



U.S. Department of Transportation
**Pipeline and Hazardous Materials
Safety Administration**

1200 New Jersey Ave, SE
Washington, D.C. 20590

/ FEB 18 2011

Mr. Roger Hine
President and CEO
Liquid Robotics, Inc.
1329 Moffett Park Drive
Sunnyvale, CA 94089

Ref. No.: 10-0264

Dear Mr. Hine:

This responds to your December 22, 2010 letter requesting clarification of the requirements in the Hazardous Materials Regulations (HMR; 49 CFR Parts 171-180) applicable to lithium ion battery powered devices. Specifically, you ask us to confirm your understanding that the battery packs described in your letter are considered separate lithium ion batteries and meet all of the applicable requirements of § 172.102(c), Special Provision 188. In addition to your letter, you enclose a drawing showing the configuration of the lithium ion battery packs.

According to your letter, the device contains seven 95 Wh lithium ion batteries consisting of twelve 2.2 ampere hour cells in a 4S3P configuration. Your letter states that each of the lithium ion cells and the battery pack both meet the applicable tests outlined in the UN Manual of Tests and Criteria. The seven lithium ion battery packs are mounted in an aluminum housing that is securely attached to a drybox designed to both mechanically isolate and prevent any movement of the batteries during transport or operation. Your letter further states that each of the battery packs are electrically isolated from each other through a set of solid state switches that can only be activated through the use of an external plug inserted into its mating jack on the drybox. The drybox will be shipped without the plug inserted and the plug secured in a manner to prevent accidental activation. Additionally, a distinct warning label affixed on the box instructs users not to transport the device with the plug inserted into the jack.

Based on the information described in your letter, it is the opinion of this office that when the plug is removed from the mating jack, the battery packs described in your letter are electrically isolated from

each other and would constitute separate lithium ion battery packs. Further, the steps taken to prevent damage, short circuits and accidental activation during transport appear to meet the requirements of § 172.102, Special Provision 188.

I hope this answers your inquiry. If you need additional assistance, please contact the Standards and Rulemaking Division.

Sincerely,

A handwritten signature in black ink that reads "Ben Supko". The signature is written in a cursive style with a long horizontal stroke at the end.

Ben Supko
Acting Chief, Standards Development Branch
Standards and Rulemaking Division



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Leary
§ 173.185
§ 172.102
Lithium Battery
10-0264

December 22, 2010

Kevin Leary
Office of Hazardous Material Standards
Pipeline and Hazardous Materials Safety Administration
U.S. Department of Transportation
1200 New Jersey Avenue, SE
Washington, DC 20590

Re: Wave Glider Lithium Ion Battery Design

Dear Mr. Leary:

I am writing as a follow-up to our conference call on December 16, 2010 regarding the lithium ion battery configuration that Liquid Robotics has designed to power our product known as the Wave Glider™. We would like confirmation from PHMSA that our current understanding of the battery configuration meets the requirements for the small battery exception in 49 CFR § 171.102, Special Provision 188 of the U.S. Hazardous Materials Regulations (HMR) and thus is exempt from the requirements of the HMR. Our current understanding is based primarily on the battery definitions in the UN Manual of Tests and Criteria, the regulatory requirements for lithium ion batteries found at 49 CFR § 173.185 and the information in the following DOT interpretation letters: Ref. #s 06-0015, 09-0066, 09-0182, 08-0029, and 10-0135.

Wave Glider

The Wave Glider is a maritime autonomous surface vehicle that serves as a platform for scientific instrumentation as well as national security applications. The lithium ion batteries for the Wave Glider are designed to power the navigation control system and are enclosed in a watertight, hermetically sealed Delrin and aluminum drybox enclosure. Typical Wave Glider deployments may operate thousands of miles from land and last up to a year. It will be important to ship these individual batteries contained within the drybox so end-users do not need to open the drybox to install the batteries, and subsequently reseal the drybox. An improperly performed resealing procedure would lead to failure of the navigation control system due to seawater damage and potentially result in the loss of the system. The Wave Glider could be used in a

variety of national security and intelligence applications where resealing the drybox in the field after shipment or losing the system would be unacceptable.

Lithium ion Batteries Designed for Wave Glider

Liquid Robotics uses seven 95 Wh lithium ion batteries (manufactured by Inspired Energy – model # NL2044) that consist of twelve 2.2 ampere-hour cells in a 4S3P configuration. Each cell has an equivalent lithium content 0.66g, and each battery has an aggregate equivalent lithium content of 7.92g. The lithium ion cells and batteries have been certified in accordance with the requirements of the UN Manual of Tests and Criteria.

The batteries are installed in a rugged aluminum housing that is securely attached to the drybox to both mechanically isolate the batteries and to prevent any movement of the batteries in shipping or in operation. A diagram illustrating the Wave Glider battery system is enclosed with this letter. The batteries are independently connected to the Wave Glider circuit board in order to prevent any individual battery from discharging and charging another individual battery. The batteries are electrically isolated from the rest of the system through a set of solid-state switches. The switches can only be activated when an external mechanical plug is inserted into its mating jack on the drybox. The system is always shipped without the plug inserted into the jack (and hence deactivated) to prevent any accidental charge or discharge of any individual battery that could result in the creation of sparks or the generation of a dangerous evolution of heat. Both the clear instructions in the Wave Glider user manual and a distinct warning label affixed on the drybox by the jack instruct users to never ship the Wave Glider with the plug inserted into the jack and the system activated. Furthermore, during shipment, the plug is packed and secured in a manner to prevent any possibility of accidental insertion into the jack and unintentional activation of the system.

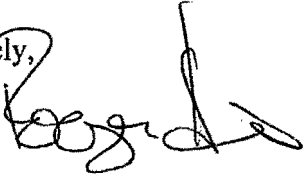
In addition, the “Charge Control” and “Battery Power Combiner” circuits (shown in the diagram) ensure that each battery in the system is charged and discharged individually. To illustrate this point, the system will charge and discharge the batteries safely and properly even if batteries of different voltages, capacities, and/or chemistries are used in the same drybox enclosure. There are no external connections to the battery circuits once the drybox is assembled to prevent any possibility of external shorting. The drybox also is backfilled with dry nitrogen gas to further prevent any combustion within the drybox.

* * *

In summary, we understand our battery design consists of seven individual batteries that meet the requirements of the small battery exception found in 49 CFR § 171.102, Special Provision 188 of the U.S. HMR, and, when these batteries are installed in the Wave Glider and offered for transport, the Wave Glider also qualifies for the exceptions found in Special Provision 188 (provided the Wave Glider plug is not connected into the jack on the dry box containing the batteries). We would appreciate written confirmation from PHMSA that our understanding of these lithium ion battery regulatory requirements is consistent with previous interpretation letters issued by PHMSA on this issue.

Thank you very much for taking the time to discuss this matter with us on the phone and for responding to our letter. Please feel free to contact our V.P. of Legal and Legislative Affairs, Suneil Thomas, at (415) 608-1608 or suneil.thomas@liquidr.com with any questions.

Sincerely,

A handwritten signature in black ink, appearing to read "Roger Hine". The signature is fluid and cursive, with a prominent vertical stroke at the beginning.

Roger Hine
President and CEO
Liquid Robotics, Inc.

Wave Glider Battery System Diagram

