

Appendix 8. Treatment of cryogenic cold burns, frostbite and asphyxia

Cryogenic Gases

Working with Cryogenic gases, e.g. liquid nitrogen is a hazardous activity, which can cause asphyxiation and cold burns. The table below details how this can happen and what the typical symptoms of exposure would be:

Potential outcome	How?	Symptoms?
Asphyxiation	The cryogenic gas displaces oxygen in the atmosphere making it difficult to breath. The gases have no odour and so cannot be detected by smell.	The physical effects displayed could include increased pulse rate, impaired judgement, headaches or feeling faint. Severity and speed of onset will depend on oxygen levels. Acute asphyxia (oxygen levels below 10% (normally 20%)) can cause immediate loss of consciousness and prove fatal without prompt treatment.
Cold burns/ frostbite to the skin	Exposing skin to low temperatures can produce effects similar to a burn. Severity will vary depending on temperature and duration of exposure.	Exposed skin may stick to any very cold uninsulated vessel or pipe which it has come into contact with. This is caused by the moisture in the skin freezing on contact. Any attempt to pull the skin away is likely to result in severe tissue damage. The person may not experience any localised pain but instead are simply aware that they are unable to remove themselves from the item. Prolonged exposure can cause frostbite.
Cold effects on the lungs and eyes	Prolonged inhalation or exposure of the eyes to cold vapours or cryogenic gases can cause burns to the tissue in the lungs and eyes.	Exposure to low concentrations may cause shortness of breath and coughing. Exposure to high concentrations would cause difficulty in breathing and could prove potentially fatal. Any splashes to the eyes will cause irritation and potentially a burning sensation.

First-aid treatment

Asphyxiation

No person should put himself or herself at risk by entering an oxygen deficient area to rescue an unconscious person. Breathing apparatus will be required as the person can become unconscious after only one breath in a severely hypoxic environment. Training must be provided for use of breathing apparatus. Any casualties recovered should be removed immediately to a normal atmosphere. If they are not breathing, perform cardiopulmonary resuscitation (CPR) with no breaths (may be dangerous for first aider to administer mouth-to-mouth resuscitation) and call 999 for immediate assistance.

Cold burns/frostbite

Flush the affected areas of skin with copious quantities of tepid water, but do not apply any form of direct heat, e.g. hot water, room heaters, etc. If the skin is stuck to a very cold object then pour tepid water onto the area until the skin is released, if safe to do so, i.e. no live electrics close by.

Move the casualty to a warm place (about 22°C; 295 K). If medical attention is not immediately available, arrange for the casualty to be transported to hospital without delay. Treatment for shock may be necessary.

While waiting for transport:

- (a) Loosen any restrictive clothing.
- (b) Continue to flush the affected areas of skin with copious quantities of tepid water.
- (c) Protect frozen skin with bulky, dry, sterile dressings. Do not apply too tightly so as to cause restriction of blood circulation.
- (d) Keep the patient warm and at rest.
- (e) Ensure ambulance crew or hospital is advised of details of accident and first aid treatment already administered.
- (f) Smoking and alcoholic beverages reduce the blood supply to the affected part and should be avoided. In addition, no pain relief medication should be administered.

Cold effects on the lungs and eyes

For lung exposure, remove the person to an area with fresh air and allow them to rest in a comfortable position. Contact 999 or if stable, transport to A&E as there may be delayed symptoms. If breathing stops, perform CPR with no breaths (may be dangerous for first aider to administer mouth-to-mouth resuscitation) and call 999.

For splashes to the eyes, flushing with tepid water for at least 15 minutes. Do not rub the eyes. The person affected will require to be checked by a medical professional in A&E.

Cryogens should never be ingested as cryogenic liquid can cause burns to internal tissues. However, if this were to happen accidentally then 999 should be called.