ENVIRONMENTAL RESISTANCE TEST RESULTS

Test Report Number: PDR-ENV-2023-142

Date of Testing: November 15-December 20, 2023

Testing Facility: Polar Dynamics Robotics Advanced Testing Laboratory

Location: 4521 Innovation Drive, Dover, Delaware 19901

1. EXECUTIVE SUMMARY

This document presents the comprehensive environmental resistance test results for Polar Dynamics Robotics' IceNav(TM)-enabled Autonomous Mobile Robot (AMR) platform, Model PDR-3000X, conducted in accordance with ISO 20653:2013 and internal testing protocols PDR-TP-2023-11.

2. TEST SPECIFICATIONS

2.1 Test Unit Specifications

- Model: PDR-3000X Autonomous Mobile Robot
- Serial Number: PDR3K-2023-0458
- Software Version: IceNav(TM) 4.2.1
- Hardware Configuration: Standard Production Unit with Arctic-Grade Components

2.2 Testing Parameters

- Temperature Range: -40 C to +50 C
- Humidity Range: 10% to 95% RH (non-condensing)
- Operational Duration: 500 hours cumulative
- Testing Cycles: 50 complete thermal cycles
- Load Capacity: Tested at 500kg (rated maximum)

3. TEST METHODOLOGIES

3.1 Temperature Resistance Testing

- Gradual temperature reduction protocol (5 C/hour)
- Sustained operation at temperature extremes
- Rapid temperature transition testing
- Cold-start capability verification

3.2 Environmental Chamber Specifications

- Make: Thermotron SE-2000
- Chamber Size: 4m x 4m x 3m
- Temperature Control Accuracy: 0.5 C
- Humidity Control Accuracy: 3% RH

4. TEST RESULTS

4.1 Low Temperature Performance

Navigation Accuracy at -40 C: 98.7% compared to baseline

Battery Performance: 92% of rated capacity maintained

Motor Efficiency: 95.3% of nominal torque preserved

Sensor Function: All critical sensors maintained calibration

4.2 High Temperature Performance

Navigation Accuracy at +50 C: 99.1% compared to baseline

Thermal Management System: Maximum internal temperature maintained below 65 C

Power Consumption: Within 110% of baseline specifications

Component Stress Testing: No thermal-induced failures observed

4.3 Humidity Response

Condensation Resistance: No internal moisture accumulation detected

Electronic Component Function: 100% operational throughout testing

Seal Integrity: All IP67 rated enclosures maintained protection

5. COMPLIANCE VERIFICATION

The PDR-3000X AMR platform has demonstrated compliance with:

- ISO 20653:2013 Road vehicles - Degrees of protection
- IEC 60529:1989+AMD1:1999+AMD2:2013 (IP Code)
- Internal Standard PDR-STD-2023-ENV-1

6. LIMITATIONS AND DISCLAIMERS

This test report represents performance under controlled laboratory conditions. Actual field

performance may vary based on specific environmental conditions, usage patterns, and maintenance procedures. These results should not be construed as a warranty or guarantee of performance under all possible operating conditions.

7. CERTIFICATION

The undersigned hereby certify that all tests were conducted in accordance with applicable standards and Polar Dynamics Robotics quality control procedures.

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Dr. Marcus Chen

Chief Technology Officer

Polar Dynamics Robotics, Inc.

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Dr. Sarah Wong

Director of Quality Assurance

Certification Number: QA-2023-PDR-142
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8. CONFIDENTIALITY NOTICE

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9. REVISION HISTORY

Version 1.0 - December 22, 2023 - Initial test report

Version 1.1 - January 2, 2024 - Updated compliance certifications

Version 1.2 - January 10, 2024 - Added extended performance data

End of Report