

1 Purpose

This SOP establishes engineering controls and safe work procedures to prevent exposure to hazardous gases during air drilling operations. The primary objective is to eliminate or minimize the need for personal protective equipment (PPE) by implementing engineering controls, including gas detection, well isolation, and ventilation systems.

2 Scope

This SOP applies to Pulsar Helium employees involved in air drilling operations. Contractors and subcontractors must develop and implement their own procedures that comply with all applicable regulations. Companies without an existing procedure may adopt this document in part or whole, but Pulsar Helium does not guarantee its accuracy or applicability. Contractors and subcontractors are responsible for ensuring compliance with relevant regulations.

3 Gas Hazards Overview

Gas	Properties	Primary Hazard
Carbon Dioxide (CO ₂)	Heavier than air, odorless	Asphyxiation, toxicity
Methane (CH ₄)	Lighter than air, flammable	Explosion, fire, asphyxiation
Simple Asphyxiants	Various densities, inert, odorless	Oxygen displacement, silent asphyxiation

Note: Simple asphyxiants pose a risk by displacing oxygen but do not present additional toxicity concerns.

4 Engineering Controls

4.1 Gas Detection & Monitoring

- Continuous gas monitoring is required at high-risk locations, including:
 - Drilling floor
 - Cellar
 - Mud logging sample area
- Alarm thresholds:
 - **CO₂:** 5,000 ppm (action level), 40,000 ppm (IDLH) - Full evacuation except for properly trained and SCBA-equipped responders. Activate emergency response.
 - **Methane (CH₄):** 10% of LEL (0.5% CH₄) – action level, 50% of LEL (2.5% CH₄) – evacuate non-essential personnel and activate emergency response measures.
 - **Asphyxiants:** Oxygen levels <19.5% - Full evacuation except for properly trained and SCBA-equipped responders. Activate emergency response
- Personal gas monitors must be used when:
 - Engineering controls are offline
 - Entering confined spaces
 - As verification when performing atmospheric testing
 - In response to any failure or incident that warrants their use

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4.2 Ventilation & Exhaust Systems

- Forced-air ventilation must be used in enclosed workspaces with potential for gas buildup.
- Extraction fans should be positioned based on gas behavior:
 - **Low areas for CO₂**
 - **High areas for Methane (CH₄) and simple asphyxiants**

4.3 Well Isolation

- **Blowout Preventer (BOP) Systems:**
 - Must be installed, pressure-tested, and remotely operable as appropriate for the hole section.
 - Used to isolate gas influxes per well control protocols.
- **Mechanical Plugs & Packers:**
 - Used to isolate gas-producing zones.
 - Cement plugs, inflatable packers, or bridge plugs may be required.
- **Wellhead Plugs:**
 - Installed with back-pressure valves or check valves prior to nipple-down operations.

5 Safe Work Procedures

5.1 Hazard Assessments

- Conduct gas hazard assessments before drilling operations.
- Ensure all engineering controls are operational.

5.2 Drilling & Well Operations

- Gas monitors must be installed before drilling into known or suspected gas-producing zones.
- Ventilation must be maintained in mud pits, air handling, and well control areas.
- If Methane (CH₄) exceeds 5% LEL, implement gas flaring.

5.3 Confined Space Entry

- Atmospheric testing must be conducted before entry.
- Forced ventilation must be used as necessary.
- Rescue personnel must be on standby with retrieval equipment.

6 Emergency Response Plan

Gas Level	Action Required
CO ₂ < 1,000 ppm	Normal conditions
CO ₂ 1,000 - 5,000 ppm	Increase ventilation, monitor personnel
CO ₂ > 5,000 ppm	Evacuate non-essential personnel

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Gas Level	Action Required
CO ₂ > 40,000 ppm (IDLH)	Full evacuation except for properly trained and SCBA-equipped responders. Activate emergency response
Methane (CH ₄) > 10% LEL (0.5% CH ₄)	Stop work, verify readings
Methane (CH ₄) > 50% LEL	Shut down ignition sources, evacuate non-essential personnel, and activate emergency response measures.
O ₂ < 19.5% (Asphyxiants)	Full evacuation except for properly trained and SCBA-equipped responders. Activate emergency response

6.1 Alarm Response

- Non-essential Personnel must evacuate to a safe location if alarms trigger evacuation thresholds.

6.2 Rescue Operations

- Only trained personnel equipped with SCBAs may conduct rescues.
- No single rescuer entry. A minimum of two personnel is required. **Exception:** A lone rescuer may only enter if it is a life-threatening emergency, but this is a last resort.
- Confined space rescues require retrieval harnesses and continuous gas monitoring.

7 First Aid Measures

7.1 CO₂ Exposure

- Move victim to fresh air immediately.
- If unconscious but breathing, place in -the recovery position.
- If not breathing, provide CPR and oxygen if available and trained to administer.

7.2 Methane (CH₄) Exposure

- Remove victim from the contaminated area.
- If explosion or fire occurs, treat burns and seek medical help.

7.3 Simple Asphyxiants Exposure

- Move victim to fresh air.
- Administer oxygen therapy if needed.
- Perform CPR if necessary and seek medical assistance.

8 Training & Compliance

- Annual gas hazard training is required, covering:
 - Gas properties, exposure risks, and engineering controls
 - Emergency response procedures
 - Confined space entry and rescue protocols



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- Respirator fit testing and medical evaluation per **OSHA 29 CFR 1910.134** for SCBA users
- Gas monitoring logs and engineering control inspections must be documented.

9 Recordkeeping & Compliance

- Maintain records for:
 - Gas monitoring logs
 - Training sessions
 - Emergency drills

10 Conclusion

By prioritizing engineering controls, this SOP aims to minimize gas exposure risks and reduce reliance on PPE, ensuring a safer work environment for all personnel.