## Reactive Gases and the Synthetic Lubricants that Love Them

Fluorine is a remarkable element. In its elemental state, it is highly reactive and toxic. However, when tightly bonded to other molecules and elements, it becomes almost totally non-reactive, taking on remarkable properties that have made the manufacture of almost totally inert lubricants possible. These lubricants not only include high temperature grease and oil but also several types of wax. Fluorine and hydrogen fluoride have a remarkable affinity for calcium and silicon. This property allows these simple fluoro-acids to do very useful things, such as etch glass (which is made from silicon-based silica) in an industrial setting. It also makes it very dangerous. That very same acid can burn right through your arm and straight to your bones. Of course, most people don't handle highly reactive fluorochemicals at any point in their lives. This is reserved for a very small number of researchers and technicians who are well aware of the danger such compounds of fluorine pose to human health. The fluorine compounds that most people come into contact with are very solidly bonded to other chemicals before most people ever come near. As such, they are mostly inert by definition - something that petroleum-based hydrocarbons certainly cannot claim. Among the most useful attributes of fluorochemical based oils are their ability to remain non-reactive in even the most critical and potentially reactive situation involving gases such as pure, high-pressure oxygen situations or other cryogenic gases that are commonly used for a wide array of functions. Anyone familiar with the highly reactive nature of gases under high pressure or stored as super-cold liquids knows that every single surface that such gases come into contact, whether on purpose or accidentally in the case of mechanical failure of the delivery device components, must not be composed of reactive substances. The gas most commonly used and stored in this way is oxygen. Though perhaps most often found in medical applications, SCUBA divers, mountaineers and high level athletes all use portable liquid oxygen tanks to deliver pure gaseous oxygen. Safety with such devices goes well beyond a smoking ban. Since mechanical devices are responsible for mixing and delivering oxygen or other reactive gasses under high pressure, an oxygen compatible delivery system requires inert oils such as the completely fluorinated or polychlorotrifluoroethylenes (PCTFE) based oils, lubricants and waxes that keep moving parts from friction while not succumbing to the fierce oxidization and other violent reactions that characterize many such gases. Life support systems that carry oxygen (and often nitrogen, too) in medical applications must meet the highest standards of oxygen safety. Only totally inert substances are allowed, even inside sealed bearings and the other hardware of an oxygen delivery system. Oxygen compatibility of halocarbon synthetic, inert oils and waxes has been investigated and approved for use by notoriously picky EU investigation bodies. These arbiters of oxygen safety concerned themselves with all types and sizes of oxygen delivery systems. Oxygen safety, especially in extreme circumstances such as those often encountered by portable oxygen units, depends upon it. Consider how such tanks can be inadvertently knocked around and tossed about while being delivered. Though the larger bullet shaped tanks are usually not moved about much, the smaller tanks that people with emphysema, asthma or cystic fibrosis often carry around on carts are the ones that have the highest likelihood of suffering damage that could be catastrophic if the correct inert lubricants weren't used on newly exposed surfaces. Industrial gas supplies (whether noble or highly reactive gases) are not usually nearly as mobile or prone to shock damage. However, large tanks can go unmaintained for a long time. Along with the use of non-reactive, synthetic lubricants, it is recommended that any gas tank be maintained on a regular schedule, by trained professionals. It doesn't matter whether you risk blowing yourself up a little or a lot - such inspections can spot areas that are in actual danger from explosion or springing a leak in a line that's been compromised at connection points, fittings or bearings. High-pressure oxygen compatible systems usually have authorized service personal that show up on a fixed schedule to care for and maintain the inside, outside and feeder lines, as per oxygen safety guidelines. Those who care for their own portable gear should be very careful not to attempt to tinker with it but instead take the apparatus in for regular inspections or tune-ups. The use of fluorochemical non-reactive and inert oils in high pressure and high performance gas delivery systems has revolutionized the applications that can safely utilize high pressure gases. The added safety has likely saved scores of lives since inert lubricants became commonplace in industry and hobby equipment.

## About the Author

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