ENVIRONMENTAL CHAMBER TEST RESULTS

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MODEL PDR-X20 AUTONOMOUS MOBILE ROBOT

Test Report No. ECT-2023-149

Polar Dynamics Robotics, Inc.

Test Period: October 15-29, 2023

Testing Facility: Advanced Environmental Testing Laboratory

Location: Plymouth, Michigan

Test Engineer: Dr. Robert Chen, P.E.

Certification: ISO/IEC 17025:2017

1. EXECUTIVE SUMMARY

This report documents the environmental chamber testing results for t
Autonomous Mobile Robot ("Test Unit"), manufactured by Polar Dyna
Inc. Testing was conducted to verify operational capabilities under ext
temperature conditions in accordance with ANSI/UL 3100 and IP65 st

2. TEST UNIT SPECIFICATIONS

1. **Model Information**

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Model Number: PDR-X20

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Serial Number: 2023-PDR-0472

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Firmware Version: 3.2.14

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BlueCore(TM) System Version: 4.1.0

2. **Physical Specifications**

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Dimensions: 1200mm x 900mm x 450mm

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Base Weight: 185 kg

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Maximum Payload: 500 kg

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Power System: Lithium Iron Phosphate (LiFePO4) 48V

3. TEST METHODOLOGY

1. **Test Parameters**

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Temperature Range: +25 C to -30 C

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Humidity Range: 20% to 95% RH

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Test Duration: 336 hours

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Cycle Count: 24 complete temperature cycles

2. **Test Sequence**

Ambient condition baseline (4 hours)

Temperature ramp-down (-2 C/minute)

Cold soak period (8 hours)

Operational testing at low temperature

Temperature ramp-up (+2 C/minute)

High temperature operational testing

Return to ambient conditions

4. TEST RESULTS

1. **Low Temperature Performance (-30 C)**

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Navigation System Response: Within specifications

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Battery Performance: 92% of rated capacity

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Motor Function: Full operational capability

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Sensor Array Accuracy: 98.7% correlation to baseline

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BlueCore(TM) System Status: Nominal

2. **Temperature Transition Performance**

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System Start-up Time: 45 seconds (within specification)

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Navigation Calibration: Successful

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Sensor Recalibration Time: 120 seconds

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Power Management: No anomalies detected

3. **High Temperature Performance (+25 C)**

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System Operations: Normal

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Battery Charging Efficiency: 99.1%

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Thermal Management: Within design parameters

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Communication Systems: Full functionality maintained

5. COMPLIANCE VERIFICATION

1. The Test Unit has demonstrated compliance with:

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ANSI/UL 3100 Safety Standard for Automated Mobile Platforms

IP65 Environmental Protection Rating

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ISO 10218-1:2011 Robot Safety Requirements

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EN 61000-6-2 EMC Immunity Standard

6. OBSERVATIONS AND RECOMMENDATIONS

1. **Notable Observations**

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Condensation management system performed above expectations

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Battery thermal management maintained optimal cell temperature

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Navigation accuracy exceeded minimum requirements by 15%

2. **Recommendations**

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Implement enhanced cold-start procedure for sub -25 C operations

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Update firmware to version 3.2.15 for optimal sensor performance

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Document achieved performance metrics in product specifications

7. CERTIFICATION

The undersigned hereby certifies that all tests were conducted in acco
with applicable standards and procedures, and the results contained h
accurate and complete.

/s/ Dr. Robert Chen, P.E.

Lead Test Engineer

Advanced Environmental Testing Laboratory

Date: October 31, 2023

/s/ Dr. James Barrett

Chief Robotics Officer

Polar Dynamics Robotics, Inc.

Date: November 2, 2023

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## 8. LEGAL DISCLAIMER
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The test results presented are valid as of the test date and under the s
conditions noted. Performance may vary under different environmenta
or product configurations. This report shall not be construed as a warr
express or implied, regarding the product's performance or reliability.

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