

Appendix C
Hazardous Materials Group Factual
Hazardous Materials Information

Wilmer, TX
HWY-05-MH-035

Section 1. Chemical product and company identification

Product Name : Oxygen
Supplier : AIRGAS INC., on behalf of its subsidiaries
259 North Radnor-Chester Road
Suite 100
Radnor, PA 19087-5283
1-610-687-5253
Product use : Synthetic/Analytical chemistry.
MSDS# : 001043
Date of Preparation/Revision : **6/28/2005.**
In case of emergency : 1-800-949-7937

Section 2. Composition, Information on Ingredients

| <u>Name</u> | <u>CAS number</u> | <u>% Volume</u> | <u>Exposure limits</u> |
|-------------|-------------------|-----------------|------------------------|
| Oxygen | 7782-44-7 | 100 | |

Section 3. Hazards identification

Physical state : Gas.
Emergency overview : Warning!
OXIDIZER.
CONTENTS UNDER PRESSURE.
Contact with combustible material may cause fire.
Do not puncture or incinerate container. Store in tightly closed container. Avoid contact with combustible materials.
Contact with rapidly expanding gases or liquids can cause frostbite.
Routes of entry : Inhalation
Potential acute health effects
Eyes : No known significant effects or critical hazards.
Skin : No known significant effects or critical hazards.
Inhalation : Slightly irritating to the respiratory system. Practically non-toxic by inhalation.
Ingestion : Ingestion is not a normal route of exposure for gases
Potential chronic health effects : **CARCINOGENIC EFFECTS** Not available.
MUTAGENIC EFFECTS Not available.
TERATOGENIC EFFECTS: Not available.
Medical conditions aggravated by overexposure : Acute or chronic respiratory conditions may be aggravated by overexposure to this gas.
See toxicological information (section 11)

Section 4. First aid measures

No action shall be taken involving any personal risk or without suitable training. If fumes are still suspected to be present, the rescuer should wear an appropriate mask or a self-contained breathing apparatus. It may be dangerous to the person providing aid to give mouth-to-mouth resuscitation.

Eye contact : In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention if irritation occurs.
Skin contact : In case of contact, immediately flush skin with plenty of water. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.
Frostbite : Try to warm up the frozen tissues and seek medical attention.

Oxygen

- Inhalation** : If inhaled, remove to fresh air. If not breathing, give artificial respiration. Get medical attention.
- Ingestion** : Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. Get medical attention if symptoms appear.

Section 5. Fire fighting measures

- Flammability of the product** : Non-flammable.
- Fire fighting media and instructions** : Use an extinguishing agent suitable for surrounding fires.
- If involved in fire, shut off flow immediately if it can be done without risk. Apply water from a safe distance to cool container and protect surrounding area.
- This material increases the risk of fire and may aid combustion. Contact with combustible material may cause fire.
- Special protective equipment for fire-fighters** : Fire fighters should wear appropriate protective equipment and self-contained breathing apparatus (SCBA) with a full facepiece operated in positive pressure mode.

Section 6. Accidental release measures

- Personal precautions** : Immediately contact emergency personnel. Eliminate all ignition sources. Keep unnecessary personnel away. Use suitable protective equipment (Section 8). Do not touch or walk through spilled material.
- Environmental precautions** : Avoid dispersal of spilled material and runoff and contact with soil, waterways, drains and sewers.

Section 7. Handling and storage

- Handling** : Store in tightly closed container. Avoid contact with combustible materials. Do not puncture or incinerate container. High pressure gas. Use equipment rated for cylinder pressure. Close valve after each use and when empty. Protect cylinders from physical damage; do not drag, roll, slide, or drop. Use a suitable hand truck for cylinder movement.
- Never allow any unprotected part of the body to touch uninsulated pipes or vessels that contain cryogenic liquids. Prevent entrapment of liquid in closed systems or piping without pressure relief devices. Some materials may become brittle at low temperatures and will easily fracture.
- Storage** : Keep container tightly closed. Keep container in a cool, well-ventilated area. Cylinders should be stored upright, with valve protection cap in place, and firmly secured to prevent falling or being knocked over. Cylinder temperatures should not exceed 52 °C (125 °F).

Section 8. Exposure Controls, Personal Protection

- Engineering controls** : Use only with adequate ventilation. Use process enclosures, local exhaust ventilation, or other engineering controls to keep airborne levels below recommended exposure limits.
- Personal protection**
- Eyes** : Safety eyewear complying with an approved standard should be used when a risk assessment indicates this is necessary to avoid exposure to liquid splashes, mists or dusts.
- When working with cryogenic liquids, wear a full face shield.
- Skin** : Personal protective equipment for the body should be selected based on the task being performed and the risks involved and should be approved by a specialist before handling this product.
- Respiratory** : Use a properly fitted, air-purifying or air-fed respirator complying with an approved standard if a risk assessment indicates this is necessary. Respirator selection must be based on known or anticipated exposure levels, the hazards of the product and the safe working limits of the selected respirator.
- The applicable standards are (US) 29 CFR 1910.134 and (Canada) Z94.4-93

Oxygen

Hands : Chemical-resistant, impervious gloves or gauntlets complying with an approved standard should be worn at all times when handling chemical products if a risk assessment indicates this is necessary.

Insulated gloves suitable for low temperatures

Personal protection in case of a large spill : A self-contained breathing apparatus should be used to avoid inhalation of the product.

Consult local authorities for acceptable exposure limits.

Section 9. Physical and chemical properties

| | |
|--|------------------------|
| Molecular weight | : 32 g/mole |
| Molecular formula | : O ₂ |
| Boiling/condensation point | : -183.11°C (-297.6°F) |
| Melting/freezing point | : -218.55°C (-361.4°F) |
| Critical temperature | : Not available. |
| Vapor density | : 1.105 (Air = 1) |
| Specific Volume (ft³/lb) | : 12.0482 |
| Gas Density (lb/ft³) | : 0.083 |
| Physical chemical comments | : Not available. |

Section 10. Stability and reactivity

Stability and reactivity : The product is stable.

Incompatibility with various substances : Extremely reactive or incompatible with reducing agents, combustible materials.

Section 11. Toxicological information

Other toxic effects on humans : No specific information is available in our database regarding the other toxic effects of this material for humans.

Specific effects

Carcinogenic effects : No known significant effects or critical hazards.

Mutagenic effects : No known significant effects or critical hazards.

Reproduction toxicity : No known significant effects or critical hazards.

Section 12. Ecological information

Toxicity of the products of biodegradation : The product itself and its products of degradation are not toxic.

Environmental fate : Not available.

Environmental hazards : No known significant effects or critical hazards.

Toxicity to the environment : Not available.

Section 13. Disposal considerations

Product removed from the cylinder must be disposed of in accordance with appropriate Federal, State, local regulation. Return cylinders with residual product to Airgas, Inc. Do not dispose of locally.

Section 14. Transport information

| Oxygen | | | | | | |
|-------------------------------|------------------|-----------------------------|--------------|-----------------------|---|---|
| Regulatory information | UN number | Proper shipping name | Class | Packing group | Label | Additional information |
| DOT Classification | UN1072 | OXYGEN, COMPRESSED | 2.2 | Not applicable (gas). |  | Limited quantity Yes. |
| | UN1073 | Oxygen, refrigerated liquid | | |  | Packaging instruction Passenger Aircraft Quantity limitation: 75 kg Cargo Aircraft Quantity limitation: 150 kg Special provisions A52 |
| TDG Classification | UN1072 | OXYGEN, COMPRESSED | 2.2 | Not applicable (gas). |  | Explosive Limit and Limited Quantity Index 0.125 |
| | UN1073 | Oxygen, refrigerated liquid | | |  | ERAP Index 3000 Passenger Carrying Ship Index 50 Passenger Carrying Road or Rail Index 75 Special provisions 42 |
| Mexico Classification | UN1072 | OXYGEN, COMPRESSED | 2.2 | Not applicable (gas). |  | - |
| | UN1073 | Oxygen, refrigerated liquid | | |  | |

Section 15. Regulatory information

United States

- U.S. Federal regulations** : TSCA 8(b) inventory: Oxygen
 SARA 302/304/311/312 extremely hazardous substances: No products were found.
 SARA 302/304 emergency planning and notification: No products were found.
 SARA 302/304/311/312 hazardous chemicals: Oxygen
 SARA 311/312 MSDS distribution - chemical inventory - hazard identification: Oxygen:
 Fire hazard, Sudden Release of Pressure, Delayed (Chronic) Health Hazard
 Clean Water Act (CWA) 307: No products were found.
 Clean Water Act (CWA) 311: No products were found.
 Clean air act (CAA) 112 accidental release prevention: No products were found.
 Clean air act (CAA) 112 regulated flammable substances: No products were found.
 Clean air act (CAA) 112 regulated toxic substances: No products were found.
- State regulations** : Pennsylvania RTK: Oxygen: (generic environmental hazard)
 Massachusetts RTK: Oxygen
 New Jersey: Oxygen

Canada

- WHMIS (Canada)** : Class A: Compressed gas.
 Class C: Oxidizing material.
 CEPA DSL: Oxygen

Section 16. Other information

United States

- Label Requirements** : OXIDIZER.
 CONTENTS UNDER PRESSURE.
 CONTACT WITH OTHER MATERIAL MAY CAUSE FIRE.

Canada

- Label Requirements** : Class A: Compressed gas.
 Class C: Oxidizing material.

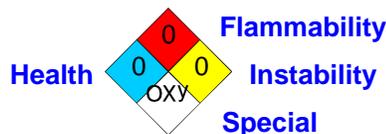
Hazardous Material Information System (U.S.A.)

| | |
|---------------------|---|
| Health | 0 |
| Fire hazard | 0 |
| Reactivity | 0 |
| Personal protection | C |

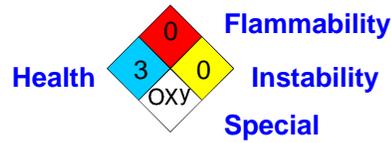
liquid:

| | |
|---------------------|---|
| Health | 3 |
| Fire hazard | 0 |
| Reactivity | 0 |
| Personal protection | |

National Fire Protection Association (U.S.A.)



liquid:



Notice to reader

To the best of our knowledge, the information contained herein is accurate. However, neither the above named supplier nor any of its subsidiaries assumes any liability whatsoever for the accuracy or completeness of the information contained herein.

Final determination of suitability of any material is the sole responsibility of the user. All materials may present unknown hazards and should be used with caution. Although certain hazards are described herein, we cannot guarantee that these are the only hazards that exist.

HANDBOOK OF
Compressed Gases

Second Edition

COMPRESSED GAS ASSOCIATION, INC.
New York, New York



VAN NOSTRAND REINHOLD COMPANY

NEW YORK

CINCINNATI

ATLANTA

DALLAS

SAN FRANCISCO

LONDON

TORONTO

MELBOURNE

Oxygen

O₂ DOT Classification: Nonflammable gas; oxidizer gas label

PHYSICAL CONSTANTS

| | <u>U.S. Units</u> | <u>Metric Units</u> |
|---|----------------------------|---------------------------------|
| International symbol | O ₂ | O ₂ |
| Molecular weight | 31.999 | 31.999 |
| Density of the gas at 70 F (21.1 C) and 1 atm | 0.08279 lb/ft ³ | 1.326 kg/m ³ |
| Specific gravity of the gas at 70 F and 1 atm (air = 1) | 1.1049 | 1.1049 |
| Specific volume of the gas at 70 F (21.1 C) and 1 atm | 12.08 ft ³ /lb | 0.7541 m ³ /kg |
| Boiling point at 1 atm | -297.3 F | -183.0 C |
| Freezing point at 1 atm | -361.1 F | -218.4 C |
| Critical temperature | -181.4 F | -118.6 C |
| Critical pressure | 731.4 psia | 5043 kPa, abs. |
| Critical density | 27.23 lb/ft ³ | 436.18 kg/m ³ |
| Triple point | -361.8 F at 0.0220 psia | -218.8 C at 0.1517 kPa, abs. |
| Latent heat of vaporization at boiling point | 91.7 Btu/lb | 213 kJ/kg |
| Latent heat of fusion at -361.1 F (-218.4 C) melting point | 5.98 Btu/lb | 13.9 kJ/kg |
| Specific heat of gas at 70 F (21.1 C) and 1 atm | | |
| C_p | 0.219 Btu/(lb)(F) | 0.917 kJ/(kg)(C) |
| C_v | 0.156 Btu/(lb)(F) | 0.653 kJ/(kg)(C) |
| Ratio of specific heats | 1.400 | 1.400 |
| Solubility in water, vol/vol at 32 F (0 C) | 0.0489 | 0.0489 |
| Weight of liquid at boiling point | 9.52 lb/gal | 1141 kg/m ³ |
| Density of gas at boiling point | 0.2959 lb/ft ³ | 4.740 kg/m ³ |

| | <u>U.S. Units</u> | <u>Metric Units</u> |
|--|--------------------------|------------------------|
| Density of liquid at boiling point | 71.27 lb/ft ³ | 1142 kg/m ³ |
| Liquid/gas ratio (liquid at boiling point, gas at 70 F and 1 atm), vol/vol | 1/860.6 | 1/860.6 |

DESCRIPTION

Oxygen, the colorless, odorless, tasteless elemental gas that supports life and makes combustion possible, constitutes about a fifth of the atmosphere (20.99 percent by volume; by weight, almost a fourth—23.2 percent). It is a transparent, pale blue liquid slightly heavier than water at temperatures ranging below some -300 F (-184 C). All elements but the inert gases combine directly with oxygen, usually to form oxides. However, oxidation of different elements occurs over a wide range of temperatures, with phosphorus and magnesium igniting spontaneously in air at ambient temperatures and the noble metals oxidizing only at very high temperatures.

All materials that are flammable in air burn much more vigorously in oxygen. Some combustibles, such as oil and grease, burn with nearly explosive violence in oxygen if ignited. Pure oxygen itself is nonflammable.

Oxygen is shipped as a nonliquefied gas at pressures of 2000 psig (13,790 kPa gage) or above, and also as a cryogenic gas at pressures below 200 psig (1379 kPa gage).

GRADES AVAILABLE

Table 1 presents the component maxima in ppm (v/v), unless shown otherwise, for the types and grades of oxygen. Gaseous oxygen is denoted as Type I and liquefied oxygen as Type II. A blank indicates no maximum limiting characteristic (see Ref. 1).

USES

Oxygen's major uses stem from its life-sustaining and combustion-supporting properties.

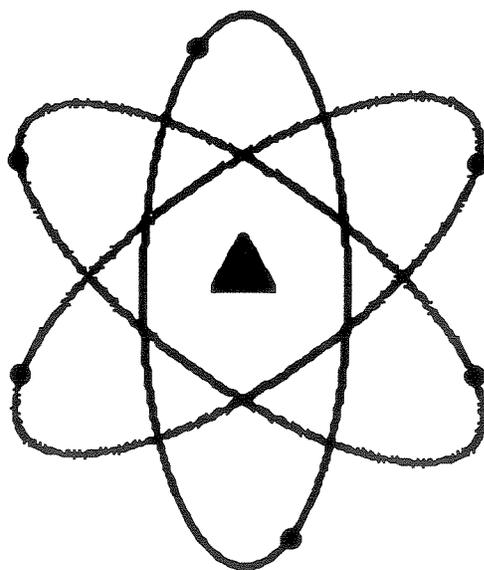
It is used extensively in medicine for therapeutic purposes, for resuscitation in asphyxia, and with other gases in anesthesia. It is also used in high-altitude flying, deep-sea diving, and as both an inhalant and a power source in the United States space program. Industrial applications include its very wide utilization with acetylene, hydrogen and other fuel gases for such purposes as metal cutting, welding, hardening, scarfing, cleaning and dehydrating. Oxygen helps increase the capacity of steel and iron furnaces on a growing scale in the steel industry. One of its major uses is in the production of synthesis gas (a hydrogen-carbon monoxide mixture) from coal, natural gas or liquid fuels; synthesis gas is in turn used to make gasoline, methanol and ammonia. Oxygen is similarly employed in manufacturing some acetylene through partial oxidation of the hydrocarbons in methane. It is also used in the production of nitric acid, ethylene and other compounds in the chemical industry.

PHYSIOLOGICAL EFFECTS

The inhalation of gaseous oxygen has a tonic effect on the human system rather than any toxic effect, and its tonic properties have led to many therapeutic applications of oxygen. Inhalation of high concentrations of oxygen at atmospheric pressure for a few hours has produced no observable harmful effects. Medical gas labels now carry a warning against high concentrations of oxygen for more than 5 hours without interruption. Exposures to oxygen at higher pressures for prolonged periods have been found to affect neuromuscular coordination and attentive powers.

FIRE CHEM I

The Basics of



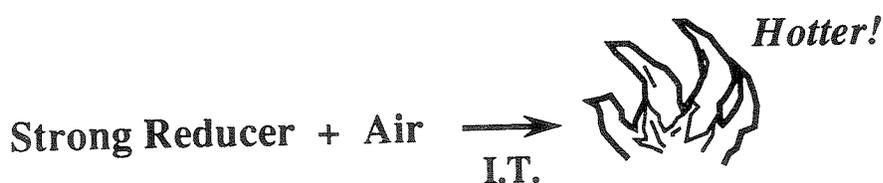
H.T.M

R. Edwards
4TH EDITION
(2nd Printing)



B. Flammable Liquids (with slow oxidation potential)

Ignition temperatures will be much lower for those flammable liquids which have slow oxidation potential, such as the ethers and aldehydes. Ignition might therefore occur from sources you would otherwise consider as safe.

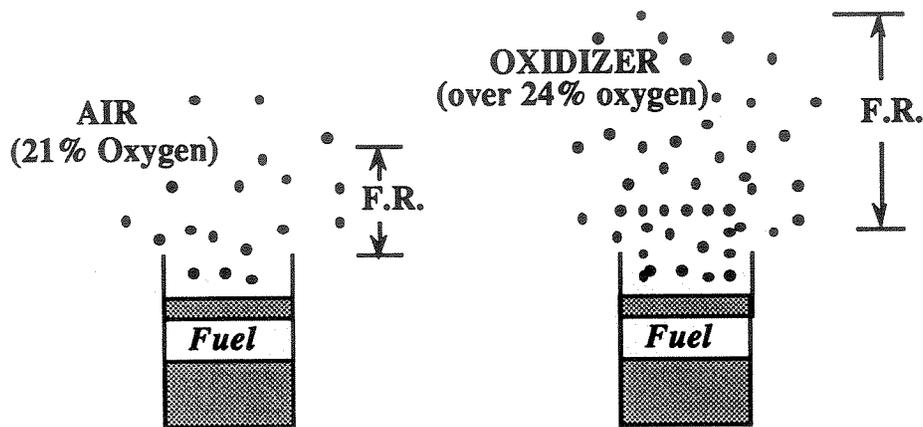


2. FLAMMABLE LIQUIDS AND OXIDIZERS

A. Hypergolic Combustion

If you recall, hypergolic combustion is commonly used in rocket engines and propellants. It occurs when a **strong reducer** activates an oxidizer, causing the oxidizer to decompose and release **oxygen**. This is immediately followed by a very exothermic oxidation of the reducer. In fact, the heat released from this reaction is usually sufficient to ignite the vapors of the reducers, especially since these liquids have such low ignition temperatures. In addition, the oxygen released by the oxidizer widens the explosive limits of the flammable reducing agent, resulting in a very rapid and intense fire.

It is important to bear in mind that this combustion is not the result of spontaneous ignition, but rather, autoignition. In other words, the reducer is not igniting itself, but is ignited by the heat released from the reactive mixture. Unlike spontaneous combustion, which may take days to occur, this combustion is very fast.



B. Regular Combustion

When ordinary flammable liquids, without slow oxidation potential, are contacted with oxidizers, generally there is no reaction. However, if an **energy activator** is present, such as a spark, flame, or heat, a combustion may occur similar to the process of hypergolic combustion. In other words the resulting fire will also be very fast and hot.

For example, if gasoline is mixed with a strong oxidizer and the vapors are ignited by auto or pilot ignition, a most intense and rapid fire results. Therefore, flammable or combustible liquids should never be stored near an oxidizer (such as fertilizers).

If you recall, an oxidizer-supported fire does not require air support. Therefore, it can occur in storage. In fact, certain oxidizers, such as the peroxides, supply so much heat in decomposition, that little if any outside heat is needed to ignite the flammable vapors of the liquid fuel.

3. FOOLERS: COMBUSTIBLE LIQUIDS

The combustible liquids are a deceiving group, in that one might not expect them to be as hazardous as the flammable liquids. And indeed, they have **high flash points** because of large molecular weights (e.g. kerosene, jet fuel and diesel fuel), which means they must be