



A surveyor's survival

A Gard surveyor writes about the dangers involved in entering enclosed spaces.

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Void spaces

Tanker men are usually familiar with the dangers of cargo tanks and other enclosed spaces; they are used to the problems of gas-freeing and checking for dangerous gases and lack of oxygen. They have the equipment and understand the need for entry procedures and entry permits.

There may be less awareness of these problems among the crew on board dry cargo vessels, but still both ballast tanks and void spaces may be very dangerous to enter. The oxygen level of the air inside may be reduced, especially if tanks are rusty. The chemical formula of rust in its most general form is hydrated iron oxide, $\text{Fe}(\text{OH})_2$, the oxygen being taken from the surrounding air. As the frequent sea water exchanges of ballast tanks make corrosion a never-ending matter, the rust effects on the oxygen level can be expected. But void spaces may be even more dangerous if there is internal ongoing corrosion, because such spaces may be much less ventilated than a ballast tank. The ballast tanks have a need for air pipes for the purpose of filling and emptying ballast water, but a void space may just be closed off, with a bolted manhole cover on the only opening.

The following incident is recounted by one of Gard's in-house surveyors.

A survivor's account

My 30 years' experience with inspections of ships has made me well aware of the dangers involved in entering enclosed spaces and I have often warned others of the danger of lack of oxygen therein. Still, one day I made the mistake of my life: I entered an unknown void space and collapsed due to the lack of oxygen. I eventually got out alive thanks to correct actions taken by a companion and a large dose of pure luck. As most victims do not get out alive from such ordeals, I am in the special position of being able to tell of my experience, having "inside information", so to speak.

It was not a complicated ship to inspect, just a barge, a big flat top barge engaged in the carriage of stones across the North Sea. A rough trade, making a condition survey warranted. A one day job, as the barge was in a repair yard two hours' drive from the Gard office in Arendal. A superintendent came to accompany me, and together we toured the deck. Rather smashed up she was, so remarks were many, and the opportunity also called for a spot check of the internal structures. Along with some ballast tanks, void spaces at the fore and the aft end had been opened up in the morning, upon my request, in order to be aired out. The void spaces were not different from the ballast tanks on board, except that there was no ballast pipe connected, so they served no ballast purpose. Such spaces should normally be maintained in dry condition, but these were not, water having been seeping through the manhole covers in deck. We first inspected the aft end space without any problem, and then did the one at the forward end. At this location there was a gangway to the yard's quay and some workers on deck. Between us the superintendent and I had more than 60 years' experience with inspection of ships and had no doubt been inside a few thousand tanks. Had we been on board a manned ship, there would have been a deck officer to guide us around, one to ask questions and to query about the ventilation of the tank. However, this was an unmanned barge and we forgot all about being careful. The entrance to the void space was through a flush manhole, 560 mm x 380 mm in size, just enough for a man to squeeze through. Eager to do the job, I was the first down by the vertical steel ladder, and the superintendent followed. I walked down the sloping plate of the barge's forebody – there was water at the bottom and rusty surfaces all around – and started to take pictures. Looking back for the superintendent I was surprised to see him climbing out, and all of a sudden I had no strength to move my feet. No warning of bad smell, no out of breath feeling, no feeling of discomfort except a need to sit down. So I did, feeling no panic, just a realisation that something was wrong. The next thing I remember was noticing a grey sector of gas coming down from the manhole, stopping and coming on again, several times.

The superintendent, feeling something was wrong with the air in the tank, had called for help and for oxygen when reaching the deck. A worker drove a fork lift into the nearby workshop and brought out a full 50 litre, 200 bar bottle of oxygen. This was placed across the manhole, and the superintendent let the gas blow into the void space, but closed and opened the valve repeatedly to avoid it freezing. This stream of oxygen made me revive and I could again move my legs, walk to the ladder and climb out. There was a sigh of relief from the people on deck when I popped my head through the deck opening, and I was surprised to see how many people there were: in addition to the superintendent and the yard workers, there was a rescue team of firemen with ropes and breathing apparatus, there was an ambulance with three men in white gowns, there were two policemen and even a journalist and a photographer from the local newspaper. I had no conception of having been unconscious, and I believed I had been in the tank for no more than 2-3 minutes. But to get all the people to the scene must have taken at least 10 or 15 minutes, and although I had a feeling of just having been sitting down for a short while before coming up, the superintendent told me that I had been lying down in the bottom of the tank, motionless. My expensive torchlight was still at the bottom of the tank proving that I had unconsciously let go of it. Well out on deck I got some oxygen through a mask and was examined by the ambulance people. A fireman tested the air at the bottom of the tank with an oxygen meter on a rope, and found a level of only 10.5 per cent – not much, considering that the result included the oxygen blown in by the superintendent.

In normal air there is 21 per cent oxygen, 78 per cent nitrogen and 1 per cent argon. An oxygen monitor will normally tell you to get out if the level sinks to 19.5 per cent. It may vary between individuals, but before the oxygen level reaches as low as 14 per cent, a person's physical abilities will be reduced. Between 14 and 11 per cent a person's physical and mental conditions are greatly affected, without the person being aware of it. That was my case: the body does not give any particular signal of low oxygen level in the air, and I did not at all realise I was in serious trouble, just wanted to sit down a bit. If the oxygen level should become as low as 11 to 8 per cent, unconsciousness without warning is likely after a few minutes, and that happened to me. At even lower values, the person will only be saved if very fast assistance to revive is provided.

Once you have experienced such an ordeal, you start to think. Could the firemen have managed to get my deadweight of 95 kg out through a narrow manhole? A standard manhole opening often in use today is 600 mm x 400 mm – not much – and on older vessels many are found to be even smaller. For the passage of a man with breathing apparatus or for evacuation of a person, an opening of at least 600 mm x 600 mm is considered necessary, and one does not find many of those as entrances to ballast tanks and void spaces. What if there had been no oxygen bottle available? What if the barge had not been at a yard? Would I have been saved if the accident had happened at the aft end of the barge, with no workers around?

You should always be prepared and know exactly where your rescue gear is if you are to have any chance of succeeding with a rescue operation. Keeping designated rescue gear in good order and performing regular exercises is a must. Stick to approved procedures when you have to enter an enclosed space and stay alive to enjoy the best air in this world: the fresh sea breeze.

Gard's safety awareness campaign on enclosed space entry training

The story above has later been captured in one of Gard's [Loss Prevention awareness videos](#) . By sharing an experienced surveyor's near fatal-mistake we aim to warn crews not to become complacent about the risks associated with enclosed space entries and to emphasise the importance of training and following established procedures - even for those that "have done this a thousand times" and are certain that they "know the procedure from A to Z".

The following link will take you to the safety awareness campaign website, which contains our video, a case study and additional loss prevention material addressing entry into enclosed spaces: <https://www.gard.no/document/enclosed-space-entry-training/>