

## STANDARD OPERATING PROCEDURE

### Decontamination of SCUBA diving equipment and underwater gear after diving in waters with diseased corals

This Standard Operating Procedure (SOP) is intended to provide step-by-step procedures for the decontamination of SCUBA diving equipment after its use in waters where there are diseased corals.

#### Overview:

In order to avoid the spread of disease in corals to waters of non-infected corals via SCUBA diving gear, decontamination protocols must be implemented. The methods and procedures described in this text were developed with input from scientists working in the field, dive equipment manufacturers and recommendations published by the Occupational Safety and Health Administration (OSHA). These protocols must be followed and adhered to in order to ensure there will be no damage or degradation to the equipment, or the environment.

Bleach solutions are commonly used as disinfectants, as bleach is inexpensive and readily available. However, bleach is extremely corrosive to metals and can compromise the integrity of rubber-based materials such as neoprene, commonly used in wetsuits (Hosea and Finlayson 2005). The dive equipment manufacturer Zeagle (2015) specifically warns against the use of bleach solutions to wash or rinse regulators, as it “can permanently damage silicone rubber components.” Also, bleach solutions must be used immediately after mixing as they degrade when exposed to organics and rapidly deteriorate.

Quaternary Ammonium Compounds (Quats) are multi-spectral biocides that are used to kill bacteria, viruses, and fungi. There are many different types and marketed brands of Quats. EPA-registered Quats are commonly used in a variety of environmental disinfecting applications. They are much less corrosive to metals than bleach, and will not compromise the integrity of other materials (Stockton and Moffitt 2013). Quats also do not degrade much when exposed to organics and dilute solutions, and once mixed, can remain effective for up to seven days. The Quat products Virkon S and RelyOn, produced by DuPont<sup>1</sup>, are broad spectrum disinfectants and are effective for treating contaminated equipment against bacterial, viral and fungal infestations. They are widely used in a variety of environments including medical and agricultural facilities. In aquatic applications, these chemicals have been tested and found to be effective at killing both adult and veliger stage dreissenid mussels, when applied to gear that has been exposed to infested waters (Moffitt et al. 2015). A 0.5% solution, was found to be 100% effective in producing mortality in all life stages of dreissenid mussels.

<sup>1</sup> Reference in this protocol to any specific commercial product, process, or service, or the use of any trade, firm or corporation name is for the information and convenience of the public, and does not constitute endorsement, recommendation, or favoring by the Department of the Interior.

## Responsibility:

All USGS protocols for the decontamination of SCUBA equipment will strictly adhere to and follow all USGS requirements. All USGS authorized divers will be responsible for their dive gear and underwater equipment.

## Dive Gear and Equipment:

Because of their ability to trap water that can transmit diseases, particular attention needs to focus on decontaminating wetsuits and the internal bladders of Buoyancy Compensation Devices (BCD's). Other equipment that should be decontaminated includes:

Drysuits  
Tanks (including boots and protective mesh)  
Mask, Fins, Snorkel  
Cameras and video equipment  
Sampling devices  
Regulators, computers and gauges

## Decontamination Protocol

This protocol is presented in three parts with each part corresponding to a specific piece, or pieces, of equipment. All dive gear and equipment used in coral disease infested waters must be inspected carefully and rid of any debris such as seagrass and sediments, prior to washing. ALWAYS REFER TO DIVE EQUIPMENT OWNER'S MANUALS PRIOR TO PERFORMING ANY TYPE OF DISINFECTION.

### Part 1 – Procedure for the decontamination of dive gear including the exterior of BCD's, wetsuits, tanks, masks, fins and snorkels

Following the manufacturers safety guidelines, mix a 0.5% solution of RelyOn (one 5 g. tablet / Liter of water), or Virkon S (1.3 oz. / 2 Gallons of water). Make enough of the solution to fill a container large enough to hold the gear to be disinfected, either all of the gear together in one large container, or individually, using multiple washes,

Immerse dive gear and equipment into container with the Virkon S / RelyOn solution. Soak equipment for 10 minutes, no more. CAUTION MUST BE USED WHEN EXPOSING METAL PARTS TO VIRKON SOLUTIONS AND EXPOSURES SHOULD NEVER EXCEED MORE THAN TEN MINUTES.

Remove equipment from disinfecting solution and put into a container of fresh water. Soak equipment in fresh water for 10 minutes, remove and allow to dry, avoiding extended exposure to sunlight.

Note: The disinfecting solution may be kept and re-used for up to seven days. Dispose of waste solution according to local regulations.

## Part 2 – Procedure for decontamination of the inside of BCD's

Using approximately ½ liter of the solution mixed in Part 1, carefully pour it into the BCD using the following guidelines, a or b, depending on the configuration of the BCD.

- a) If the BCD is equipped with removable dump valves, then unscrew one of the dump valve covers, remove the dump valve assembly and pour in the sanitizing solution. Screw the cover and valve assembly back on to the BCD.
- b) If the BCD does not have removable dump valves, then carefully pour the sanitizing solution into the mouthpiece of the exhaust hose while depressing the exhaust button. When adding the solution to the BCD, the exhaust hose must be higher than the BCD in order to ensure all of the solution goes into the BCD.

Once the solution is in the BCD, inflate the BCD, and gently rotate the BCD, in all directions, to ensure the solution has reached all of the internal parts. Allow the BCD to sit for 10 minutes. After 10 minutes, immediately dump the solution into a container and flush the BCD two times by adding at least 2 liters of fresh water, installing dump valves (if equipped), and rotating the BCD to circulate rinse water. Flushing can be performed by either removing the dump valve assembly or pouring into the exhaust hose as described previously. If a garden hose is used, high pressure attachments cannot be used to add water as this could damage internal parts. Dump the waste water via the exhaust hose, into a container. Do one final rinse, repeating the previous step.

Dispose of waste solution according to local regulations.

## Part 3 – Procedure for the decontamination of diving regulators, gauges and dive computers.

Due to the importance of breathing apparatus, gauges and dive computers to the safety of the diver, it is recommended that Quat chemical disinfection procedures not be used on these instruments. Although, Quat's are only mildly corrosive to some soft metals, it is best to err on the side of caution when it comes to chemical treatments on life sustaining instruments.

Prepare a bath with a solution of warm, fresh water and anti-bacterial dish soap. NOTE: WATER TEMPERATURES MUST NOT EXCEED 120° F. AS IT MAY DAMAGE REGULATORS AND COMPUTERS.

Make sure the dust cap is firmly attached to the first stage regulator and immerse regulators, computers and / or gauges into the water bath for a period of 20 minutes

(Aqualung 2012).

Remove regulators, computers and / or gauges from the soapy water bath and rinse in a container of fresh water. Remove from rinse water bath and allow to dry, avoiding extended exposure to sunlight.

Waters from the soapy bath and rinse container should be disposed of in a drain connected to a municipal water treatment facility.

## References

Aqua Lung International, Inc. 2012 Regulator Owner's Manual, P/N 127861 rev. 02/12. [www.aqualung.com](http://www.aqualung.com)

Hosea, R. C., and B. Finlayson. 2005. Controlling the spread of New Zealand mud snails on wading gear. California Department of Fish and Game, Office of Spill Prevention and Response, Administrative Report 2005-02, Sacramento.

Moffitt, Christine M, Barenburg, Amber, Stockton, Kelly A., and Watten, Barnaby J., 2015, Efficacy of two approaches for disinfecting surfaces and water infested with quagga mussel veligers: CRC Press, p. 467-477.

Stockton, K. A., and C. M. Moffitt. 2013. Disinfection of three wading boot surfaces infested with New Zealand mudsnails. North American Journal of Fisheries Management 33:529-538.

Zeagle Regulator Owner's Manual. 2015. [www.zeagle.com](http://www.zeagle.com)

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