



Chemical oxygen generation
milspec MPOG & EO2-30
safe, reliable, high quality

The milspec MPOG & EO2-30 oxygen generators

Over the past decade, using forward thinking product design and training and logistics analyses, Molecular Products has developed the milspec Multi Purpose Oxygen Generator (MPOG) and EO2-30 sodium chlorate oxygen generator that safely provide breathable oxygen for use in closed circuits environments.



Both the milspec MPOG and EO2-30:

- use a phosphorus match initiator mechanism that is both easy to use and easy to source
- are in service with NATO navies across the globe
- have a 10 year shelf life with no maintenance requirements
- have been shock and vibration tested to meet the requirements of a submarine environment
- are safer compared to pressurised and liquid oxygen systems
- give 380 litres of breathable oxygen per litre of storage space
- can be deployed in less than a minute



milspec MPOG & EO2-30

The technology behind the milspec MPOG and EO2-30

The milspec MPOG and EO2-30 use sodium chlorate technology to safely provide >98% purity. As a method of storing oxygen, sodium chlorate is roughly eight times more efficient than compressed air and twice as efficient as compressed oxygen.

Due to the thermal degradation mechanism for oxygen generation and the choice of fuel source, once the product has been initiated the chemical process ensures the prescribed amount of oxygen is delivered at a constant rate.

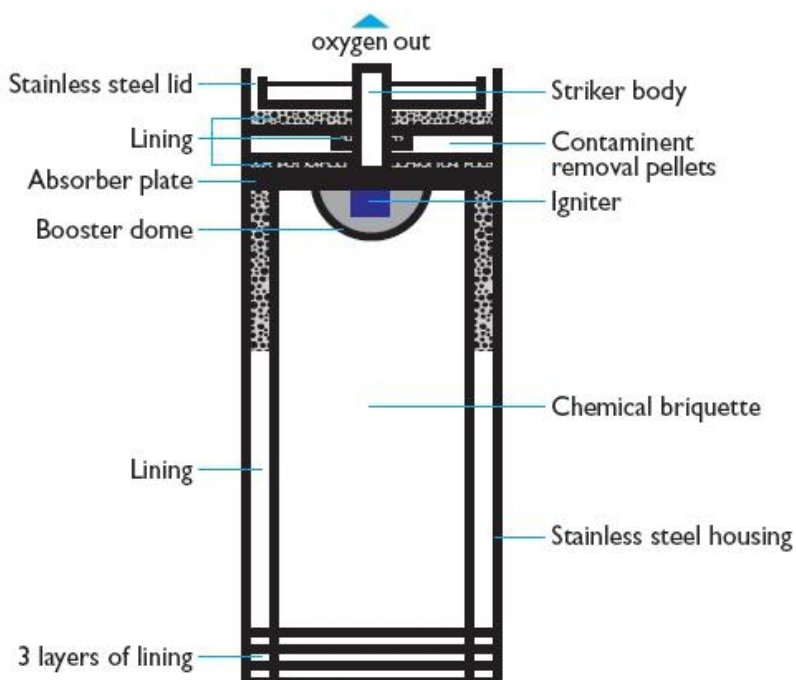
The product is started by a phosphate match that, when turned against the igniter, creates the initial highly localised heat source that is required to start the reaction.

Once the reaction has been started, it will instantaneously produce oxygen. The reaction cannot be stopped once initiated, which means it is a single use product.

The subtlety of the technology comes from the careful manipulation of the iron and sodium chlorate concentrations in order to control the rate of the reaction and the volumes produced.

Sodium chlorate chemistry has been commercially proven over decades of use. It has been used for the generation of breathable oxygen since the early 1900s, used very effectively for many years in submarines and circa 50% of commercial aircraft use this technology for passengers in the event of cabin depressurisation.

Molecular Products specialises in the manufacture and distribution of chemical technology for the purification of air to preserve life and protect the environment. Founded in 1924, it is a global leader in its field, offering a complete product solution for the removal of carbon dioxide, the generation of oxygen and filtration of hazardous or harmful emissions.



Sodium chlorate - the facts

- Sodium chlorate requires no maintenance
- It is eight times more efficient than compressed air and twice as efficient as compressed oxygen
- The chemical reaction behind sodium chlorate chemistry is relatively simple; iron reacts with a small oxygen source to produce iron oxide (rust)
- The heat from this reaction enables the sodium chlorate to decompose into oxygen and sodium chloride (table salt)
- Sodium chlorate is extremely stable in storage

Extreme testing

- It can be safely operated between -20°C and $+70^{\circ}\text{C}$, and between 1 and 5 bar atmospheric pressure
- The technology has been shock, environmental and vibration tested and meets the extreme requirements of submarine usage

The development of the milspec MPOG and EO2-30 oxygen generators

Case study: HMS Tireless

The milspec MPOG and EO2-30 represent the current evolution in Molecular Products Ltd. range of oxygen generators. They have been developed through rigorous product design, influenced greatly by the tragic explosion on HMS Tireless on 21st March 2007.

Molecular Products representatives worked with the UK MoD and after a two year inquest, the Board of Inquiry determined that the origin of the explosion was a Self-contained Oxygen Generator (SCOG) that had been badly dented allowing it to become heavily contaminated with hydraulic fluid with a safety information pack that predicted such a scenario having been disposed of at the point of receipt of goods.

Driven by the evidence and recommendations made by external review bodies, Molecular Products Ltd. embarked on an extensive development and education programme with the aim of creating an intrinsically safer through-life product based on a comprehensive understanding of its lifecycle.

The first evolution of the SCOG resulted in changes to the design, training and logistics management, all focused on creating a safer to use product, the EO2-26. These changes included;

- Safety datasheet supplied as an integral part of the product
- Safety awareness training courses
- Unique pin marker on each unit
- Bespoke metal transport stillages
- An anti-pollution wrap to help minimise contamination during stowage
- Designated on-board stowage lockers
- An improved cap seal along with carrying handle and a doubling in the thickness of stainless steel used



Continued development has led to the milspec MPOG and EO2-30 oxygen generators with both products incorporating even more safety features.

In the case of the milspec MPOG, the anti-pollution bag was replaced with a hermetically sealed stainless steel out tin and a moisture indicator was added between the inner and outer tins to show seal integrity. The starting mechanism was updated from a less reliable and difficult to source 410 cartridge, to an easier to use internally produced phosphorus match mechanism.

In the case of the EO2-30 the cap seal was further improved and the anti-pollution bag designed to rip before any damage to the oxygen generator has occurred, thus giving a clear indication to users that the product will require a visual inspection. The total volume of oxygen produced was increased to meet customer requirements and the starting mechanism was also updated to the phosphorus match.

The exact specifications of both the milspec MPOG and EO2-30 can be found in the technical datasheet on the following page.

Technical Data Sheet

	milspec MPOG (NSN 4240-99-570-0565)		EO2-30 (NSN 4240-99-176-7914)
Specifications	Stowage	In use	Stowage & In use
Depth x width (mm)	Circa 133 x 133 mm	Circa 133 x 133 mm	140 - 142 mm
Height (mm)	Circa 400 mm	Circa 384 mm	400 - 420 mm
Weight (kg)	<15 kg		<15 kg
Storage volume (litre)	Circa 7 litres		7.8 litres
Oxygen generation (litre)		2600 @ NTP	> 3000 @ NTP
Delivery duration (minutes)		60 - 90	25 - 45
Purity of oxygen (%)		>98 +	> 98 +
Carbon monoxide (max. ppm)		<50 ppm	<100 peak <25 average
Carbon dioxide (max. ppm)		<1000 ppm	<10000 peak <5000 average
Chlorine (max. ppm)		0.1 ppm	<10 peak <0.1 average
Sodium chloride - salt (max. mg/l)		<10	<10
Starter mechanism (not interchangeable)	Phosphorous match supplied separately		Phosphorous match supplied separately within packaging

Packaging, transportation and disposal

milspec MPOG

The generators are packed in stillage (one stillage contains 25 oxygen generators). Dimensions 80 x 80 x 70 cm, net weight 225 kg, gross weight 430 kg.

The units are not shipped with the starter. The units are classified as hazardous UN 1479, class 5.1 oxidiser; packing group II, can be supplied packed in accordance with IATA regulations for airfreight (not passenger aircraft) or IMDG regulations for seafreight.

EO2-30

Generators are packed with 25 generators in each stillage. Dimensions 80 x 80 x 70 cm, net weight 225 kg, gross weight 430 kg. Oxygen generators are classified as hazardous UN 3356, class 5.1 oxidiser; packing group II, and are packed in accordance with IATA regulations for airfreight (not passenger aircraft) or IMDG regulations for seafreight (special rules apply in the USA).

Spent oxygen generators are classified as non-hazardous and can be disposed of according to local legislation in landfill. Contact Molecular Products regarding disposal of damaged or retired devices.

NSN Number of starter Ignitor: 1375-99-667-8543

Operation and safety

Once the reaction has been started it will instantaneously produce oxygen that is at ambient temperature by the time it reaches the dispensing mask. The reaction cannot be stopped once initiated which means this is a single use product.

The product is essentially resistant to its environmental surroundings when in use. It can be safely operated between -20°C and $+70^{\circ}\text{C}$ and between 1 and 5 bar atmospheric pressure. The oxygen generators can be operated in any orientation and its orientation can be changed during its operation, without any effect on its performance or consequences to its safety. The technology has been shock, environmental and vibration tested and meets the extreme requirements of submarine usage.

Sinusoidal and random vibration testing, impact, pressurisation/depressurisation and thermal cycling performance meet the requirements of the submarine environment.

As part of the technology's environmental testing Molecular Products has shot and drop tested the milspec MPOG and EO2-30. The shot test was performed with a 12.7mm armour piercing round fired from a rigidly mounted machine gun, modified to fire a single shot from 20m (figure 1). The entrance and exit points can be seen in figures 2 and 3 respectively. The sodium chlorate generator was successfully initiated at the end of the test. The drop test, as seen in figures 4 and 5, was performed from 12m and although the outer casing suffered significant damage. It was again successfully initiated at the end of the test.

Fig. 1



Fig. 2



Fig. 3



Fig. 4



Fig. 5



Molecular Products - about us

Molecular Products is a privately owned business with direct subsidiaries in Europe, North America and Asia. The Group offers leading chemical technology for the purification of air to preserve life and protect the environment. Founded in 1924, the company has shown consistent growth through acquisitions and on-going investment in research and development. A highly skilled work force liaising closely with customers around the world has helped establish Molecular Products as a global leader in its field.

Molecular Products Ltd has highly sophisticated production facilities in Essex, UK, and Denver, USA, for the manufacture and supply of chemical technologies for the treatment of breathable gases. These products are used in the removal of carbon dioxide, the generation of oxygen and the filtration of hazardous or harmful emissions.

Molecular Products supplies a large number of the world's Navies with products to maintain a breathable atmosphere in submarines, by removing carbon dioxide and generating oxygen. Oxygen production is achieved by a full range of oxygen generators which are stored on submarines for use during maintenance of the central oxygen generation system or when additional oxygen is required.

Contact us

For further information on the milspec MPOG and EO2-30, and to discuss potential supply requirements, please contact us:

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Quality and innovation

Our aim is to manufacture chemical products which satisfy completely the needs of our customers.

All products are rigorously tested to ensure conformance to the specification. Our activities comply to the requirements of ISO 9001:2008.

Molecular Products has a proven track record of remarkable innovation. Our expertise in research and development, along with employing the latest technologies in our manufacture, enables us to ensure that all of our products conform to the highest international standards and exceed customers' expectations.

ISO 9001:2008 encompassing all company activities
ISO 13485:2003 (certificate number: MD76532)
CE mark on all medical devices and a number of mechanical devices





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