

SUB-ZERO SYSTEM INTEGRATION TEST RESULTS

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Test Protocol Reference: PDR-SIT-2023-142

Date of Testing: December 12-15, 2023

Location: Polar Dynamics Testing Facility, Minneapolis, MN

Document Version: 1.0

1. EXECUTIVE SUMMARY

This document presents the comprehensive system integration test re
Polar Dynamics Robotics, Inc.'s ("Company") BlueCore(TM) autonom

platform operating in sub-zero environments. Testing was conducted with ISO/IEC 17025:2017 standards and Company's proprietary cold-testing protocols.

2. TEST PARAMETERS

2.1 Environmental Conditions

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Temperature Range: -40 F to +32 F (-40 C to 0 C)

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Humidity: 15% to 85% RH

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Surface Conditions: Varied (dry concrete, frost-covered surfaces, ice)

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Air Pressure: 980-1020 hPa

2.2 Test Duration

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Continuous Operation: 72 hours

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Duty Cycle: 95% active / 5% charging

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Total Distance Traversed: 47.2 kilometers

3. SYSTEM COMPONENTS TESTED

3.1 Navigation Systems

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BlueCore(TM) Proprietary Cold-Environment Navigation Suite v4.2

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LiDAR Arrays (4x Frost-Resistant Units)

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Temperature-Hardened IMU System

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Cold-Resistant Camera Arrays (6x Units)

3.2 Mechanical Systems

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Arctic-Grade Motor Assemblies

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Reinforced Chassis Structure

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Cold-Resistant Wheel Components

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Thermal Management System

3.3 Power Systems

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Low-Temperature Battery Pack (Model PDR-BTR-450)

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Rapid Charging System

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Power Distribution Network

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Emergency Backup Systems

4. TEST RESULTS

4.1 Navigation Performance

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Position Accuracy: 98.7% within 2cm

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Path Planning Success Rate: 99.3%

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Obstacle Avoidance Success Rate: 99.8%

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Average Navigation Latency: 12ms

4.2 Mechanical Performance

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Motor Efficiency at -40 F: 92.4%

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Chassis Structural Integrity: No deformation observed

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Wheel Traction Coefficient: 0.82 (exceeds minimum requirement of 0.7)

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Thermal Management Efficiency: 94.8%

4.3 Power Systems Performance

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Battery Runtime: 16.4 hours (exceeds specification by 2.4 hours)

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Charging Time: 42 minutes (within specification)

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Power Consumption: 12% below projected maximum

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Emergency System Response: 100% success rate

5. COMPLIANCE VERIFICATION

5.1 Safety Standards

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ANSI/RIA R15.06-2012

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ISO 10218-1:2011

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IEC 61496-1:2020

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UL 3300 First Edition

5.2 Performance Standards

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ASTM F3200-19

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ISO/TS 15066:2016

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IEC 60068-2-1 (Cold Test)

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IP65 Rating Verified

6. ANOMALIES AND RESOLUTIONS

6.1 Observed Anomalies

Minor sensor calibration drift at -35 F (resolved via firmware update)

Battery charging efficiency reduction of 3% below -30 F (within acceptance)

Temporary communication latency increase during rapid temperature

6.2 Resolution Actions

Firmware Update PDR-FW-4.2.1 implemented

Battery management system parameters adjusted

Communication protocol optimization completed

7. CERTIFICATION

The undersigned hereby certify that all tests were conducted in accordance with the Company's Standard Operating Procedures and applicable industry standards. The BlueCore(TM) platform has demonstrated compliance with all specified requirements for sub-zero operations.

Test Director:

/s/ Dr. James Barrett

Chief Robotics Officer

Polar Dynamics Robotics, Inc.

Quality Assurance:

/s/ Sarah Chen

Senior QA Engineer

Certification #PDR-QA-2023-089

Independent Verification:

/s/ Dr. Michael Frost

Arctic Robotics Certification Board

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8. LEGAL DISCLAIMER

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