

August 25, 2015

ZMarine™ - Z700® and Z3000®

FairfieldNodal Lithium Ion Battery Pack Testing – 221.7655.0001

**UN Manual of Tests and Criteria, Part III, Subsection 38.3
Exponent, March 18, 2009, their reference 09000467.0200 A0F0 0303 R165..**

Exponent[®]

Electrical & Semiconductors Practice

**Fairfield Industries UN Test
Summary**

Z Marine battery Test
March 2009

Fairfield Industries UN Test Summary

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March 18, 2009

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Introduction

Exponent was retained by Fairfield Industries to test their Lithium Ion battery packs (Figure 1) in accordance with the UN transportation of Dangerous Goods criteria as defined by the United Nations document ST/SG/AC.10/11/Rev. 4. This testing consists of seven parts that will be discussed in detail in the following sections, including tables of results: altitude simulation, thermal, vibration, shock, external short circuit, impact, and overcharge.

For this testing, we received twelve new production battery packs and twelve production packs that had been conditioned previously with 50 cycles of charging and discharging. The battery pack identification numbers for the packs received are shown in Table 1. Unless otherwise stated, all tests were performed at an ambient temperature of $25 \pm 5^\circ\text{C}$.

Table 1: Battery packs received for testing.

| Battery Pack State | Battery Pack ID | |
|---------------------------|-----------------|--------|
| 1 cycle Fully Charged | 2182UN | 3927UN |
| | 2649UN | 4018UN |
| | 3085UN | 5184UN |
| | 3878UN | 5689UN |
| 1 cycle fully discharged | 3017UN | |
| | 3200UN | |
| | 4031UN | |
| | 472UN | |
| 50 cycle fully charged | 1000UN | 1043UN |
| | 1011UN | 6152UN |
| | 1012UN | 6510UN |
| | 1036UN | 935UN |
| 50 cycle fully discharged | 1007UN | |
| | 1009UN | |
| | 3300UN | |
| | 6116UN | |

Summary

Exponent tested the marine lithium ion battery packs from Fairfield Industries in accordance with the UN transportation of Dangerous Goods criteria as defined by the United Nations document ST/SG/AC.10/11/Rev. 4. The battery packs passed all seven required test. No smoke, flames, rupture, excessive temperatures or disassembly was observed during any of the seven tests performed.

The testing and evaluation conducted by Exponent is documented in this report. Should additional information become available or should additional testing or analysis provide further insight, Exponent reserves the right to amend these conclusions.

August 19, 2015

ZMarine™; Z700® and Z3000® UN 38.3 Battery Pack Testing

Testing required under UN Manual of Tests and Criteria, Part III, Subsection 38.3 was successfully completed on the FairfieldNodal lithium ion battery pack part number **221.7655.0001** by **Exponent** on **March 18, 2009**, their reference **09000467.0200 A0F0 0303 R165**.

I confirm FairfieldNodal lithium ion battery pack part numbers; **221.7655.0002**, and **221.6994.0001** are the same design, manufacturing process and does not differ from the tested type outlined in 38.3.2.2 shown below.

This battery pack is used in the following Nodes;
Z700® Nodes: 221.6862.0001 to .0004,
Z3000® Nodes: 221.6605.0002 & .0003

I do hereby certify these facts to be true and correct to the best of my knowledge.

FAIRFIELDNODAL

Michael Morris,



Manager, Marine Product Development

Date 28 Aug 2015

Validated

William Guyton



Manager of Engineering

Date 8/28/15

38.3.2.2 Lithium metal and lithium ion cells and batteries shall be subjected to the tests, as required by special provisions 188 and 230 of Chapter 3.3 of the Model Regulations prior to the transport of a particular cell or battery type. Cells or batteries which differ from a tested type by:

- (a) For primary cells and batteries, a change of more than 0.1 g or 20% by mass, whichever is greater, to the cathode, to the anode, or to the electrolyte;
- (b) For rechargeable cells and batteries, a change in nominal energy in Watt-hours of more than 20% or an increase in nominal voltage of more than 20%; or
- (c) A change that would lead to failure of any of the tests, shall be considered a new type and shall be subjected to the required tests.

NOTE: The type of change that might be considered to differ from a tested type, such that it might lead to failure of any of the test results, may include, but is not limited to:

- (a) A change in the material of the anode, the cathode, the separator or the electrolyte;
- (b) A change of protective devices, including hardware and software;
- (c) A change of safety design in cells or batteries, such as a venting valve;
- (d) A change in the number of component cells; and
- (e) A change in connecting mode of component cells.

In the event that a cell or battery type does not meet one or more of the test requirements, steps shall be taken to correct the deficiency or deficiencies that caused the failure before such cell or battery type is retested.