

Marine Information Bulletin

Carbon monoxide hazards and your boat

Issued 1 February 2011; last reviewed 25 November 2013

Carbon monoxide

In a recent incident in Queensland, two infants exposed to carbon monoxide (CO) stopped breathing. Adults on board the boat were unaffected by the low level exhaust fumes. Fortunately, the children were resuscitated and after a short hospitalisation were discharged with no further ill effects. The incident highlights these facts:

- the toxic effects of carbon monoxide are real and dangerous
- carbon monoxide can have a severe effect on infants and children before older persons are aware of any problem
- the value of cardio pulmonary resuscitation training.

Carbon monoxide is a toxic gas produced by incomplete combustion of carbon-based fuels such as petrol, propane, charcoal, wood and oil.

Carbon monoxide is colourless, odourless and tasteless, so you cannot rely on your senses to detect the gas. Carbon monoxide weighs about the same as air and so it mixes evenly through air (it distributes itself throughout a space and does not rise or fall like some other gases).

If you can smell exhaust gas then carbon monoxide is definitely present. Carbon monoxide may also be present without the smell of exhaust gas.

Toxin

When carbon monoxide enters your lungs it reacts with blood haemoglobin and reduces the oxygen carrying capacity of the blood. The resulting lack of oxygen leads to tissue damage, permanent brain damage and subsequent death. Tissue damage can leave a victim with long term health problems, such as heart disease and reduced life span.

High concentrations of carbon monoxide can be fatal in minutes. The cumulative effects of the toxin mean lower concentrations can be fatal and cannot be ignored.

Early symptoms of carbon monoxide poisoning – irritated eyes, headache, nausea, weakness, and dizziness – are often confused with seasickness or intoxication so those affected may not receive the medical attention they need.

Dangerous areas

Sources of carbon monoxide on your boat include propulsion and auxiliary engines, gas cooking ranges and gas space and water heaters.

Petrol engine exhaust contains more carbon monoxide than diesel engine exhaust. The exhaust from a poorly tuned engine carries more carbon monoxide than the exhaust from a well-tuned unit.

Exhaust leaks – the leading cause of death by carbon monoxide – can allow carbon monoxide to migrate throughout the boat and into enclosed areas.

Carbon monoxide can accumulate in all weather conditions and when the boat is moored, anchored or underway.

Concentrations of carbon monoxide can occur within the cabin or other enclosed areas and also in some conditions in areas considered as open air, such as the rear deck and stern seat.

Carbon monoxide will also concentrate in areas off the boat. Areas of concern are near exhaust outlets, such as the swimming platform and during activities such as teak surfing, wake surfing and even water skiing close to the stern.

Carbon monoxide alarms

Fitting and maintaining carbon monoxide detectors and alarms is a way to minimise the risks of carbon monoxide poisoning.

The attached appendices provide more information about carbon monoxide and how to avoid exposure and the resulting poisoning. See:

Appendix 1 – Carbon monoxide poisoning

Appendix 2 – Carbon monoxide on your boat

Appendix 3 – Engine and equipment maintenance

Appendix 4 – Carbon monoxide alarms.

Further information

For further information contact your local Maritime Safety Queensland office:

Airlie Beach	4841 4500
Bundaberg	4132 6600
Cairns	4052 7400
Gladstone	4971 5200
Hervey Bay	4194 9600
Mackay	4944 3700
Mooloolaba	5452 1825
Brisbane	3632 7500
Gold Coast	5585 1810
Townsville	4421 8100

Other Marine Information Bulletins about the safe operation of ships are on Maritime Safety Queensland's website www.msq.qld.gov.au.

Appendix 1

Carbon monoxide poisoning

Carbon monoxide enters your bloodstream through the lungs and reacts with blood haemoglobin to reduce the oxygen carrying capacity of the blood and blocking the oxygen your body needs.

Prolonged exposure to low concentrations, or very quick exposure to high concentrations will cause brain and other tissue damage leading to permanent health problems or death. For instance concentrations in parts per million (ppm) of:

- less than 35 ppm will not affect a healthy adult
- 100 ppm will cause slight headache, fatigue, shortness of breath, errors in judgment
- 200 ppm will cause headache, fatigue, nausea, dizziness
- 800 ppm will cause headache, confusion, collapse and death if exposure is prolonged
- 1500 ppm will cause will cause headache, dizziness, nausea, convulsions, collapse and death within 1 hour
- 12 000 ppm will cause instant death.

Increased risk

Infants and children are far more susceptible to carbon monoxide poisoning than adults. Persons with pre-existing heart disease are also at increased risk and foetuses of pregnant women are at increased risk – especially when mothers are exposed to high carbon monoxide levels. Remember that symptoms of carbon monoxide poisoning may resemble the symptoms of other ailments and are easily overlooked.

Symptoms

Symptoms are flu-like and are often confused with seasickness or intoxication, so those affected may not receive the medical attention they need.

Consider possible carbon monoxide poisoning when someone on a boat experiences any of these symptoms:

- irritated eyes
- headache
- mental confusion
- hallucinations

- shortness of breath
- weakness
- fatigue
- dizziness
- unstable gait (stumbling around)
- nausea and vomiting
- unconsciousness.

Skin colouring in victims of severe carbon monoxide poisoning will often be bright pink or flushed red – not pale or blue as is usual with other breathing problems.

Response to carbon monoxide poisoning

If carbon monoxide poisoning is suspected, follow these steps:

- Consider your own safety and act accordingly.
- Move the victim to fresh air – breathing fresh air will stop the poisoning from getting worse.
- A victim of carbon monoxide poisoning requires urgent medical treatment and oxygen delivery equipment – if immediate medical assistance is not available then seek medical advice by radio or telephone.
- Follow first aid procedures until help arrives – apply cardio pulmonary resuscitation (CPR) if necessary.
- Find and fix the source of the carbon monoxide.

Consult a medical practitioner if you or others experience even mild symptoms of carbon monoxide poisoning.

A person trained in first aid and CPR has an advantage when responding to carbon monoxide poisoning. Ask your trainer for specific advice about carbon monoxide during your next first aid/CPR course.

Appendix 2

Carbon monoxide on your boat

In a recent incident in Queensland two children were seriously affected by carbon monoxide while in the cabin area of an 11 metre boat. The cabin was open to the stern and thought to have been adequately ventilated from ahead.

Carbon monoxide can accumulate anywhere in and around your boat. Watch for these situations:



Inadequately ventilated canvas enclosures.



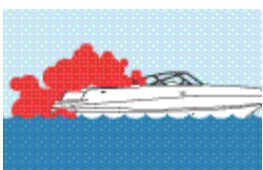
Exhaust gas trapped in enclosed places.



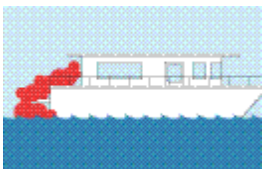
Blocked exhaust outlets.



Another vessel's exhaust. CO from the boat docked next to you can be just as deadly.



"Station wagon effect" or back drafting.



At slow speeds, while idling, or stopped. Be aware that CO can remain in or around your boat at dangerous levels even if your engine or the other boat's engine is no longer running!

Skiing, teak surfing and wake surfing

Teak surfing involves hanging on to the swimming platform (often made of teak wood) at the back of a boat while the boat is moving slowly forward. The swimmer then lets go of the platform to body surf on the boat's wake. A practiced teak surfer can even surf back to the boat and grab the swimming platform again.

Wake surfing is performed by riding a board on the boat's wake close to the transom.

In addition to the obvious danger of proximity to the propeller with teak or wake surfing, is a major, often unrecognised, hazard because this area behind the boat may be filled with carbon monoxide from the exhaust. An added hazard is that as teak surfers rarely wear personal flotation devices (PFDs) because they inhibit one's ability to surf a wake, a person incapacitated by carbon monoxide can rapidly drown.

Water skiing too close to the stern of a ski boat may also place the skier in a hazardous area.

The study *Carbon Monoxide Safe Distance Study, September 2003* by the United States Coast Guard and the American Boat and Yacht Council concluded that:

'CO levels in the stern seat of a ski boat are high enough to be cause for concern. CO levels at 20 feet (6 m) behind the towed boat are high enough to affect towed tubers who tend to be young children. CO levels at 5 feet (1.5 m) above the water in excess of 60 feet (18 m) behind the ski boat are low enough to not be of concern to recreational skiers.'

The study is available at the USCG website at http://www.uscgboating.org/safety/carbon_monoxide.aspx.

Fitting carbon monoxide detectors/alarms in strategic positions on your boat is a way to protect yourself and your family from carbon monoxide poisoning.

Graphics courtesy of the United States Coast Guard.

Appendix 3 Engine and equipment maintenance

Regular maintenance and proper boat operation can reduce the risk of injury from carbon monoxide. The exhaust from a poorly tuned engine carries more carbon monoxide than a well-tuned unit.

Petrol engine exhaust contains more carbon monoxide than diesel engine exhaust.

Checklists

Every trip

- Test the operation of each carbon monoxide alarm by pressing the test button.
- Confirm that exhaust cooling water flows when the engines are started.
- Listen for any change in exhaust sound, which could indicate an exhaust component failure.
- Make sure you know where sources of carbon monoxide are located (i.e. engine exhaust systems and gas appliances).
- Educate all on board about the symptoms of carbon monoxide poisoning
- Educate all on board about where carbon monoxide may accumulate.
- When moored alongside or rafted with another boat stay aware of exhaust emissions from the other boat
- Ensure that temporary rain and weather covers are not blocking the normal free flow of air around the boat
- Keep forward facing hatches open to allow fresh air to circulate.

Regularly

- Check your exhaust systems:
 - mounting clamps are in place and secure
 - no rust, exhaust soot, water leaks, corroded or cracked fittings evident
 - rubber hoses should be pliable and free of kinks with no burned or cracked sections
 - confirm that exhaust cooling water flows when the propulsion and auxiliary engines are started

- listen for any change in exhaust sound that could indicate an exhaust component failure
- Check the burners on your gas appliances.
- Check your carbon monoxide detector:
 - test the operation of each detector
 - make sure the detector battery is installed properly and is in good condition
 - never remove the detector battery unless replacing it with a new battery.

Annually

Have a marine mechanic:

- Ensure that propulsion and auxiliary engines are well tuned and maintained.
- Check and repair or replace as necessary:
 - exhaust components for cracking, rusting, leaking or loosening
 - hoses
 - cooling systems and water pumps
 - cylinder head and exhaust manifold components.

Have a gas fitter:

- Check your gas installation and appliances.

Appendix 4

Carbon monoxide alarms

Carbon monoxide enters the air as a product of incomplete combustion. There are small and varying concentrations of carbon monoxide in the air due to cigarette smoke, engine exhaust, bush fires and other forms of combustion.

A smoke detector will give an alarm immediately on sensing smoke. A carbon monoxide alarm operates differently. The low concentrations of carbon monoxide mentioned above will not trigger an alarm. The sensor monitors the level of the gas and the alarm is on a time delay when low concentrations of the gas are detected. As the concentration of carbon monoxide increases, the delay time for the alarm is reduced. A carbon monoxide alarm will sound the alarm before carbon monoxide concentrations become hazardous. If carbon monoxide levels rise quickly, there will be an alarm.

This concentration-time function is intended to mimic the uptake of carbon monoxide in the body, while also preventing false alarms due to relatively common sources of carbon monoxide such as cigarette smoke.

It is possible that you may not be experiencing symptoms when you hear the alarm. Do not wait for symptoms – do not ignore your alarm. Take appropriate action to ensure your safety and the safety of those on board.

Carbon monoxide alarms are available from about \$120. Models include:

- Brooks E1205
- FirstAlert FCD3NCNAUS
- Kidde Carbon Monoxide Alarm.

There are carbon monoxide and smoke alarm combinations also available.