Practice (AB OH&S Code, Part 4)

Scope

This document applies to work performed at Suncor-operated sites in the Regional Operations – Upstream area including Base Plant, In Situ, Major Projects, Fort Hills, and East Tank Farm. It applies to all Suncor employees, contractors, vendors, and visitors hereafter referred to as personnel, with potential exposure to benzene.

Terms, Definitions and Acronyms

The following terms, definitions and acronyms are used in this standard:

AB OH&S	Alberta Occupational Health and Safety
ACGIH	American Conference of Governmental Industrial Hygienists
AIHA	American Industrial Hygiene Association
CSST	Commission de la Santé et de la Sécurité du Travail
IARC	International Agency for Research on Cancer
IDLH	IDLH (Immediately Dangerous to Life and Health)
NIOSH	National Institute for Occupational Safety and Health
OEL	Occupational Exposure Limit
OVC	Organic Vapor Cartridges
RPE	Respiratory Protective Equipment

Roles and Responsibilities

The following individuals and groups have the following roles and responsibilities:

Document Owner

- Ensures that Suncor Industrial/Occupational Hygiene reviews this document according to the required revision cycle.
- Ensures the document is updated to accommodate Suncor, provincial, and federal regulations changes.
- Ensures the document is updated to mitigate risks identified during incident investigations.

Document Approver

- Ensures this standard is necessary and that it aligns with management and company direction.

Supervisors

- Is familiar and trained in dealing with benzene hazards
- Is aware of concerns regarding area equipment and machinery for the potential presence of benzene and aware of area restrictions and personal protective equipment requirements for the area.
- Ensure that benzene areas have been identified and that workers with potential for exposure have been informed of the possible hazards and instructed on proper handling procedures.
- Ensure adequate steps have been taken to identify, control or eliminate benzene hazards and environmental contamination.
- Obtain appropriate permits and authorizations for benzene containing vessels or processes.
- Ensure that workers with potential exposure to benzene receive fit-testing for air purifying respirators or air supplied equipment. Moreover, they receive training in the proper use and limitations of such respirators as per Respiratory Protection Standard RHS00036.

Employees

- Understand and follow this Standard whenever the benzene level inside a vessel or equipment or an area exceeds 50% of the OEL,
- Use personal protective equipment, engineering controls and adhering to administrative work practices as instructed.
- Inform the Job Supervisor and leave the restricted work area immediately if problems develop with their RPE or in the event of an emergency.
- Report any infractions of this Standard immediately to their supervisor or designate.

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Continued - ***Roles and Responsibilities***

Industrial Hygiene	• Conduct benzene hazard evaluations, airborne sampling when required, and assist supervision in identifying at-risk tasks. • Record results of personal benzene assessments in Medgate (Cority) or other Industrial Hygiene databases. • Assist business unit representatives with developing job-specific procedures and provide technical guidance on benzene management. • Review this procedure according to the revision recycle and update it whenever changes occur and impact it.
Maintenance	Shall coordinate the transfer of all benzene waste (including used containers, etc.) to the Hazardous Waste Yard or other disposal location in consultation with the Suncor Environmental Advisor - Waste Specialist.
Health & Wellness	Shall conduct a baseline health assessment (including fit testing), followed by a subsequent evaluation for Suncor employees exposed to benzene every 2 years.

Standard

1. Technical Information

Item	Description
1.1	Effective controls to mitigate potential adverse health effects from benzene exposure must be identified, implemented, and communicated prior to activities commencing where benzene is or may be present or handled. Handling, storing, and disposing of benzene waste shall be performed in compliance with applicable regulations and in a manner that minimizes any impact to the environment.
1.2	Hydrocarbon storage facilities and other operations that involve crude oil or fuels may release benzene and other hydrocarbons. A small amount of benzene, usually less than 1 percent by weight (10,000 ppm) is present in gasoline sold in North America. Laboratories still use benzene for its solvent and reagent properties. Crude oil and natural gas condensate contain benzene.
1.3	Upgrading, Extraction, Tailings, and In Situ are business units where benzene is present. Suncor Operations Laboratories also carry benzene.
1.4	The product, intermediate and process streams at Suncor-operated sites in the Regional Operations – Upstream area including Base Plant, In Situ, Major Projects, Fort Hills, and East Tank Farm, which contain benzene include the treated Naphtha product, distillate untreated naphtha and diluted bitumen, diluted bitumen blend, south tank farm slops, fuel gas, natural gas, and gasoline in fuel stations. The concentrations of benzene in the product, intermediate and process streams is in the range of less than 0.1% to 2.5%.
1.5	Benzene, toluene, ethyl benzene and xylene (BTEX) aromatic compounds are normally found as liquids in gas condensates and crude oil streams. Normally, condensate is stored and transported in a closed system of vessels lines and pumps, but workers can be exposed when those systems are opened for maintenance.
1.6	Benzene's CAS number is 71-43-2 and its chemical formula is C6H6. The odour threshold for benzene can vary between 0.78 parts of benzene per million parts of air (ppm) to 160 ppm depending on the individual. The CSST has determined benzene's average odour threshold to be 2 ppm while the ACGIH indicates that it is closer to 12 ppm. Benzene is flammable with a flashpoint of -11°C. Its explosive limit in air ranges from 1.3% to 7.1% by volume.
1.7	Suncor-operated sites in the Regional Operations – Upstream area including Base Plant, In Situ, Major Projects, Fort Hills, and East Tank Farm have no process streams which are pure benzene. However, all other process streams (excluding fresh water and heating fluids) should be considered to have some amount of benzene. The following table lists the typical sources of benzene at Suncor-operated sites in the Regional Operations – Upstream area including Base Plant, In Situ, Major Projects, Fort Hills, and East Tank Farm. facilities.

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Item	Description

1.8 **Table 1: Typical operations where benzene might be present**

Operation	Typical Source of Benzene
Conventional Oil and Natural Gas	Oil, hydrocarbon condensate, condensate storage tanks, flare stacks, chemical injection and maintenance operations (i.e., filter change-outs, tank or vessel cleaning, etc.).
Heavy Oil	Oil storage tanks, sand storage pits, flare stacks, chemical injection and maintenance operations (i.e., filter change-outs, tank cleaning and sampling).
Oil Sands	Extraction Plant 4, Plant 16 NRU, Plant 87, Tailings Ponds Upgrading Plants 5/25/52/57 DRUs, Plant 52 dehexanizer GRU, Plants 7/55/64 NHTs, Plant 20 and 21 (sampling and maintenances at tank farm), Industrial drainage (API), Laboratory, flare stacks, chemical injection and maintenance operations (i.e., filter change-outs, tank cleaning).
In Situ	Water treatment, maintenance & operations (i.e., filter change-outs, tank or vessel cleaning, collecting samples and maintaining centrifuge, etc.).
Lab	Hydrocarbon solvent used in the lab analysis process and products, intermediate and process samples from operations (using solvent and analyzing the samples)
Pipelines	Oil and gas storage, pumping and compressor stations, pigging operations, and tank cleaning.

2. Health Effects

Item	Description

2.1 Exposure to benzene can impact the respiratory system as well as the skin and eyes, central nervous system, and blood system.

2.2 Short Term

- Short-term exposures may irritate the nose and throat, and result in dizziness, drowsiness, loss of appetite and headaches.
- Repeated skin contact defats the skin and subcutaneous tissue, and repeated contact irritates the eyes.

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Item	Description
2.3	Long Term • Benzene is a known human carcinogen. • Long term inhalation and skin exposure has been shown to cause several effects related to blood-forming cells in the bone marrow, which may take many years to become apparent. These effects include decreased number in functional red blood cells (anemia) and white blood cell cancer (leukemia). Although there is not enough information to fully understand how benzene causes these cancers, there is sufficient evidence of carcinogenicity in some individuals with long-term exposures greater than current OELs (0.5 ppm for an 8-hour shift). • Studies of workers have shown that the damage to the blood system can occur with exposure to benzene at concentrations of 30 ppm to 120 ppm over 3 months to 7 years. • Benzene is also known to be a human mutagen. When found in a human mother's milk, it can cross the blood-placental barrier. Reproductive (teratogenic) effects occur in many animal studies.

3. Benzene Occupational Exposure Limit (OEL)

Item	Description
3.1	Exposure to benzene can impact the respiratory, skin and eyes, central nervous system, and blood system. Suncor Energy uses the following for benzene: • an Occupational Exposure Limit (OEL) of 0.5 ppm for an 8-hour shift, • an Occupational Exposure Limit (OEL) of 0.25 ppm for an 12-hour shift and, • a Short-Term Exposure Limit (STEL) of 2.5 ppm for 15-minutes.

4.Regulatory Requirements and Standards

Item	Description
4.1	The following are the applicable regulatory requirements and standards for benzene in Alberta as listed in Schedule 1 of the Alberta OHS Code:
4.2	**Section 16:** (1) An employer must ensure that a worker's exposure to any substance listed in Schedule 1, Table 2 is kept as low as reasonably achievable, and (2) does not exceed its occupational exposure limit (OEL). Refer to the occupational exposure limits (OELs) for details.

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Item	Description
4.3	**Section 26.1 and Schedule 1, Table 2** identifies benzene as a substance requiring a written code of practice to cover the storage, handling, use, and disposal of benzene-containing streams and waste when it is present at a work site: • as a pure substance in an amount exceeding 10 kg., or • in a mixture in which the amount of the substance is more than 10 kg and at a concentration of 0.1 percent by weight or more. There is no regulatory requirement for workers exposed to benzene in Alberta to have a health assessment.

5. Evaluation

Item	Description
5.1	**Real Time Detection** Benzene detection systems (direct reading or pull tubes) should be available in operational areas for use by operators where a benzene hazard exists over the OEL. At Suncor, the benzene levels have been monitored over the years. Benzene levels have been detected over the OEL in Firebag and at some base plant vessels during maintenance. Further evaluation is being conducted in other areas. Suppose operations/maintenance anticipate the presence of benzene in a vessel or area, Industrial Hygiene or other competent personnel as designated by Industrial Hygiene shall conduct the benzene testing to specify the adequate control measures for vessel entry and when working inside the vessel. Any process stream, vessel, tank, and a waste stream containing Suncor naphtha may potentially contain benzene. Benzene testing shall be conducted when total hydrocarbon levels from process stream containing Suncor naphtha exceed 20 ppm. According to the monitoring equipment manufacturer's specifications, testing shall be completed using a calibrated Photoionization Detector (PID) or other benzene measuring methods (for example, Drager tubes). • Measurements should be taken in the atmosphere inside the vessel or area where personnel works. • Equipment or areas shall be considered as containing a benzene hazard if any measurement exceeds regulatory limits. • If the equipment exceeds the criteria level, the equipment or area shall have warning signage installed as per Section 6.2. • Work conducted in or on benzene–containing equipment or area must utilize the controls listed in Section 5.0 and follow the safe work procedures as detailed in Section 6.0. • Sample results of initial and periodic monitoring from benzene testing by competent personnel will be reported in industrial hygiene reports and recorded in Medgate.

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Item	Description
5.2	**Air Monitoring** When there is potential exposure to benzene during a task that Industrial Hygiene has never evaluated, an industrial hygienist will conduct a comprehensive benzene exposure evaluation for that task and worker group involved according to the Suncor Exposure Assessment Strategies. Air monitoring results: • Determine whether personal exposures to benzene are acceptable or not. • Determine the effectiveness of specific engineering or administrative controls in minimizing exposures to benzene. • Dictates the most adequate respiratory protective equipment for a task. Industrial Hygiene use and maintain air monitoring results as per Industrial Hygiene guidelines.
5.3	**Occupational Health – Medical Monitoring and Surveillance** Suncor provides a baseline and periodic occupational health assessments for its workers with potential exposure to health hazards that meet the enrollment criteria into these surveillance programs. The aim is to detect adverse health effects early enough and take corrective actions timely. These actions include redesigning control measures to prevent injury and illness reoccurrence and initiating health intervention. As there is no regulatory requirement for workers exposed to benzene to have a health assessment in Alberta, Suncor recommends that, at a minimum, workers must complete their fit testing to achieve the best respirator fitting achievable. The Health and Wellness Advisor will review a medical questionnaire with eligible workers before their fit testing.

6.0 Controls

Item	Description
6.1	When benzene is present in a vessel or equipment, all practical measures must be taken to prevent benzene from becoming airborne. Maintenance activities associated with equipment cleaning or repairs may disturb benzene to create a health hazard. The specific task and specific work area and the results of the initial benzene evaluation must guide and determine the selection of the most appropriate control measures.
6.2	**Engineering Controls** Possible engineering controls include engineered ventilation, air filtration, process automation, and closure of emission points that maintain the benzene concentrations as low as reasonably achievable and below the OEL.

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Item	Description
6.3	**Administrative Controls**

6.3.1 Training and Awareness

Personnel working in areas where benzene concentrations may exceed the regulatory limit will receive training from their industrial hygienist about benzene's health hazards and controls before beginning the work assignment. This training may be in the form of a toolbox talk and should include the following:

a) Identification/evaluation of the hazards presented by benzene and the necessary controls.
b) Adequate use of PPE, including respirator selection and limitations.
c) Monitoring procedures required in benzene hazardous areas before inspection, repair, or maintenance; and
d) Safe work procedures outlined in this Standard

6.3.2 Identification of Benzene Hazardous Equipment

All equipment or areas identified as contaminated by benzene shall have restricted access as per Section 6.3. This restriction shall be removed once the equipment or area is closed and returned to service or testing indicates concentrations are below regulatory OELs.

6.3.3 Hazard Evaluation

In confirmed benzene areas, ensure that the benzene hazard is identified when conducting Field Level Hazard Assessment (FLHA).

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Item	Description
6.4	**Respiratory Protective Equipment (RPE)**

Workers are to don personal protective equipment when working on the interior of equipment or in areas where benzene hazards might be present, as per section 6.4.1.

6.4.1 Respiratory Protective Equipment (RPE)

The following Table 2 highlights the type of respirator to be used based on benzene concentration:

If the exposure is above the IDLH (Immediately Dangerous to Life and Health) of 500 ppm or if there is the possibility of an uncontrolled release, or exposure levels are unknown, then use a positive pressure-demand full-face supplied-air respirator with an escape bottle or SCBA. Wear an approved full-facepiece airline respirator with emergency escape provisions in the positive pressure mode.

Table 2: Benzene Respiratory Protection Requirements

Shift Length	Benzene Concentration (ppm)	RPE Required
8 hours	Less than **0.5**	No RPE required
	0.5 to less than **5**	Half-face respirator with OVC cartridge
	5 to less than **25**	Full-face respirator with OVC
	25 and above or unknown	SCBA or SABA
10 hours	Less than **0.35**	No RPE required
	0.35 to less than **3.5**	Half-face respirator with OVC
	3.5 to less than **17.5**	Full-face respirator with OVC
	17.5 and above or unknown	SCBA or SABA
12 hours	Less than **0.25**	No RPE required
	0.25 to less than **2.5**	Half-face respirator with OVC
	2.5 to less than **12.5**	Full-face respirator with OVC
	12.5 and above or unknown	SCBA or SABA

For non-fire emergencies, positive pressure SCBA and structural firefighter's protective clothing will provide only limited protection. Firefighters should wear a self-contained breathing apparatus (SCBA).

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Item	Description

6.4.2 Chemical Protective Clothing

Since the skin absorbs benzene and benzene vapours, workers who handle the material (field or laboratory) shall wear solvent-resistant gloves and other chemical protective clothing (CPC). Different protective clothing and glove materials will be needed depending on whether the worker will be exposed to pure benzene, or benzene as a component in a mixture (e.g., gasoline). At Suncor-operated sites in the Regional Operations – Upstream area including Base Plant, In Situ, Major Projects, Fort Hills, and East Tank Farm, workers are more likely to be exposed to benzene as a component in a mixture.

Workers who may be exposed to benzene via skin contact or splashing should ensure that they wear protective clothing that covers and protects the arms and legs. Close fitting goggles or face shield should be worn to protect the eyes from irritation or splashes. Where skin contact with liquids containing benzene occurs, the area should be thoroughly washed immediately.

The specific level of CPC required will depend on the conditions. The level of protection selected should be based on the potential benzene concentration and the likelihood of contact. When benzene in a mixture is handled in closed systems, and there is no potential personal exposure, no CPC is required. Chemical splash-suits with positive-pressure-supplied air respirators are required in situations such as large spills.

Some general CPC selection recommendations for exposure to benzene include Viton™ and North Silver Shield™ (or similar material).

7.0 Safe Work Practices

Item	Description

- A restricted work area must be physically restricted using red-flagging labelled "**DANGER - DO NOT ENTER**", forming a perimeter approximately 1 meter around the work area where the concentration of the vapour is 0.25 ppm (for a entire 12-hour shift). The flagging must be in place before the work begins and shall be tagged and managed as per RHS00005 – Erection, Identification and Removal of Flagging.
- Exposures shall be evaluated in hazardous work areas containing benzene, as per Section 4.
- Personnel shall wear PPE as identified in Section 5.3.
- Dispose of all hydrocarbon liquids in the appropriate disposal sink system; never pour hydrocarbons down a water sink. All benzene waste cylinders/sample bottles shall be segregated, labelled, stored, disposed of, or reused, using established procedures as approved by Suncor Environmental Affairs.
- On skin or eye contact with benzene, immediately wash or shower for 15 minutes.
- Specific operational and emergency procedures should be developed for areas with potential benzene concentrations above the OEL.

8.0 Exceptions

There are no exceptions to this standard

End of Standard

Feedback: **Please submit your feedback for this document to your Supervisor.**	**Comments on this document (Is this document up to date?):**
	Suggested Improvements:

Sign: _____ Date: _____
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Print:

References

- Alberta Occupational, Health and Safety Code, December 1, 2021
- Respiratory Protection Standard RHS00036
- Forsberg, K., et al. Quick selection guide to chemical protective clothing. 3rd edition. Van Nostrand Reinhold, 1997.
- RHS00005 Erection, Identification, and Removal of Flagging

Summary of Changes

Rev No.	Date	Section Changed	Revision Made
1	Dec 2017	Header	Previously numbered LMS0098A
2	Jan 2023	Header	▪ Changed the Document Owner Title from “Director, Environment Affairs & Industrial Hygiene” to “Director RMWB EH&S Integration.”
		Purpose	▪ Reword succinctly the purpose
		References	▪ Changed the Alberta OHS Code revision (2021 vs 2009) ▪ Move the references section to the end of the standard (page 3 to page 13) ▪ Changed the Respiratory Protection Standard LMS0052A to RHS00036
		Terms, acronyms, and definitions	▪ Move the terms, acronyms, and definitions section up (page 3 to page 1), and updated the section (e.g., OVC, CSST)
		6.4 Respiratory Protective Equipment (RPE)	▪ Updated Table 2 – Benzene Respiratory Protective Equipment Requirements. ○ Changed the Assigned Protection Factor (APF) for full-face respirator from 100 (CSA CAN/CSA-Z94. 4-93 of 3/1/1993) to 50 (CSA CAN/CSA-Z94. 4-18 of September 2018).
		Roles and Responsibilities	▪ Changed the Respiratory Protection Standard LMS0052A to RHS00036

The following individuals have aproved this document

UserName: Michelle Vessey
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Date: 2023-09-27
Meaning: I approve that this document is valid
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