SAFETY

SANITIZATION PROTOCOL FOR SCUBA EQUIPMENT

There are still no specific tests carried out regarding the survival of SARS-CoV-2 virus on diving equipment especially where they have penetration cavities or threaded sections. It is, therefore imperative that diving equipment are disinfected after use in order to neutralise the virus. Some products, such as quaternary ammonium compounds, are effective and highly compatible with typical diving equipment materials (rubber, neoprene, plastics, metal, etc.), however difficult to source or harmful for the marine environment. Other products, such as bleach (sodium hypochlorite), are easier to find and cheaper, but must be used in accordance with the guidelines for COVID-19. There are also other products (EW80, Virkon S etc.), commonly used by divers, that have been proven to be effective against the virus.

In the United States, the EPA (Environmental Protection Agency) provides a list of disinfectants effective against the SARS-CoV-2 virus. In Europe, the ECDC (European Centre for Disease Prevention and Control) has published some guidelines. Regardless of the active ingredients chosen or the method of disinfection, it is of the utmost importance that its effectiveness against the new coronavirus is proven.

Wash or sanitize hands frequently, keep masks on and do not touch the face help to reduce the contact transmission risks. So, the best practice for divers is to wash/sanitize hands before and after touching their own and someone else's gear, meaning before and after the dive in most instances. Note that being in water may reduce contact transmission risks, but experts remain divided on the degree or duration required to inactivate COVID-19 in particular, so a conservative approach is recommended.

Sanitizing procedures included in this document do NOT ensure to avoid the possible contagion by COVID19 or other type of bacteria, but they are a reminder of how to proceed with the cleaning and disinfection of personal or rental equipment related to underwater activity. They are based on recommendations from DAN, CDC, and WHO.

Equipment should be disinfected, especially when it comes into contact with the face, eyes or mouth. This includes but is not limited to:

- Second stage regulator mouthpiece and internal surfaces
- Snorkel
- BCD oral inflator
- Mask

To disinfect scuba equipment to kill the COVID-19 virus a disinfectant on the EPA's List N should be used (https://www.epa.gov/pesticide-registration/list-n-disinfectants-coronavirus-covid-19), checking if it has been registered with the EPA for the use on dive equipment, respirators or the materials these are made of.

When using any disinfectant, be sure to follow the manufacturer's instructions for use. Follow this with a thorough rinse in fresh water, and allow the equipment to dry completely before use. Since some chemicals

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can damage surfaces, they should be tested prior to use for each individual item or surface. After disinfecting, one must take care not to contaminate the equipment, such as by handling it when storing. Therefore, dry, pack and store any sanitized equipment in a disinfected bag or container using washed/sanitized hands.

Quaternary ammonium compounds

Quaternary ammonium compounds, or quats, are a group of chemicals that are exceedingly common as active ingredients in cleaning solutions. These agents are hydrophobic and as such are effective against enveloped viruses. Quats are thought to react with the viral envelope and "disorganize" it, leading to the contents of the virus leaking out and degrading. The World Health Organization (WHO) recommends the use of cleaning products containing these compounds to fight the coronavirus disease.

There are quaternary ammonium-containing products commonly used in the scuba industry to disinfect equipment, such as the Steramine™ sanitizing tablets. However, these compounds are harmful to the environment, so care must be taken in their use and disposal.

Bleach

Common bleach, marketed under different brands and with variable percentages (5-10%) of its active ingredient, sodium hypochlorite has been studied in many different concentrations, and its effectiveness against viruses has been proven. It is a strong oxidant that works by damaging the viral genome. In a study that examined SARS-CoV-2 specifically, it was found that a sodium hypochlorite concentration of 0.1% or 1,000 ppm in water was needed to reduce infectivity when sprayed onto a hard-non-porous surface. A second study on the same virus found that 0.1% sodium hypochlorite would inactivate the virus within 1 minute.

CDC recommends a solution of 1/3 cup bleach per gallon of water (22 ml bleach per litre of water) with a soaking time of 1-2 minutes for hard, nonporous surfaces. This relatively weak 2% bleach solution and short contact time should not cause damage to scuba regulators.

When using bleach, the use of gloves, a mask, and eye protection is encouraged. It is important to read the product label carefully, checking the percentage of active ingredient, and diluting it in water in the right ratio. Mix the water and bleach solution in well-ventilated areas, and use cold water, as hot water will decompose the active ingredient. It is important to never mix bleach with other chemicals, since highly toxic gases can result. Remove all organic matter from items to be disinfected, as this too will inactivate the active ingredient. Make fresh solutions frequently (at least daily) and after any moderate use. Aluminium can be affected by bleach contact if it is not rinsed promptly, so rinse immediately after the five minute soak. Items disinfected with bleach must be thoroughly rinsed with fresh water and allowed to dry before use, as it is corrosive to stainless steel (in higher concentrations) and irritating to mucous membranes, skin and eyes. Highly concentrated bleach solutions have also been found to be harmful to life-support equipment, causing metal fatigue and in some cases hose failure during the Hart building anthrax attack. Do not use bleach in CCR counterlungs and other breathing loop components unless advised otherwise by the manufacturer. Disinfect counterlungs as directed by the manufacturer.

Heat

Studies have shown that infectivity of the virus is reduced as temperature increases. It is very stable at 40°F

(4°C) but is inactivated in 5 minutes at 158°F (70°C). Therefore, theoretically, heat is an efficient way to kill the new coronavirus. When possible, the scuba equipment may be soaked in hot water for 10-15 minutes for sanitization. However, using heat may not be the best method of disinfecting in terms of time-effectiveness, needing to maintain an almost constant water temperature for that duration.

Alcohol

According to the CDC, to combat COVID-19, an alcohol solution of at least 70% isopropanol or ethanol should be used to disinfect surfaces. A contact time of 1 minute should inactivate the new coronavirus, meaning that the surface must stay wet for this amount of time. Repeated use of alcohol can harm certain types of plastic and rubber by causing swelling, hardening and cracking of these materials, so it is most likely not the best disinfectant to use on scuba equipment.

The use of alcohol-based hand sanitizers is recommended only when soap and water is not available. Alcohol-based substances should not come into contact with some equipment, including cylinders and fill whips that are used with any compressed gas but especially oxygen-enriched gas. This would increase the risk of fire and explosion due to the high volatility of alcohol and its ability to ignite at relatively low temperatures.

Commercial Wipes

If you would like to take extra steps to protect yourself from transmissible diseases, disinfecting commercial wipes (alcohol and hypochlorite based) can be used. Again, then rinse with fresh water before use.

Resources and References

CDC (Centers for Disease Control and Prevention):

https://www.cdc.gov/coronavirus/2019-ncov/index.html

DAN (Divers Alert Network) and DAN Europe:

- ✓ COVID-19 and Diving Operations PDF (https://www.daneurope.org/c/document_library/get_file?uuid=acd21b88-05a1-408a-8e2b-b408af49c6b0&groupId=10103)

- ✓ Disinfection of Scuba Equipment and COVID-19 (https://www.diversalertnetwork.org/emailview/landing/coronavirus/gearDisinfection/index.html)

- ✓ Dive Operations and COVID-19: Prepping for Return (https://www.diversalertnetwork.org/emailview/landing/blogs/prepareForReturn20/index.html)

WHO (World Health Organization):

https://www.who.int/emergencies/diseases/novel-coronavirus-2019/advice-for-public