
# NATIONAL TRAINERS' EXCHANGE

# HAZARDS POSED BY THE DENSITY OF A GAS OR VAPOR

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# WELCOME:

*Your presenters*:

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# Objectives:

- ✓Define gas/vapor density
- ✓Identify the main hazard of air displacement
- ✓Explain how displacement of air can occur
- ✓Identify where this information can be found
- ✓Identify the density of air, $CO^2$, and helium
- ✓Demonstrate how the density of $CO^2$ and helium can change an environment

# Dangers of Gas and Vapor Density

## Silent killer, workers have no chance to escape.

On January 28, 2021, a liquid nitrogen leak occurred at a poultry processing plant in Gainesville, GA.. The poultry plant had installed the liquid nitrogen system four to six weeks prior to the leak to quickly freeze chicken products. A maintenance manager was able to shut off an external isolation valve, stopping the flow of liquid nitrogen to the process and likely preventing further exposures. The leak killed six workers, sent 12 others to the hospital, and forced the evacuation of 130 people.

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# Dangers of Gas and Vapor Density

## Silent killer, workers have no chance to escape.

In the U.S., nitrogen asphyxiation hazards caused 80 deaths from 1992 to 2002 and 14 from 2012 to 2020.

- ✓These incidents occurred in a variety of facilities, including industrial plants, laboratories, and medical facilities
- ✓Almost half of the incidents involved contractors

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# Definition of Gas or Vapor density

Vapor density is defined as:

- **The relative weight of a gas or vapor compared to air, which has an arbitrary value of one, therefore**.
- If a gas has a vapor density of less than one, it will generally rise in air.
- If the vapor density is greater than one the gas will generally sink in air.

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# Hazards caused by the displacement of Air

When air is displaced, oxygen levels drop, if they drop below **19.5%** you may suffer:

- ✓Fatigue
- ✓Confusion
- ✓Rapid heart rate

When the oxygen level **drops** even further, you may:

- ✓**Lose Consciousness**
- ✓**Have Convulsions**
- ✓**Even Die**

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# How can air be displaced?

## Air can be displaced in many ways:

1. Purging can be taking place in a work area (confined space).
2. Unexpected leak in a cooling system (nitrogen).
3. Gases permeating from soil into a trench or excavation.
4. Welding equipment, hose leaking (argon) in a space.

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# Examples of heavier than air gasses

Propane,
Hydrogen sulfide,
Ethane,
Butane,
Chlorine,
Sulfur dioxide,

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# Examples of lighter than air gasses

Acetylene,

Methane,

Hydrogen,

Ammonia,

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# Where can we find this information?

- ✓Safety Data Sheet
- ✓NIOSH Pocket guide
- ✓New Jersey Fact Sheets (RTK Center)
- ✓ERG?

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# Let's Look at the SDS

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# Density of Air

## Section 9. Physical and chemical properties

| | | |
|---|---|---|
| **Appearance** | | |
| **Physical state** | : | Gas. |
| **Color** | : | Colorless. |
| **Odor** | : | Odorless. |
| **Odor threshold** | : | Not available. |
| **pH** | : | Not available. |
| **Melting point** | : | -216.2°C (-357.2°F) |
| **Boiling point** | : | -194.3°C (-317.7°F) |
| **Critical temperature** | : | Lowest known value: -146.95°C (-232.5°F) (nitrogen). |
| **Flash point** | : | Not available. |
| **Evaporation rate** | : | Not available. |
| **Flammability (solid, gas)** | : | Not available. |
| **Lower and upper explosive (flammable) limits** | : | Not available. |
| **Vapor pressure** | : | Not available. |
| **Vapor density** | : | Highest known value: 1.1 (Air = 1) (oxygen). Weighted average: 1 (Air = 1) |
| **Gas Density (lb/ft $^3$)** | : | 0.0749 |
| **Relative density** | : | Not applicable. |
| **Solubility** | : | Not available. |
| **Solubility in water** | : | Not available. |
| **Partition coefficient: n-octanol/water** | : | Not available. |
| **Auto-ignition temperature** | : | Not available. |
| **Decomposition temperature** | : | Not available. |
| **Viscosity** | : | Not applicable. |
| **Flow time (ISO 2431)** | : | Not available. |

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# Density of Helium

## Section 9. Physical and chemical properties

| | | |
|---|---|---|
| **Appearance** | | |
| **Physical state** | : | Gas. [Compressed gas.] |
| **Color** | : | Colorless. |
| **Odor** | : | Odorless. |
| **Odor threshold** | : | Not available. |
| **pH** | : | Not available. |
| **Melting point** | : | -272.2°C (-458°F) |
| **Boiling point** | : | -268.9°C (-452°F) |
| **Critical temperature** | : | -267.9°C (-450.2°F) |
| **Flash point** | : | [Product does not sustain combustion.] |
| **Evaporation rate** | : | Not available. |
| **Flammability (solid, gas)** | : | Not available. |
| **Lower and upper explosive (flammable) limits** | : | Not available. |
| **Vapor pressure** | : | Not available. |
| **Vapor density** | : | 0.14 (Air = 1) Liquid Density@BP: 7.8 lb/ft3 (125 kg/m3) |
| **Specific volume ($ft^3/lb$)** | : | 96.1538 |
| **Gas Density ($lb/ft^3$)** | : | 0.0104 |
| **Relative density** | : | Not applicable. |
| **Solubility** | : | Not available. |
| **Solubility in water** | : | Not available. |
| **Partition coefficient: n-octanol/water** | : | 0.28 |
| **Auto-ignition temperature** | : | Not available. |
| **Decomposition temperature** | : | Not available. |
| **Viscosity** | : | Not applicable. |
| **Flow time (ISO 2431)** | : | Not available. |
| **Molecular weight** | : | 4 g/mole |

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# Density of $CO^2$

## Section 9. Physical and chemical properties

| | | |
|---|---|---|
| **Appearance** | | |
| **Physical state** | : | Gas. [Compressed gas.] |
| **Color** | : | Colorless. |
| **Odor** | : | Odorless. |
| **Odor threshold** | : | Not available. |
| **pH** | : | Not available. |
| **Melting point** | : | Sublimation temperature: -79°C (-110.2 to °F) |
| **Boiling point** | : | Not available. |
| **Critical temperature** | : | 30.85°C (87.5°F) |
| **Flash point** | : | [Product does not sustain combustion.] |
| **Evaporation rate** | : | Not available. |
| **Flammability (solid, gas)** | : | Not available. |
| **Lower and upper explosive (flammable) limits** | : | Not available. |
| **Vapor pressure** | : | 830 (psig) |
| **Vapor density** | : | 1.53 (Air = 1) Liquid Density@BP: Solid density = 97.5 lb/ft3 (1562 kg/m3) |
| **Specific Volume ($ft^3$/lb)** | : | 8.7719 |
| **Gas Density (lb/$ft^3$)** | : | 0.114 |
| **Relative density** | : | Not applicable. |
| **Solubility** | : | Not available. |
| **Solubility in water** | : | Not available. |
| **Partition coefficient: n-octanol/water** | : | 0.83 |
| **Auto-ignition temperature** | : | Not available. |
| **Decomposition temperature** | : | Not available. |
| **Viscosity** | : | Not applicable. |
| **Flow time (ISO 2431)** | : | Not available. |
| **Molecular weight** | : | 44.01 g/mole |

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# Density of Hydrogen

## Section 9. Physical and chemical properties

| | | |
|---|---|---|
| **Appearance** | | |
| **Physical state** | : | Gas |
| **Color** | : | Colorless. |
| **Odor** | : | Odorless. |
| **Odor threshold** | : | Not available. |
| **pH** | : | Not available. |
| **Melting point** | : | -259.15°C (-434.5°F) |
| **Boiling point** | : | -253°C (-423.4°F) |
| **Critical temperature** | : | -240.15°C (-400.3°F) |
| **Flash point** | : | Not available. |
| **Evaporation rate** | : | Not available. |
| **Flammability (solid, gas)** | : | Extremely flammable in the presence of the following materials or conditions: oxidizing materials. |
| **Lower and upper explosive (flammable) limits** | : | Lower: 4%<br>Upper: 76% |
| **Vapor pressure** | : | Not available. |
| **Vapor density** | : | 0.07 (Air = 1) Liquid Density@BP: 4.43 lb/ft3 (70.96 kg/m3) |
| **Specific Volume ($ft^3/lb$)** | : | 12.0482 |
| **Gas Density ($lb/ft^3$)** | : | 0.083 |
| **Relative density** | : | Not applicable. |
| **Solubility** | : | Not available. |
| **Solubility in water** | : | Not available. |
| **Partition coefficient: n-octanol/water** | : | Not available. |
| **Auto-ignition temperature** | : | 500 to 571°C (932 to 1059.8°F) |
| **Decomposition temperature** | : | Not available. |

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# In Review

## Upon completion of this session, we were able to:

- ✓Define gas/vapor density
- ✓Identify the density of air
- ✓Identify the density of Helium
- ✓Identify the density of Carbon dioxide
- ✓Identify the main hazard of air displacement
- ✓Explain how displacement of air can occur

# Let's Demo!!!

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# Thank you for Participating

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