

Ensuring Gas Cylinder Safety

PHYSIOLOGICAL PROPERTIES OF CARBON DIOXIDE

Carbon dioxide is not usually considered to be a “toxic” gas in the generally accepted sense of the term (i.e. poisonous).

Normal levels in atmospheric air: approximately 0.03% (300 ppm)

The Threshold Limit Value (TLV) for carbon dioxide

The TLV is set at 0.5% by volume (5,000 ppm) as the maximum level which can reasonably be tolerated over an eight hour day.

This limited exposure provides a good safety margin for medically fit personnel (provided that normal levels of oxygen are present in the inhaled air). Cardiac or respiratory defects increase hazards of inhalation and bronchitis should be particularly careful to avoid heavy exposure.

The Threshold Limit Value of 0.6% (5,000 ppm) should be regarded as the maximum level of exposure of the individual concerned.

As the carbon dioxide concentration in the atmosphere is increased beyond these limit levels, air is displaced and there will therefore be a corresponding reduction of the oxygen content in the atmosphere. Inhalation has the effects of stimulating respiration and may also produce mild narcotic effects.

Breathing becomes more laboured as the level is further increased and at very high concentrations, carbon dioxide can paralyse the respiratory centre.

The potential hazard of asphyxiation should therefore be understood by personnel handling carbon dioxide and should be taken into account, particularly where there is a possibility of high concentrations accumulating in enclosed spaces.

Individual tolerances can vary widely, dependent on the physical conditions of the person and the temperature and humidity of the atmosphere, but as general guide, the effects of inhaling varying concentrations of carbon dioxide are likely to be as follows;

It should be appreciated that 1 kg of liquid or solid carbon dioxide will give rise to approximately 0.5m³ of gas.

Assuming, for example, an unventilated cellar measuring, 4m wide x 6m long x 2.5m high and having a total capacity of 60m³ then complete discharge of a cylinder containing 6.35 kg of carbon Dioxide would produce an average carbon dioxide concentration of approximately 5%.

Similarly, an 11.5 kg block of dry ice, left standing in the same cellar, would slowly sublime to produce a final average carbon dioxide concentration of approximately 10%.

However, since the gas is heavier than air, it will in practice accumulate in high concentration at the lower levels. It is therefore, possible for relatively “safe” and ‘unsafe’ concentrations to be present at the same time in the space concerned. In the event of accident or loss of consciousness an unaccompanied person could fall to floor level and be exposed to high concentrations for an Extended period before rescue. It is, therefore, advisable that a second person is present when an enclosed space is entered under such circumstances.

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| Concentration By volume | Likely |
|------------------------------------|---|
| 1% | <ul style="list-style-type: none">• Slight and unnoticeable increase in breathing rate. No other significant effects. |
| 2% | <ul style="list-style-type: none">• Breathing becomes deeper and the rate will increase to about 50% above the normal level.• Prolonged exposure for several hours may cause a headache and feeling of exhaustion. |
| 3% | <ul style="list-style-type: none">• Breathing will start to feel laboured and increased to approximately twice the normal rate.• The gas will be weakly narcotic at this level, giving rise to reduced hearing ability, coupled with a headache and an increase in blood pressure and pulse. |
| 4-5% | <ul style="list-style-type: none">• Breathing will become laboured and increase to approximately four times the normal rate.• In addition to the symptoms produced by lower concentrations, signs of intoxication will become evident after approximately 30 minutes exposure and a slight choking feeling will be experienced. |
| 5-10% | <ul style="list-style-type: none">• At these concentrations, carbon dioxide will have a characteristic, sharp and rather stimulating smell, similar to the “gassing” from freshly poured carbonated mineral water.• Breathing will become very laboured, leading to physical exhaustion.• This will be accompanied by a headache, visual disturbance ringing in the ears.• Judgement may be impaired and the confusion will probable followed within minutes by loss of consciousness. |
| 10-100% | <ul style="list-style-type: none">• As the carbon dioxide concentrations increases above the level of 10% unconsciousness will occur more rapidly and unless prompt action is taken, further prolonged exposure to high concentrations may then eventually result in death from asphyxiation. <p>At 100% concentration, death will occur very rapidly.</p> |

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