SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1. Product identifier : Oxygen (Refrigerated)

CAS No. : 7782-44-7

Chemical formula : O2

Synonyms : Oxygen (refrigerated), Oxygen USP, LOX, Cryogenic Liquid Oxygen

REACH Registration Number: Listed in Annex IV / V REACH, exempted from registration.

1.2. Relevant identified uses of the substance or mixture and uses advised against

Use of the Substance/Mixture : Industrial and professional use. Perform risk assessment prior to use.

Restrictions on Use : Not for consumer use.

1.3. Details of the supplier of the safety data sheet : Air Products Ireland Ltd
Unit 950 Western Industrial Estate
Kileen Road
Dublin 12
Ireland

Email Address – Technical Information : GASTECH@airproducts.com

Telephone : 1-4659650

1.4. Emergency telephone number : (01) 463 4200 / +353 1 463 4200

SECTION 2: Hazards identification

2.1. Classification of the substance or mixture

Oxidizing gases - Category 1 H270:May cause or intensify fire; oxidiser.
Gases under pressure - Refrigerated liquefied gas. H281:Contains refrigerated gas; may cause cryogenic burns or injury.

2.2. Label elements

Hazard pictograms/symbols

Signal Word: Danger

Hazard Statements:

H270:May cause or intensify fire; oxidiser.
H281:Contains refrigerated gas; may cause cryogenic burns or injury.

Precautionary Statements:

Prevention : P220:Keep away from clothing and other combustible materials.
P244:Keep valves and fittings free from oil and grease.
P282:Wear cold insulating gloves/face shield/eye protection.

Response : P370+P376 :In case of fire: Stop leak if safe to do so.
P336 :Thaw frosted parts with lukewarm water. Do not rub affected area.
P315 :Get immediate medical advice/attention.

Storage : P403:Store in a well-ventilated place.

2.3. Other hazards

Extremely cold liquid and gas under pressure.
Direct contact with liquid can cause frostbite.
May react violently with combustible materials.
Keep oil, grease, and combustibles away.
Substance does not meet the criteria for PBT and vPvB according to Regulation (EC) No 1907/2006, Annex XIII.

SECTION 3: Composition/information on ingredients

3.1. Substances

Components	EINECS / ELINCS Number	CAS Number	Concentration (Volume)
Oxygen	231-956-9	7782-44-7	100 %

Components	Classification (CLP)	REACH Reg. #
Oxygen	Ox. Gas 1 ;H270 Press. Gas (Ref. liq.) ;H281	*1

*1:Listed in Annex IV / V REACH, exempted from registration.
*2:Registration not required: substance manufactured or imported < 1 t/y.
*3:Registration not required: substance manufactured or imported < 1 t/y for non-intermediate uses.

Refer to section 16 for full text of each relevant hazard statement (H).

Concentration is nominal. For the exact product composition, please refer to technical specifications.

3.2. Mixtures : Not applicable.

SECTION 4: First aid measures

4.1. Description of first aid measures

Eye contact : In the case of contact with eyes, rinse immediately with plenty of water and seek medical advice.

Skin contact : In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash frost-bitten areas with plenty of water. Do not remove clothing. As soon as practical, place the affected area in a warm water bath- which has a temperature not to exceed 40 °C (105 °F). Cover wound with sterile dressing.

Ingestion : Ingestion is not considered a potential route of exposure.

Inhalation : Consult a physician after significant exposure. Move to fresh air.

4.2. Most important symptoms and effects, both acute and delayed

Symptoms : No data available.

4.3. Indication of any immediate medical attention and special treatment needed

Treatment : If exposed or concerned: Get medical attention/advice.

SECTION 5: Firefighting measures

5.1. Extinguishing media

Suitable extinguishing media : The product itself does not burn.
Use extinguishing media appropriate for surrounding fire.

Extinguishing media which must not be used for safety reasons. : Do not use water jet to extinguish.

5.2. Special hazards arising from the substance or mixture

: Combustibles in contact with liquid oxygen may explode on ignition or impact. Some materials which are noncombustible in air may burn in the presence of an oxidizer. Contact with organic and most inorganic materials may cause fire. Move away from container and cool with water from a protected position. Do not direct water spray at container vent. If possible, stop flow of product. Gas is heavier than air and may collect in low areas or travel along the ground where there may be an ignition source present. Vapor cloud may obscure visibility.

5.3. Advice for firefighters

: Fire resistant clothing may burn and offer no protection in oxygen rich atmospheres. Wear self contained breathing apparatus for fire fighting if necessary. Standard protective clothing and equipment (Self Contained Breathing Apparatus) for fire fighters. Standard EN 137 - Self-contained open-circuit compressed air breathing apparatus with full face mask. Standard EN 469 - Protective clothing for firefighters. Standard - EN 659: Protective gloves for firefighters.

Further information : Some materials that are noncombustible in air will burn in the presence of an oxygen enriched atmosphere (greater than 23.5%). Fire resistant clothing may burn and offer no protection in oxygen rich atmospheres.

SECTION 6: Accidental release measures

6.1. Personal precautions, protective equipment and emergency procedures	:	Clothing exposed to high concentrations may retain oxygen 30 minutes or longer and become a potential fire hazard. Stay away from ignition sources. Evacuate personnel to safe areas. Ventilate the area. Monitor oxygen level. Spill will rapidly vaporize forming an oxygen rich vapor cloud. Gas/vapor heavier than air. May accumulate in confined spaces, particularly at or below ground level. Personnel who have been exposed to high concentrations of oxygen should stay in a well-ventilated or open area for 30 minutes before going into a confined space or near an ignition source.
6.2. Environmental precautions	:	No data available.
6.3. Methods and material for containment and cleaning up	:	Ventilate the area.
Additional advice	:	Increase ventilation to the release area and monitor oxygen level.
6.4. Reference to other sections	:	For more information refer to Sections 8 & 13

SECTION 7: Handling and storage

7.1. Precautions for safe handling

All gauges, valves, regulators, piping and equipment to be used in oxygen service must be cleaned for oxygen service. Oxygen is not to be used as a substitute for compressed air. Never use an oxygen jet for cleaning purposes of any sort, especially clothing, as it increases the likelihood of an engulfing fire. Know and understand the properties and hazards of the product before use. Only experienced and properly instructed persons should handle compressed gases/cryogenic liquids. Before using the product, determine its identity by reading the label. Do not remove or deface labels provided by the supplier for the identification of the cylinder contents. Before connecting the container, check the complete gas system for suitability, particularly for pressure rating and materials. Before connecting the container for use, ensure that back feed from the system into the container is prevented. Close container valve after each use and when empty, even if still connected to equipment. Never attempt to repair or modify container valves or safety relief devices. Damaged valves should be reported immediately to the supplier. If user experiences any difficulty operating cylinder valve discontinue use and contact supplier. Do not remove or interchange connections. Prevent entrapment of cryogenic liquid in closed systems not protected with relief device. When moving cylinders, even for short distances, use a cart (trolley, hand truck, etc.) designed to transport cylinders. When doubt exists as to the correct handling procedure for a particular gas, contact the supplier. Employ suitable pressure regulating devices on all containers when the gas is being emitted to systems with lower pressure rating than that of the container. Do not subject containers to abnormal mechanical shock. Only transfer lines designed for cryogenic liquids shall be used. Use only with equipment cleaned for oxygen service and rated for cylinder pressure. Never permit oil, grease, or other readily combustible substances to come into contact with valves or containers containing oxygen or other oxidants. All vents should be piped to the exterior of the building.

7.2. Conditions for safe storage, including any incompatibilities

Containers should be stored in a purpose build compound which should be well ventilated, preferably in the open air. Do not allow storage temperature to exceed 50°C (122°F). Full containers should be stored so that oldest stock is used first. Do not store in a confined space. Full and empty cylinders should be segregated. Store

containers in location free from fire risk and away from sources of heat and ignition. Return empty containers in a timely manner. Stored containers should be periodically checked for general condition and leakage. Protect containers stored in the open against rusting and extremes of weather. Containers should not be stored in conditions likely to encourage corrosion. Cryogenic containers are equipped with pressure relief devices to control internal pressure. Under normal conditions these containers will periodically vent product. Where necessary containers containing oxygen and oxidants should be separated from flammable gases by a fire resistant partition.

7.3. Specific end use(s)

Refer to section 1 or the extended SDS if applicable.

SECTION 8: Exposure controls/personal protection

8.1. Control parameters

If applicable, refer to the extended section of the SDS for further information on CSA.

DNEL: Derived no effect level (Workers)
None available.

PNEC: predicted no effect concentration
None available.

8.2. Exposure controls

Engineering measures

Natural or mechanical to prevent oxygen-enriched atmospheres above 23.5% oxygen.

Personal protective equipment

Respiratory protection	:	None necessary.
Hand protection	:	Wear work gloves when handling gas containers. Gloves must be clean and free of oil and grease. If the operation involves possible exposure to a cryogenic liquid, wear loose fitting thermal insulated or cryo-gloves. Standard EN 388 - Protective gloves against mechanical risk. Standard EN 511 - Cold insulating gloves.
Eye/face Protection	:	Safety glasses recommended when handling cylinders. Wear goggles and a face shield when transfilling or breaking transfer connections. Standard EN 166 - Personal eye-protection.
Skin and body protection	:	Personnel who have been exposed to high concentrations of oxygen should stay in a well-ventilated or open area for 30 minutes before going into a confined space or near an ignition source. Never allow any unprotected part of the body to touch uninsulated pipes or vessels which contain cryogenic fluids. The extremely cold metal will cause the flesh to stick fast and tear when one attempts to withdraw from it. Safety shoes are recommended when handling cylinders. Standard EN ISO 20345 - Personal protective equipment - Safety footwear. Encapsulated chemical protective suit in emergency situations.
Special instructions for protection and hygiene	:	Ensure adequate ventilation, especially in confined areas.

Environmental Exposure Controls	:	If applicable, refer to the extended section of the SDS for further information on CSA.

SECTION 9: Physical and chemical properties

9.1. Information on basic physical and chemical properties

(a/b) Physical state/Colour	:	Liquefied gas. blue
(c) Odour	:	No odor warning properties.
(e) Relative Density	:	1.1 (water = 1)
(f) Melting point / freezing point	:	-362 °F (-219 °C)
(g) Boiling point/range	:	-297 °F (-183 °C)
(h) Vapor pressure	:	Not applicable.
(i) Water solubility	:	0.039 g/l
(j) Partition coefficient: n-octanol/water [log Kow]	:	Not applicable for inorganic gases.
(k) pH	:	Not applicable for gases and gas mixtures.
(l) Viscosity	:	No reliable data available.
(m) Particle characteristics	:	Not applicable for gases and gas mixtures.
(n) Upper and lower explosion / flammability limits	:	Non flammable.
(o) Flash point	:	Not applicable for gases and gas mixtures.
(p) Autoignition temperature	:	Non flammable.
(q) Decomposition temperature	:	Not applicable.

9.2. Other information

Explosive properties	:	Not applicable.
Oxidizing properties	:	Ci =1
Molecular Weight	:	32 g/mol
Odor threshold	:	Odour threshold is subjective and inadequate to warn of overexposure.
Evaporation rate	:	Not applicable for gases and gas mixtures.

Flammability (solid, gas)	:	Refer to product classification in Section 2
Relative vapor density	:	1.105 (air = 1) Heavier than air.

SECTION 10: Stability and reactivity

10.1. Reactivity	:	No reactivity hazard other than the effects described in sub-sections below.
10.2. Chemical stability	:	Stable under normal conditions.
10.3. Possibility of hazardous reactions	:	Violently oxidises organic material.
10.4. Conditions to avoid	:	None under recommended storage and handling conditions (see section 7).
10.5. Incompatible materials	:	Avoid oil, grease and all other combustible materials. Flammable materials. Organic materials. finely divided aluminium Reducing agents. Materials such as carbon steel, low alloy carbon steel and plastic become brittle at low temperatures and are subject to failure. Use appropriate materials compatible with the cryogenic conditions present in refrigerated liquefied gas systems.
10.6. Hazardous decomposition products	:	No data available.

SECTION 11: Toxicological information

11.1. Information on toxicological effects

Likely routes of exposure

Effects on Eye	:	Contact with liquid may cause cold burns/frostbite.
Effects on Skin	:	Contact with liquid may cause cold burns/frostbite. May cause severe frostbite.
Inhalation Effects	:	Breathing 75% or more oxygen at atmospheric pressure for more than a few hours may cause nasal stuffiness, cough, sore throat, chest pain and breathing difficulty. Breathing pure oxygen under pressure may cause lung damage and also central nervous system effects. Breathing 75% or more oxygen at atmospheric pressure for more than a few hours may cause nasal stuffiness, cough, sore throat, chest pain and breathing difficulty. Breathing pure oxygen under pressure may cause lung damage and also central nervous system effects.
Ingestion Effects	:	Ingestion is not considered a potential route of exposure.
Symptoms	:	No data available.

Acute toxicity

Acute Oral Toxicity	:	No data is available on the product itself.
Acute Inhalation Toxicity	:	No data is available on the product itself.
Acute Dermal Toxicity	:	No data is available on the product itself.
Skin corrosion/irritation	:	No data available.
Serious eye damage/eye irritation	:	No data available.
Sensitization.	:	No data available.

Chronic toxicity or effects from long term exposures

Carcinogenicity	:	No data available.
Reproductive toxicity	:	No data is available on the product itself.
Germ cell mutagenicity	:	No data is available on the product itself.
Specific target organ systemic toxicity (single exposure)	:	No data available.
Specific target organ systemic toxicity (repeated exposure)	:	No data available.
Aspiration hazard	:	No data available.

SECTION 12: Ecological information

12.1. Toxicity

Aquatic toxicity	:	No data is available on the product itself.
Toxicity to other organisms	:	No data is available on the product itself.

12.2. Persistence and degradability

No data available.

12.3. Bioaccumulative potential

Refer to Section 9 "Partition Coefficient (n-octanol/water)".

12.4. Mobility in soil

Because of its high volatility, the product is unlikely to cause ground pollution.

12.5. Results of PBT and vPvB assessment

If applicable, refer to the extended section of the SDS for further information on CSA.

12.6. Other adverse effects

This product has no known eco-toxicological effects.

Effect on the ozone layer	:	No known effects from this product.
Ozone Depleting Potential	:	None
Effect on global warming	:	No known effects from this product.
Global Warming Potential	:	None

SECTION 13: Disposal considerations

13.1. Waste treatment methods : Return unused product in original cylinder to supplier. Contact supplier if guidance is required. Refer to the EIGA code of practice Doc. 30 "Disposal of Gases", downloadable at http://www.eiga.org for more guidance on suitable disposal methods. List of hazardous waste codes: 16 05 04*: gases in pressure containers (including halons) containing hazardous substances.

Contaminated packaging : Return cylinder to supplier.

SECTION 14: Transport information

14.1. UN number

UN/ID No. : UN1073

14.2. UN proper shipping name

Transport by road/rail (ADR/RID)	:	OXYGEN, REFRIGERATED LIQUID
Transport by air (ICAO-TI / IATA-DGR)	:	Oxygen, refrigerated liquid
Transport by sea (IMDG)	:	OXYGEN, REFRIGERATED LIQUID

14.3. Transport hazard class(es)

Label(s) : 2.2 (5.1)

Transport by road/rail (ADR/RID)

Class or Division	:	2
ADR/RID Hazard ID no.	:	225
Tunnel Code	:	(C/E)

Transport by sea (IMDG)

Class or Division	:	2.2

14.4. Packing group

Transport by road/rail (ADR/RID)	:	Not applicable.
Transport by air (ICAO-TI / IATA-DGR)	:	Not applicable.
Transport by sea (IMDG)	:	Not applicable.

14.5. Environmental hazards

Transport by road/rail (ADR/RID)
Marine Pollutant : No

Transport by air (ICAO-TI / IATA-DGR)
Marine Pollutant : No

Transport by sea (IMDG)
Marine Pollutant : No
Segregation Group : None

14.6. Special precautions for user

Transport by air (ICAO-TI / IATA-DGR)
Passenger and Cargo Aircraft : Transport forbidden
Cargo Aircraft only : Transport forbidden

Further Information
Avoid transport on vehicles where the load space is not separated from the driver's compartment. Ensure vehicle driver is aware of the potential hazards of the load and knows what to do in the event of an accident or an emergency. The transportation information is not intended to convey all specific regulatory data relating to this material. For complete transportation information, contact customer service.

14.7. Transport in bulk according to Annex II of Marpol and the IBC Code

Not applicable.

SECTION 15: Regulatory information

15.1. Safety, health and environmental regulations/legislation specific for the substance or mixture

Country	Regulatory list	Notification
USA	TSCA	Included on Inventory.
EU	EINECS	Included on Inventory.
Canada	DSL	Included on Inventory.
Australia	AICS	Included on Inventory.
South Korea	ECL	Included on Inventory.
China	SEPA	Included on Inventory.
Philippines	PICCS	Included on Inventory.
Japan	ENCS	Included on Inventory.

Other Regulations
REGULATION (EC) No 1907/2006 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 18 December 2006 concerning the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH), establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation (EEC) No 793/93 and Commission Regulation (EC) No 1488/94 as well as Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC.

COMMISSION REGULATION (EU) 2015/830 of 28 May 2015 amending Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH).

Regulation (EC) No 1272/2008 the European Parliament and of the Council of 16 December 2008 on classification, labelling and packaging of substances and mixtures, amending and repealing Directives 67/548/EEC and 1999/45/EC, and amending Regulation (EC) No 1907/2006.

15.2. Chemical safety assessment

A CSA does not need to be carried out for this product.

SECTION 16: Other information

Ensure all national/local regulations are observed.

Hazard Statements:
H270 May cause or intensify fire; oxidiser.
H281 Contains refrigerated gas; may cause cryogenic burns or injury.

Indication of Method:
Oxidizing gases Category 1 May cause or intensify fire; oxidiser. Calculation method

Gases under pressure Refrigerated liquefied gas. Contains refrigerated gas; may cause cryogenic burns or injury. Calculation method

Abbreviations and acronyms:
ATE - Acute Toxicity Estimate
CLP - Classification Labelling Packaging Regulation; Regulation (EC) No 1272/2008
REACH - Registration, Evaluation, Authorisation and Restriction of Chemicals Regulation (EC) No 1907/2006
EINECS - European Inventory of Existing Commercial Chemical Substances
ELINCS - European List of Notified Chemical Substances
CAS# - Chemical Abstract Service number
PPE - Personal Protection Equipment
Kow - octanol-water partition coefficient
DNEL - Derived No Effect Level
LC50 - Lethal Concentration to 50 % of a test population
LD50 - Lethal Dose to 50% of a test population (Median Lethal Dose)
NOEC - No Observed Effect Concentration
PNEC - Predicted No Effect Concentration
RMM - Risk Management Measure
OEL - Occupational Exposure Limit
PBT - Persistent, Bioaccumulative and Toxic
vPvB - Very Persistent and Very Bioaccumulative
STOT - Specific Target Organ Toxicity
CSA - Chemical Safety Assessment
EN - European Standard
UN - United Nations
ADR - European Agreement concerning the International Carriage of Dangerous Goods by Road
IATA - International Air Transport Association
IMDG - International Maritime Dangerous Goods
RID - Regulations concerning the International Carriage of Dangerous Goods by Rail
WGK - Water Hazard Class

Key literature references and sources for data:

ECHA - Guidance on the compilation of safety data sheets
ECHA - Guidance on the application of the CLP Criteria
ARIEL database

Prepared by : Air Products and Chemicals, Inc. Global EH&S Department

For additional information, please visit our Product Stewardship web site at
http://www.airproducts.com/productstewardship/

This Safety Data Sheet has been established in accordance with the applicable European Directives and applies to all countries that have translated the Directives in their national laws. COMMISSION REGULATION (EU) 2015/830 of 28 May 2015 amending Regulation (EC) No 1907/2006 of the European Parliament and of the Council on the Registration, Evaluation, Authorisation and Restriction of Chemicals (REACH).

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