



Guide to gases: Nitrogen

Wilhelmsen Ships Service supplies a broad range of gases in high pressure cylinders to the maritime industry. These gases are used in a wide variety of applications onboard vessels around the world.

Of all these gases, nitrogen (N_2) is the most common inert gas. Nitrogen is present in the atmosphere (78,9%) along with oxygen (20,9%), argon (0,9%) and other trace gases (0,1%).

Production

Nitrogen is produced mainly through the process of fractional distillation of liquefied air. Ambient air is compressed and cooled to down until it liquefies. The liquid is then fed into a distillation column and the three prime components are separated here; nitrogen, oxygen and argon. The installations are called ASUs (Air Separation Units). The result is a high purity nitrogen in high volumes.

There are other methods of producing nitrogen (adsorption and diffusion separation) but the quality of the nitrogen produced is lower and the production rate is much slower.



Liquid nitrogen “boiling” at room temperature (Courtesy AGA)

Nitrogen is transported to the end-user either as compressed gas in cylinders (150-300 bar) or in liquid form in so called “Dewars”, which are heavily insulated stainless steel containers.

Properties

Nitrogen is used mainly for its inert properties. It can shield (blanket) potentially reactive materials or products and protect them from contact with oxygen (O_2). Although under specific conditions it is possible to have nitrogen react with some products, in general it is considered an effective low-cost inert gas. Other inert gases such as argon and helium are more expensive.



The facts:	
Boiling point	: -195.8 °C
Specific gravity gas (Air=1)	: 0.974
Specific gravity liquid (Water=1)	: 0.808

In liquid form (at boiling point) it is mainly used as a coolant (it absorbs large quantities of heat when it evaporates) and also for its inert properties.

On board applications

Typical marine applications because of its inert properties are:

- **Blanketing**
To protect flammable liquids from coming into contact with air (= oxygen and or moisture), these products are transported under a blanket of pure nitrogen. During loading, unloading and transport, the space above the cargo is completely filled with nitrogen replacing any air. By maintaining a slight overpressure (approx. 0,10 bar), the ingress of fresh air is prevented. The nitrogen lies as an inert blanket on the cargo, hence the name. Other names for the same process are padding and inerting. Food products is a typical range of products for which nitrogen blanketing during transport is used.
- **Purging**
Pipelines used for loading and unloading also need to be protected. Removal of the remains of flammable products (both liquid and gas) can be done by flushing the pipelines with copious amounts of nitrogen under high velocity. This is called purging. Prior to maintenance such as demounting and welding, purging is the standard procedure for ensuring a safe working environment.

Typical marine applications because of its cooling properties are:

- **Shrink fitting**
Shafts and similar precision parts are often fitted to seals in other rotating components using shrink fitting. The shaft is cooled down, which causes the material to shrink. Cooling is often done by immersing the part in liquid nitrogen (-195,8 °C). When the shrunk shaft is then placed in the other component, the shaft will start to expand again (warming up to room temperature) and a strong tight connection will have been made.

Safety

Although nitrogen is an inert gas (not poisonous), working with the gas can sometimes create conditions that are life-threatening especially in confined, badly ventilated spaces. Asphyxiation is usually associated with nitrogen and other inert gases, such as argon, CO₂ and helium, since they do not support life and are capable of reducing oxygen concentration to very low levels through displacement and dilution.

Most asphyxiation accidents occur when crew enter rooms or tanks that are connected to a nitrogen supply that have not been properly checked for oxygen concentration before entry. Nitrogen is lighter than air and differences in oxygen contents between the top and bottom of the area can therefore occur. It is important always to measure both to be sure. Complete entry is not essential for a very serious or fatal accident to occur: fatalities have occurred where crewmen have simply leaned in to inspect a tank with an oxygen-depleted atmosphere. Inhalation of an oxygen depleted atmosphere can cause a person to immediately lose consciousness without warning and die from asphyxiation. Tragically, there



have been many examples of fellow crewmen going to the aid of victims and becoming victims themselves because they were not aware of the cause of the initial incident.

Working with liquid nitrogen has extra risks caused by the extreme low temperature. When skin comes in contact with liquid nitrogen the tissue will immediately freeze. Once defrosted, all cells in the tissue are damaged and the frozen tissue will die and turn black, similar to the experience of frostbite.

Nitrogen is a relatively cheap gas used for blanketing and purging and when used carefully it is also one of the safest.

Wilhelmsen Ships Service supplies nitrogen in two grades (3.0 = 99.9% pure and 5.0 = 99.999% pure) and in two sizes of compressed gas cylinder (10 and 50 litre at 200 bar). Liquid nitrogen is not supplied as a standard product, but can be delivered in certain ports as a special order.

Wilhelmsen Ships Service supplies regulatory products and services, Unitor marine products, Nalfleet marine chemicals, maritime logistics and ships agency.

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