

PDR-MAIN-145: Preventive Maintenance Procedures for Arctic AMRs

Document Classification: CONFIDENTIAL

Version: 3.2

Effective Date: January 15, 2024

Document Owner: Technical Operations Division

1. PURPOSE AND SCOPE

1. This document establishes mandatory preventive maintenance procedures for Polar Dynamics Robotics, Inc.'s ("PDR") Arctic-series Autonomous Mobile Robots ("Arctic AMRs"), including models AR-200, AR-300, and AR-400X operating in sub-zero environments.
2. These procedures are essential for maintaining operational integrity and compliance with PDR's warranty terms and service level agreements.

2. DEFINITIONS

1. "Arctic AMR" refers to any PDR autonomous mobile robot equipped with IceNav(TM) navigation system and ColdCore(TM) thermal management technology.
2. "Qualified Technician" means an individual certified by PDR's Technical Training Program (TTP-Arctic-2023) for Arctic AMR maintenance.
3. "Critical Components" include thermal management systems, cold-resistant actuators, and IceNav(TM) sensors.

3. MAINTENANCE INTERVALS

1. Level 1 Inspection (Daily)
 - Visual inspection of external housing integrity
 - Verification of thermal seal status
 - Battery charge level assessment
 - IceNav(TM) sensor cleaning
2. Level 2 Inspection (Weekly)
 - ColdCore(TM) system diagnostic scan

- Actuator movement range verification
- Thermal management system performance check
- Navigation calibration verification

3. Level 3 Inspection (Monthly)

- Complete system diagnostic
- Firmware validation
- Thermal coating inspection
- Battery performance analysis

4. CRITICAL COMPONENT PROCEDURES

1. ColdCore(TM) Thermal Management System

- Inspect heat exchanger efficiency every 200 operating hours
- Verify thermal compound integrity monthly
- Replace thermal interface materials every 2,000 operating hours
- Document temperature differential readings daily

2. Cold-Resistant Actuators

- Lubricate with PDR-approved Arctic-grade lubricant (PDR-LUB-01) monthly
- Test movement precision at -40 C quarterly
- Replace seals annually or at 3,000 operating hours
- Verify torque specifications weekly

3. IceNav(TM) Sensor Array

- Clean optical surfaces daily using PDR-approved solutions
- Calibrate depth sensors weekly
- Verify sensor alignment monthly
- Replace protective covers every 6 months

5. DOCUMENTATION REQUIREMENTS

1. Maintenance Records

- All maintenance activities must be logged in PDR's Maintenance Management System (MMS)

- Include technician ID, date, time, and environmental conditions
- Document all component replacements with serial numbers
- Maintain digital photographs of critical findings

2. Compliance Reporting

- Generate monthly compliance reports
- Record any deviations from standard procedures
- Document corrective actions taken
- Maintain calibration certificates

6. SAFETY PROTOCOLS

1. Required Personal Protective Equipment

- Cold environment suit rated to -50 C
- Anti-static safety boots
- Insulated gloves with tactile capability
- Safety glasses with anti-fog coating

2. Environmental Requirements

- Maintain workspace temperature monitoring
- Ensure proper ventilation
- Monitor humidity levels
- Verify emergency power systems

7. WARRANTY IMPLICATIONS

1. Adherence to these maintenance procedures is mandatory for maintaining PDR warranty coverage.
2. Failure to perform and document required maintenance may void warranty protection and service agreements.

8. PROPRIETARY NOTICE

This document contains confidential and proprietary information of Polar Dynamics Robotics, Inc. Any unauthorized reproduction, distribution, or disclosure is strictly prohibited. All rights reserved.

9. REVISION HISTORY

Version 3.2 - January 15, 2024

- Updated ColdCore(TM) maintenance intervals
- Added new IceNav(TM) calibration requirements
- Revised safety protocols for -50 C operations

10. APPROVAL

APPROVED BY:

—

Dr. James Barrett

Chief Robotics Officer

Polar Dynamics Robotics, Inc.

Date: _

—

Sarah Nordstrom

Chief Operating Officer

Polar Dynamics Robotics, Inc.

Date: _