Safety advice.

Oxygen Enrichment.

Properties

Oxygen supports and accelerates combustion
Oxygen is essential to life; the normal concentration of oxygen in the air we breathe is approximately 21 %, it is not flammable but supports combustion. Most materials will burn fiercely sometimes explosively as the concentration of oxygen in the air increases. This increases the risk of a fire.

Oxygen gives no warning
Because oxygen is colourless, odourless and has no taste, an increase in the oxygen concentration cannot be detected by the human senses.

Oxygen is heavier than air
Being heavier than air, oxygen can accumulate in low lying areas such as pits or cellars, especially during or after a spill of liquid oxygen as the gas is colder and therefore denser.

Example of increased reactivity for cotton overall material exposed to fire in atmospheres containing increasing levels of oxygen
Hazards

Health effects
The health effects of inhaling high levels of oxygen, for example of 75%, includes irritation of the respiratory tract, dizziness, nausea and visual disturbances.

Cold burns
In addition liquid oxygen has a very low temperature (-183°C) at which it can cause "cold burns" to human tissue and make certain materials brittle. Also the rapid evaporation of the liquid can cause frostbite and cold burn.

Conditions needed for a fire
For a fire to occur, three elements are required: combustible material, oxygen and an ignition source. The fire triangle is the normal way of illustrating these conditions. When any one of these three elements is missing a fire cannot occur.

Causes for Oxygen enrichment
Leaking oxygen equipment
This can lead to oxygen enrichment, i.e. an increased fire hazard. Leaking connections, flanges, and fittings etc. will cause the oxygen concentration to increase especially where there is insufficient ventilation.

Oxygen used in cutting and welding processes
In processes such as laser or flame cutting, gouging, scarving and thermal lancing, oxygen is used, in quantities greater than necessary for the burning process. The unused oxygen remains in the atmosphere, and if ventilation is inadequate the air can become enriched with oxygen.

Oxygen used in metallurgical processes
The incorrect use of blowpipes can lead to oxygen enrichment, especially in confined spaces.

Desorption
Oxygen can be released, in large quantities, when cold materials that have absorbed oxygen such as absorbents (molecular sieve, silica gel, etc.) or insulation materials are then warmed up to room temperature.

Liquid Oxygen spill
A spill of liquid oxygen creates a dense cloud of oxygen enriched air as it evaporates. The clothing of personnel entering the cloud will become enriched with oxygen. When liquid oxygen impregnates ground which contains organic material such as wood or asphalt, there is a danger that the organic material may ignite and burn if subjected to an impact.

Condensing of atmospheric oxygen
When handling cryogenic gases having a temperature below the boiling point of oxygen (e.g. nitrogen, helium, hydrogen) condensing of atmospheric oxygen and local enrichment is possible.
Precautions

Never use hydrocarbons i.e. oil or grease to lubricate oxygen equipment!
Equipment contaminated with oil and grease must only be cleaned using approved cleaning agents and methods. Always check that any material, part or substance, which can come into contact with oxygen, is approved for oxygen service.

Leak test
Leak test equipment, newly assembled or after maintenance, before putting it into service.

Ventilation
Rooms where there is a risk of oxygen enrichment of the atmosphere must be well ventilated. In many cases natural ventilation can be sufficient e.g. in halls or rooms provided with ventilation openings. The openings should have a flow area greater than 1/100 of the room’s floor area, be diagonally opposite each other and must ensure a free circulation of air with no obstructions. Where natural ventilation is not possible a ventilation unit, with a capacity of approximately 6 air changes per hour must be provided. Special consideration must be given to the ventilation of underground rooms, vessels, pits, ducts and trenches. There shall be a safety warning to indicate if the ventilation unit fails. For any confined space there must be a particular risk assessment carried out and a permit to work system used if there is a possibility of oxygen enrichment.

Ignition sources
In areas where oxygen enrichment can occur, do not smoke or use naked flames. If hot work (welding, flame cutting, soldering, grinding, etc.) has to be carried out, ensure that the atmosphere has been checked and confirmed as safe and remains safe and obtain a permit to work. If you have been in an oxygen enriched atmosphere ventilate your clothing in the open air for at least 15 minutes before smoking or going near a source of ignition.

Do not use oxygen for applications for which it is not intended!
Do not use oxygen as a substitute for air, e.g. when:

- operating pneumatic tools
- dusting benches, machinery or clothing
- cooling the air in confined spaces
- pressurising and purging systems
- inflating tyres, rubber boats, etc.
- spray painting
- replacing air or an inert gas
- starting diesel engines

Only use material, parts and substances approved for oxygen.
Ventilate clothing exposed to O₂ in the open air.
Do not use oxygen as a substitute for air.
Emergency

Oxygen is an oxidiser and supports combustion. Exposure to fire may cause containers to rupture/explode. Damaged containers should be handled only by specialists.

Spill or leak
1. Keep combustibles (wood, paper, oil, etc.) away from spilled material
2. Stop leak, if possible
3. If safe to do so, isolate container and position it so that the leak is from the gas phase
4. Do not direct water at spill or source of leak
5. Use water spray to reduce vapours or divert vapour cloud drift
6. Prevent entry into waterways, sewers, basements or confined areas
7. Isolate area until gas has dispersed

First aid
1. Inhalation: remove victim to uncontaminated area and fresh air.
2. Skin/eyes contact with liquid oxygen: in case of frostbite or cold burn, spray with water for at least 15 minutes. Do not remove clothes. Apply a sterile dressing. Obtain medical assistance. Immediately flush eyes thoroughly with water for at least 15 minutes.

Fire
1. Use extinguishing medium for the type of surrounding fire, oxygen supports combustion
2. Remove containers to safe area, if possible
3. Cool containers with water from a protected position. Exposure to fire may cause containers to rupture or explode
4. Do not direct water at source of leak or safety device
5. Advise Fire Service of containers location and contents

Refer to the relevant Safety Data Sheet for further information / Contact your local Linde supplier for specific questions.

Cylinders exposed to fire must be cooled from a protected position.

The safety data sheet informs users about chemical and physical properties of a material and its generic use, provides advice on the safe handling, storage, transport, use and disposal of the material, provides information about the health effects, exposure control, environmental effects and emergency procedures.