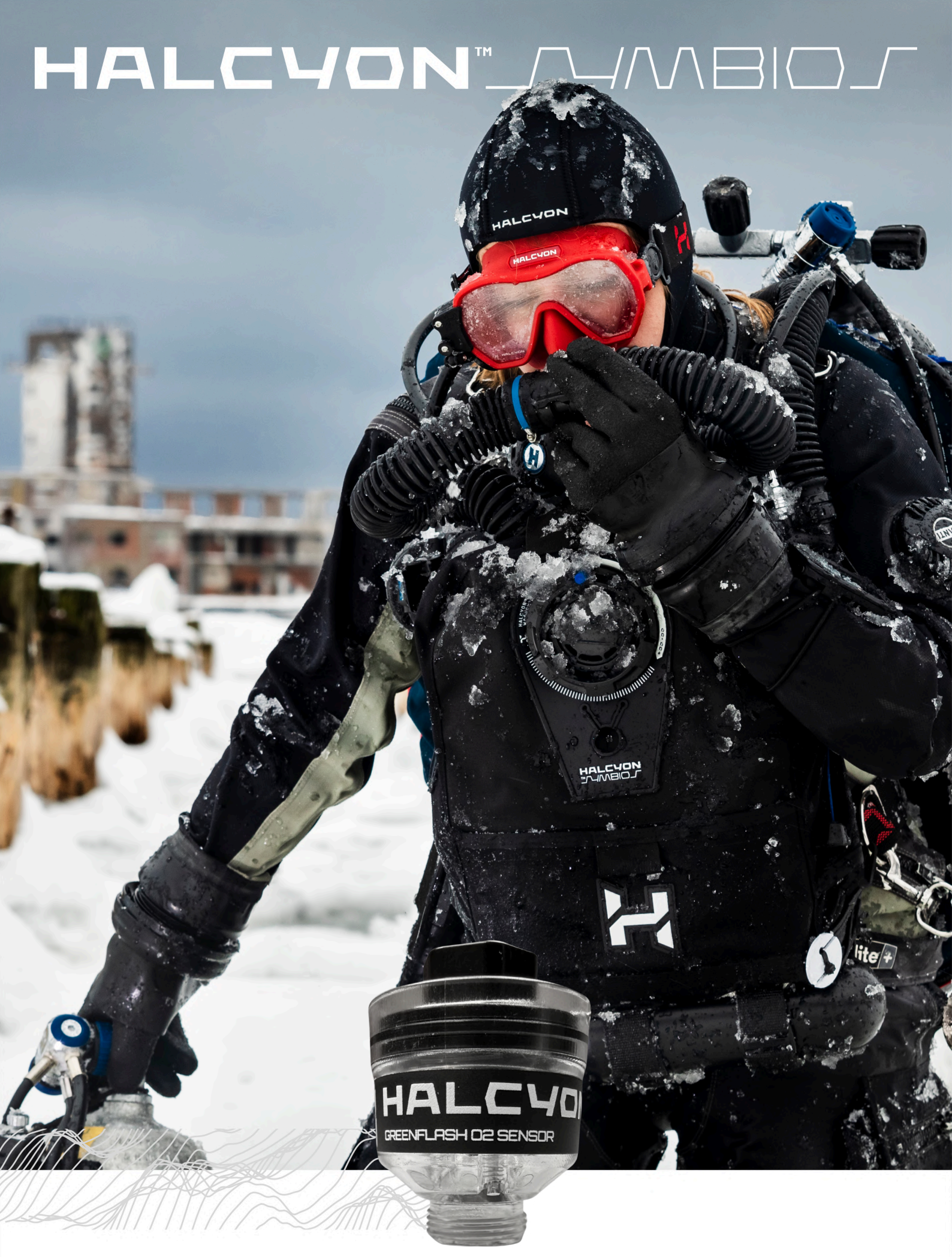
HALCYON™ SYMBIOS



HALCYON™ WORLDWIDE
DIVE SYSTEMS EST.96

_GREENFLASH™
SOLID-STATE O_2 SENSOR MANUAL

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1 Introduction

Thank you for choosing Halcyon.
The Halcyon GREENFLASH™ Solid-State O_2 Sensor represents a significant advancement in oxygen monitoring technology, combining scientific innovation with the reliability required for modern diving life-support systems. Utilizing advanced optical fluorescence quenching technology rather than traditional galvanic cell chemistry, the GREENFLASH directly measures oxygen partial pressure with exceptional stability, accuracy, and longevity. Its low-power architecture delivers industry-leading battery life while a user-replaceable battery supports extended field use and simplified maintenance. Designed from the outset as a flexible sensing platform, GREENFLASH is straightforward to integrate into rebreather systems and other oxygen-monitoring applications, with performance validated through appropriate testing. This flexibility, combined with robust optical sensing technology, enables manufacturers and developers to implement advanced oxygen monitoring solutions with reduced integration complexity while benefiting from the stability and longevity of solid-state measurement technology.

This manual has been prepared to help you understand, install, and operate the GREENFLASH™ Solid-State O_2 Sensor safely and effectively. Please read it in its entirety before using the device to ensure that you understand all warnings, cautions, and operating instructions.

If any aspect of this manual remains unclear, please contact a Halcyon representative before using the device.

2 Safety Considerations

The following precautionary symbols are used to rank the type of information being communicated. Orange for vital information that must not be ignored under any circumstances; yellow for caution; and blue for technical or other recommendations for safe and reliable operation of the device.

⚠ WARNING

WARNING statements describe potentially hazardous situations that, if not avoided, could result in death or serious injury. Avoid these situations under all circumstances.

⚠ CAUTION

CAUTION indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

NOTICE

NOTICE statements highlight information about installation, operation, maintenance, performance, and important tips, or describe a procedure or situation that might cause damage to the device but is unrelated to physical injury.

Warnings

⚠ WARNING

Before using the GREENFLASH Solid-State O_2 Sensor, read the manual in its entirety and become familiar with the device and its functions.

⚠ WARNING

This sensor is designed for industrial measurement and for systems in which it

has been thoroughly tested and certified for use.

⚠ WARNING

Do not use this sensor in life support systems where the sensor has not been thoroughly tested and certified for use.

⚠ WARNING

Do not use this sensor for medical applications.

⚠ WARNING

Do not use this sensor for scuba diving unless the sensor has been thoroughly tested and certified for use within the system.

⚠ WARNING

Do not expose the sensor to bright sunlight. Sunlight may bleach and damage the sensor.

⚠ CAUTION

Do not operate the sensor in bright light, as the internal amplifiers may become overloaded, causing the measurement to be incorrect.

⚠ CAUTION

Do not operate the sensor in an environment illuminated with fluorescent light. Fluorescent light can disturb the sensor readings.

3 Measurement Principle

The GREENFLASH Solid-State O_2 Sensor features an O_2-sensitive sensor spot, which incorporates a special dye. When this dye is excited with green light, it starts fluorescing and emits red light. O_2 quenches the fluorescence; thus, the higher the partial pressure of O_2 (pO_2), the lower the amplitude and lifetime of the red fluorescence signal.

The GREENFLASH Solid-State O_2 Sensor excites the sensor's spot with a green light modulated with a sinusoidal signal. The fluorescent signal is acquired with a high-speed analog-to-digital converter (ADC). The GREENFLASH Solid-State O_2 Sensor performs a fast Fourier transform to calculate the amplitude and lifetime of the fluorescence, including temperature compensation. The system calculates the pO_2 based on calibration values obtained during the production of the sensor.

The GREENFLASH Solid-State O_2 Sensor switches automatically between three operational modes:

Sleep Mode: If the sensor is not installed in a device or is installed in a digital configuration, it remains in Sleep Mode, checking the input impedance every 20 seconds to conserve battery power. In a controlled environment, the battery lasts approximately 2 years in this mode, subject to the variable conditions presented below.

Low-pO_2 Mode: If the sensor is installed in an analog configuration, but pO_2 is less than 0.3 bar, it measures once every 15 seconds, keeping battery consumption to a minimum. The battery lasts approximately 6 months in this mode, subject to the variable conditions presented below.

Normal Operation: Where the pO_2 is greater than 0.3 bar, the sensor runs continuously, and the battery lasts approximately 300 hours, subject to the variable conditions presented below.

⚠ WARNING

Variable Conditions. Battery longevity depends heavily on use, environmental conditions, and battery quality, and is subject to unknown variability. All batteries should be checked at the time of installation and regularly as part of pre-dive checks. Please ensure that the minimum battery voltage at the beginning of a dive is at least 2.5 V.

⚠ CAUTION

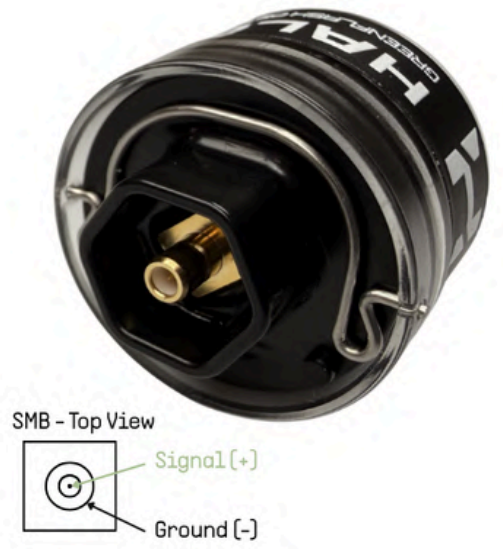
Bright light and, in particular, fluorescent light can interfere and cause incorrect sensor readings. Use the sensor inside the housing of a measurement system or in a light-protected environment.

4 Analog Interface

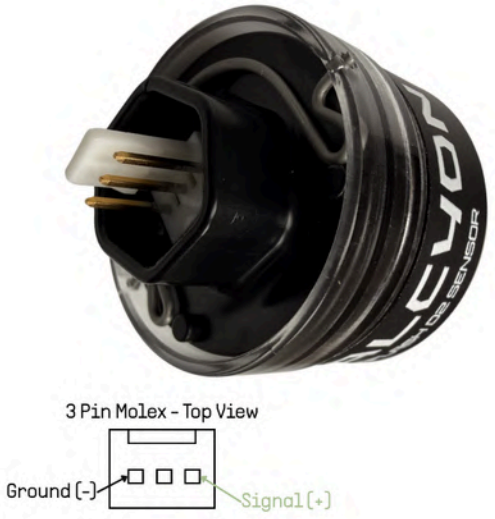
The GREENFLASH Solid-State O_2 Sensor features a patent-pending smart interface, which allows use of the sensor in analog as well as digital instrumentation:

If the GREENFLASH Solid-State O_2 Sensor is installed in a measurement device with an input impedance between 10 kΩ and 150 kΩ, it will output an analog signal with a slope of approximately 10 mV at 0.21 bar pO_2. Otherwise, it will output a digital signal (see below for details).

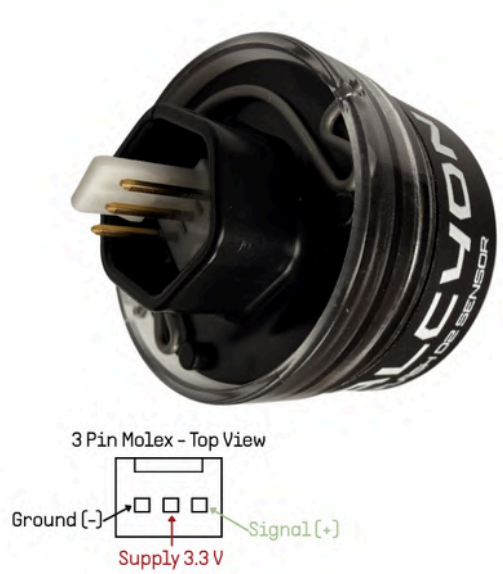
The GREENFLASH Solid-State O_2 Sensor is equipped with either a male SMB connector or a male 3-pin Molex connector.



GREENFLASH Solid-State O_2 Sensor with SMB connector



GREENFLASH Solid-State O_2 Sensor with Molex connector



GREENFLASH Solid-State O_2 Sensor with Molex connector and external supply (3 to 3.3 V, 15 mA peak)

5 General Specifications

- Measurement range pO_2: 0.1 to 2.0 bar
- Measurement range O_2 fraction: 10 to 100%
- Response time (t63): approx. 2 s
- Operating temperature: 0 to 40 °C/32 to 104 °F
- Storage temperature: -10 to 50 °C/14 to 122 °F
- Accuracy: compliant with ISO 80601-2-55:2018
- Supply: CR2477 lithium battery
- Battery capacity: > 900 mAh

⚠ CAUTION

After exposing the GREENFLASH Solid-State O_2 Sensor to temperatures higher than 40 °C/104 °F, the accuracy may be reduced.

⚠ CAUTION

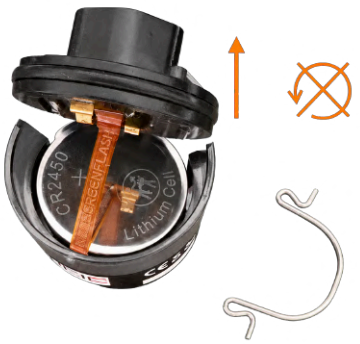
Operation at temperatures below 10 °C/50 °F may lead to increased battery consumption.

5.1 Battery Replacement

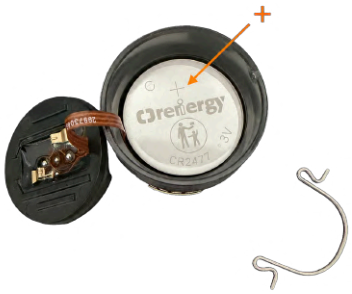
The GREENFLASH™ Solid-State O_2 Sensor uses a replaceable CR2477 lithium battery.

To replace the battery:
1. Carefully remove the retaining clip from the bottom of the sensor.

2. Gently lift the connector base straight upward. Do not twist the base or pull it farther than necessary, as this may damage the connecting ribbon.



3. Remove the old battery and insert a new CR2477 battery with the positive (+) pole facing upward.



4. Carefully reposition the connector base without twisting or pinching the ribbon.
5. Reinstall the retaining clip. Ensure that both ends of the clip are fully seated in the recessed holes on either side of the sensor.

6 Troubleshooting

Problem: The GREENFLASH Solid-State O_2 Sensor produces fluctuating sensor signals.
Solution: Protect the sensor from ambient light.

Problem: The GREENFLASH Solid-State O_2 Sensor blinks green once every 15 seconds, but does not output digital or analog data.
Solution:
A. Expose the sensor to a pO_2 greater than 0.3 bar.
B. Check the electrical connection.
C. Check that the input impedance of the measurement system matches the specification of the GREENFLASH Solid-State O_2 Sensor.

Problem: The GREENFLASH Solid-State O_2 Sensor is installed in a measurement device, but does not blink green once every 15 seconds.
Solution:
A. Check the electrical connection.
B. Check that the input impedance of the measurement system matches the specification of the GREENFLASH Solid-State O_2 Sensor.
C. Replace the battery if its voltage is below 2.3 V.

7 Technical Specifications

Digital, Current-Coded Interface

If the output of the GREENFLASH Solid-State O_2 Sensor is loaded with a resistor < 3 kΩ, the sensor will output a digital, current-coded, serial signal.

- single wire USART
- 115200 baud
- Logic low: approx. 0 to 5 µA
- Logic high: approx. 50 to 150 µA

The output string includes the following values:

- pO_2 [bar]
- Raw value 1
- Raw value 2
- Temperature [°C]
- Battery voltage [mV]
- Sensor serial number

Serial Interface

If the output of the GREENFLASH Solid-State O_2 Sensor is connected to a pull-up resistor of 5.6 kΩ to a 3 to 3.3 V level, it will enter single-wire bidirectional USART mode.

_ single wire USART
_ 115200 baud

The GREENFLASH Solid-State O_2 Sensor transmits "X\n" every 2 seconds as an “alive” signal.

Available commands:
"Mn\n"
The GREENFLASH Solid-State O_2 Sensor returns the pO_2 [bar]
"Tt\n"
The GREENFLASH Solid-State O_2 Sensor returns the temperature [°C]

8 Warranty

Halcyon Manufacturing, Inc. Limited Warranty

During the warranty period, Halcyon Manufacturing, Inc. or an authorized service center will remedy defects in materials or workmanship free of charge, at its sole discretion, by repairing, replacing, or refunding, subject to the terms and conditions of this limited warranty.

Warranty period:
_ The limited warranty period begins on the date of original purchase.
_ The warranty period is 2 years for products, unless otherwise specified.
_ The warranty period for accessories is 1 year.

The limited warranty does not cover:
_ normal wear and tear, such as scratches, abrasions, and alteration of the color.
_ defects caused by inappropriate handling
_ defects or damage resulting from use contrary to intended and/or recommended use, improper care, negligence, and accidents such as dropping, crushing, and flooding
_ printed materials and packaging

The limited warranty is not enforceable if the product or accessory:
_ has been opened or tampered with by unauthorized individuals or entities
_ has been altered using unauthorized spare parts
_ has been repaired by an unauthorized service center
_ has been exposed to polymer-damaging chemicals, including but not limited to sunscreen, insect repellent, solvents, fuels, oils and other chemicals capable of degrading polymer components

8.1 Limitations of Liability

With the purchase of the GREENFLASH™ Solid-State O_2 Sensor, you hereby agree to the following exclusions and limitations of Halcyon Manufacturing, Inc.’s liability to you.

You agree and understand that scuba diving is a high-risk, possibly life-threatening activity, and the use of the GREENFLASH™ Solid-State O_2 Sensor is in no way a substitute for proper scuba training and certification.

You understand and agree that scuba diving contains inherent risks and due to the varying nature of such and the diverse potential effect on individuals engaged in

scuba diving, Halcyon Manufacturing, Inc. does not warrant or guarantee that your use of this product will prevent decompression sickness, embolism, narcosis, or any other condition or injury you may incur.

You understand and agree that variables may include, but are not limited to, dehydration, obesity, age, prior injuries, or other physical conditions of the diver, or temperature extremes, poor training, poor diving practices, or other acts or omissions that may cause injury or death.
You agree that you understand and accept all risks associated with diving, and that Halcyon Manufacturing, Inc., its elected and appointed officials, employees, volunteers or others working on behalf of Halcyon Manufacturing, Inc. are not liable to you or any other person, including your heirs, executors, agents, officers, attorneys, successors, assigns or personal representatives, for any loss, damage, cost, expense, or claim arising out of, caused by, or relating to your personal injury or death while diving, even if your personal injury or death is caused, in whole or in part, and directly or indirectly, by the purchase of the GREENFLASH™ Solid-State O_2 Sensor or your use thereof, or arising from breach of the warranty, breach of contract, negligence, strict tort, or any other legal or equitable theory, even if Halcyon Manufacturing, Inc. knew, or should have known of the likelihood of such damages, and regardless of whether or not the GREENFLASH™ Solid-State O_2 Sensor functioned properly or was defective in any way. Halcyon Manufacturing, Inc. shall not be liable for delay in rendering service under the limited warranty, or loss of use during the time the product is being repaired.

You hereby irrevocably waive and release Halcyon Manufacturing, Inc., its elected and appointed officials, employees, volunteers or others working on behalf of Halcyon Manufacturing, Inc. from any liability or obligation to you or your heirs, executors or personal representatives for any loss, damage, cost, expense, or claim arising out of, caused by, or relating to your personal injury or death while diving, even if your personal injury or death is caused, in whole or in part and directly or indirectly, by the GREENFLASH™ Solid-State O_2 Sensor or your use of the GREENFLASH™ Solid-State O_2 Sensor, or arising from breach of the warranty, breach of contract, negligence, strict tort, or any other legal or equitable theory, even if Halcyon Manufacturing, Inc. knew, or should have known of the likelihood of such damages, and regardless of whether or not the GREENFLASH™ Solid-State O_2 Sensor functioned properly or was defective in any way.

You have read, and you accept the agreement with all limitations and exclusions of Halcyon Manufacturing, Inc.'s liability to you.

9 Information

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