



DESIGN IMPROVEMENTS TO THE MPOG OXYGEN GENERATOR



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MOLECULAR PRODUCTS GROUP

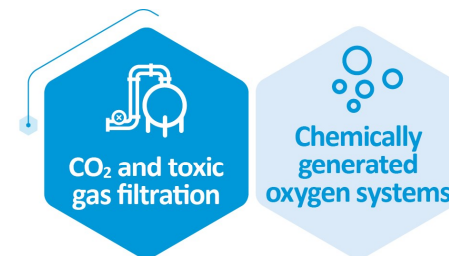


ABOUT US



GLOBAL LEADER

Molecular Products is a world leading Pure Air Technologies company. Our products purify air in life critical applications and we are preeminent in the market for:



O₂ FAMILY OF PRODUCTS



Oxygen generator	Oxygen (litres)	Size (mm) H x D x W	Weight (kg)	Duration (mins)
CAN33	3341	295 x 165	12.7	40-60
MPOG	2600	400 x 133 x 133	12.2	60-90
EO2-30	3000	420 x 142 x 140	15.0	25-45
ROG	90	270 x 115 x 115	2.3	15

CHLORATE O₂ CHEMISTRY APPLICATIONS



- Chlorate O₂ solutions used globally in applications including submarines, aircraft, battlefield and mine refuge chambers
- Supply oxygen generators to NATO and allied force navies throughout Europe, Americas, Asia and Australia
- The chemistry is commercially proven and well understood by Molecular Products





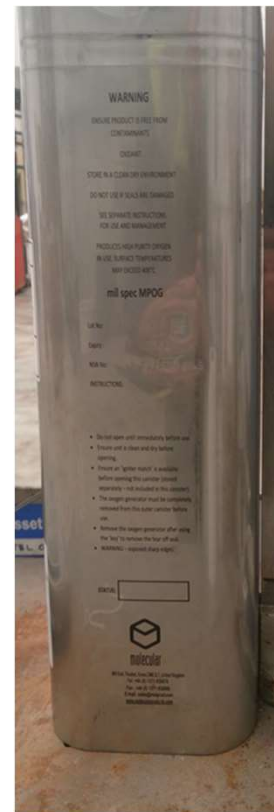
THE BEST SOLUTIONS COME THROUGH COLLABORATION AND PARTNERSHIP

- Close collaboration between the Royal Navy and Molecular Products that led to the development of the MPOG
- When launched in 2011, the MPOG was a new evolution of oxygen generator
- Offers improved user experience and better protection
- MilSpec and MineSpec oxygen generators are used globally to provide breathable oxygen in closed environments; primarily submarines, mines and safe havens
- These life support devices used in some of the world's most inhospitable environments, so we rely on close working relationships with our customers and honest feedback to make our products better
- This is what has happened with the MPOG and led to the Mk2

SWOLLEN OUTER TIN

- Royal Navy reported to Molecular Products that swollen MPOGs had been identified onboard a submarine
- Molecular Products visited Faslane to inspect the units
- MPOG shipped back to Molecular Products' facility in UK to be opened in a controlled manner and tested
- No recorded history of swollen tins throughout the years of oxygen manufacturing at Molecular Products

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Standard
outer tin



Swollen
outer tin



THE CONCLUSION - SWOLLEN OUTER TIN

- Inner chemical block produces a small amount of oxygen rich gas over a number of years
- This oxygen produces a slight over pressure in the inner tin and can, on occasion, produce bulging of the outer thinner walled canister
- Present in all generators, but finds an escape route. Improved sealing of MPOG results in this gas being trapped
- Heating the generators in storage may slightly increase the rate of the gas build up
- No evidence to suggest that the slight pressurisation leads to a reduction in performance or a hazardous or unsafe condition



THE PROBLEM – PARTICULATE MATTER

- MoD reported a small amount of particulate being discharged with the gas release of an MPOG onboard a Royal Navy submarine
- Concern that part of the chemical block being discharged and that MPOG would not perform as expected
- Molecular Products visited Faslane to inspect the units
- Representative sample of MPOGs across a range of LOT numbers and in-use/in-stores product shipped back to Molecular Products' facility in UK for testing

THE INVESTIGATION – PARTICULATE MATTER



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- Outer tins opened using the normal key and inner tins removed for inspection
- Bag taped to top of a selection of the tins and the MPOGs opened, capturing any gas/particulates within the bag
- MPOGs then tested following normal test procedures for this product
- MPOGs performed to specification
- When analysed, particulate ejected from filter section not part of chemical block



THE INVESTIGATION – PARTICULATE MATTER

Batch	Gas release	Particles with the gas release	Duration (mins) (spec 60-90)	O ₂ output (spec 2600 +/- 100)	Max surface temp °C (spec 500°C)	CO (ppm) (spec 50 ppm)	CO ₂ (ppm) (spec 1000 ppm)
O50-116	Yes	No	90	2671	275	10	23
N50-044	No	No	75	2619	312	12	42
L50-128	Yes	No	77	2655	305	8	25
B50-060	Yes	Yes	80	2687	337	18	104
J50-005	Yes	Yes (8g)	74	2621		18	51
J50-032	Yes	No	84	2627	322	14	40
H50-078	Yes	No	71	2635	339	19	118
H50-141	Yes	No	68	2623	348	13	79
B50-070	Yes	Yes	72	2684	341	11	135

MPOGs tested performed to specification



THE SOLUTION – PARTICULATE MATTER

- Prevent discharge and update the filter material
- Escape route for particles is through the centre of the lid/filter plate. This hole is required for insertion of brass starter and so open (within a sealed unit) until initiation is required
- Further testing proved the effectiveness of:
 - Addition of a brass plug to block hole in centre of filter plate
 - Change filter assembly during manufacturing process from outside to within MPOG

THE SOLUTION – PARTICULATE MATTER

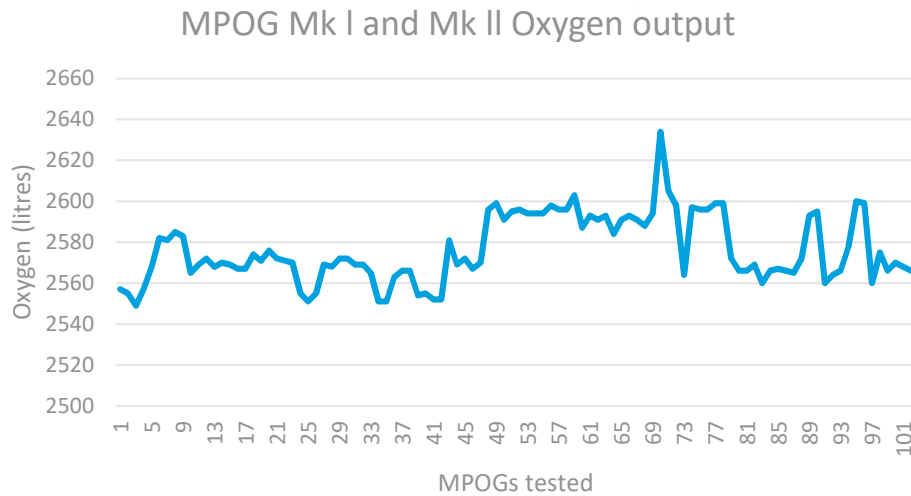


Difference between MPOG with a brass plug and without after opening pressurised units

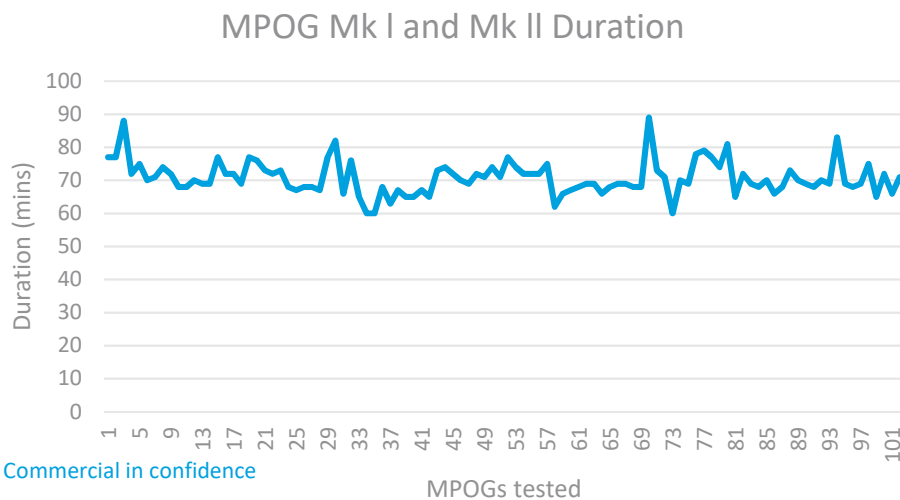


Shows the filter plate and underside of the lid of both the new including brass plug (right) and old design (left)

THE SOLUTION



- Results of testing demonstrate that there is no concern regarding performance of MPOG Mk2



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MPOG MK2



- Introduction of the MPOG Mk2 is the result of collaboration between Molecular Products and MoD following period of feedback and review
- For end user, the changes from Mk1 to Mk2 are only in the initiation. Once tear off cap is pulled off, the brass plug needs removing to enable initiation
- Testing carried out by both Molecular Products and an independent test house on the MPOG Mk2 demonstrate that the changes have removed the likelihood of particulates escaping from MPOG Mk2



THANK YOU



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