

# PDR-OPS-010 BATTERY PERFORMANCE TESTING IN EXTREME CONDITIONS

## PDR-OPS-010 BATTERY PERFORMANCE TESTING

### Standard Operating Procedure & Testing Protocol

*Version 2.4 - Effective Date: January 15, 2024*

*Document Classification: Confidential*

### 1. PURPOSE AND SCOPE

1. This document establishes mandatory procedures and protocols for
2. This protocol applies to all battery systems utilized in PDR-Series r

## **2. DEFINITIONS**

1. "BlueCore(TM) Battery System" refers to Polar Dynamics Robotics
2. "Extreme Conditions" means operational environments with ambient
3. "Testing Cycle" means a complete sequence of charge-discharge c

## **3. TESTING REQUIREMENTS**

1. Environmental Chamber Specifications

-

Temperature range capability: -40 C to +25 C

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Humidity control: 20% to 80% RH

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Temperature stability: 0.5 C

-

Chamber volume: Minimum 2m

## 2. Required Test Equipment

-

Calibrated voltage meters (accuracy 0.1%)

-

Current measurement devices (accuracy 0.5%)

-

Temperature sensors (accuracy 0.2 C)

-

Data logging system with 1-second sampling rate

-

Load bank rated for maximum discharge current

## **4. TESTING PROCEDURES**

### **1. Pre-Test Preparation**

a) Document initial battery condition including:

-

Serial number

-

Manufacturing date

-

Cycle count

-

Initial voltage

-

Internal resistance measurement

b) Visual inspection for:

-

Physical damage

-

Terminal condition

-

Casing integrity

-

Thermal sensor placement

2. Standard Test Sequence

a) Temperature Stabilization

-

Place battery in chamber at test temperature

-

Allow 4-hour minimum stabilization period

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Verify core temperature sensors reach target

#### b) Capacity Testing

-

Full charge at specified temperature

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Rest period: 1 hour

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Discharge at C/2 rate to cutoff voltage

-

Record voltage every 60 seconds

- - 6 -

Monitor temperature at 5 points

## **5. PERFORMANCE CRITERIA**

### **1. Minimum Performance Requirements**

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Capacity retention: 80% of rated capacity at -30 C

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Maximum internal resistance increase: 200% of room temperature value

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Voltage sag under load: 12% at 50% depth of discharge

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Self-discharge rate: 5% per month at -20 C

## 2. Safety Parameters

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Maximum cell temperature deviation: 5 C

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Maximum voltage imbalance: 50mV between cells

-

BMS cutoff response: 500ms

-

Thermal runaway protection activation: 2s

## 6. DOCUMENTATION REQUIREMENTS

1. Test Reports shall include:

-

Complete test parameters



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Raw data logs

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Temperature profiles

-

Voltage/current curves

-

Capacity calculations

-

Anomaly documentation

-

Testing engineer certification

## 2. Data Retention

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All test data maintained for 7 years

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Backup storage in secure cloud location

-

Monthly verification of data integrity

## **7. QUALITY CONTROL**

### **1. Testing Personnel Requirements**

-

Minimum Level 2 Battery Testing Certification

-

Annual safety training completion

-

Documented proficiency with test equipment

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Emergency response training current

## 2. Equipment Calibration

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Monthly verification of all measurement devices

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Quarterly full calibration of environmental chamber

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Annual third-party certification

## 8. LEGAL COMPLIANCE

1. This testing protocol complies with:

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UL 2580 Standards

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UN 38.3 Transportation Testing

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IEC 62133 Safety Requirements

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ANSI/CAN/UL-2272

2. All testing must be conducted in accordance with applicable federal

## **9. REVISION HISTORY**

Version 2.4 - January 15, 2024

-

Updated temperature stabilization requirements

- - 12 -

Added new safety parameters

-

Revised documentation requirements

Version 2.3 - July 1, 2023

-

Modified capacity testing procedures

-

Updated equipment specifications

## **10. AUTHORIZATION**

This document is authorized by:

/s/ Dr. James Barrett

Chief Robotics Officer

Polar Dynamics Robotics, Inc.

Date: January 15, 2024

/s/ Marcus Chen

Chief Technology Officer

Polar Dynamics Robotics, Inc.

Date: January 15, 2024

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