PDR-SPEC-103: Arctic-Grade Motor Specifications and Performance Data

Document Classification: CONFIDENTIAL

Version: 3.2 | Effective Date: January 15, 2024

Polar Dynamics Robotics, Inc.

1. SCOPE AND APPLICATION

1. This specification document ("PDR-SPEC-103") defines the mandatory performance requirements, technical specifications, and operational parameters for Arctic-Grade Motors ("AG Motors") utilized in Polar Dynamics Robotics' autonomous mobile robot systems designed for sub-zero environments.

2. This document applies to all AG Motor units designated for use in Series X-500 and X-700 autonomous mobile robots operating in temperature ranges from +20 C to -40 C.

2. DEFINITIONS

1. "AG Motor" refers to Polar Dynamics Robotics' proprietary Arctic-Grade motor assemblies (Models AGM-2024-X and AGM-2024-Z).

2. "Operating Environment" means controlled industrial spaces maintaining temperatures between +20 C and -40 C.

3. "Thermal Management System" or "TMS" refers to the integrated temperature control and monitoring system (Patent Pending, Application #US2023/0789456).

3. TECHNICAL SPECIFICATIONS

1. Physical Specifications

- Dimensions: 180mm x 120mm x 120mm (2mm tolerance)
- Weight: 4.8kg (0.2kg)
- Housing Material: Aerospace-grade aluminum alloy (AL-7075-T6)
- Thermal Coating: Proprietary PDR CryoShield(TM) coating

2. Performance Parameters

- Nominal Voltage: 48V DC
- Peak Power Output: 2.8kW
- Continuous Power Rating: 1.9kW
- Maximum Torque: 12.5 Nm
- Rated Speed: 3600 RPM
- Efficiency at Rated Load: 92%

3. Environmental Specifications

- Operating Temperature Range: +20 C to -40 C
- Storage Temperature Range: +35 C to -50 C
- Humidity Tolerance: 5% to 95% non-condensing
- IP Rating: IP67
- Thermal Shock Resistance: Certified for T 60 C/hour

4. PERFORMANCE REQUIREMENTS

1. Cold Start Capability

- Must achieve full operational status within 90 seconds at -40 C
- Integrated heating elements must maintain minimum 15 C at motor bearings
- Power consumption during cold start shall not exceed 3.2kW

2. Continuous Operation

- Maintain specified torque output (5%) for 12-hour continuous operation
- Temperature differential between motor core and ambient not to exceed 45 C
- Thermal protection system must engage at predetermined thresholds per TMS Protocol v2.4

3. Safety Systems

- Automatic shutdown if internal temperature exceeds 85 C
- Integrated current limiting protection at 150% of rated current
- Real-time temperature monitoring at 12 distinct points
- Fault detection and reporting via CAN bus interface

5. QUALITY ASSURANCE

1. Testing Requirements

- 100% functional testing at extreme temperature points
- Minimum 4-hour burn-in test at -30 C
- Vibration testing per MIL-STD-810H, Method 514.8
- EMC compliance testing per EN 61000-6-2

2. Documentation Requirements

- Individual motor test reports
- Temperature cycle logs
- Performance validation certificates
- Material traceability documentation

6. COMPLIANCE AND CERTIFICATION

1. Required Certifications

- UL 1004-1 (Motors - General Requirements)
- CSA C22.2 No. 100-14
- CE Marking (where applicable)
- RoHS 3 (EU 2015/863) compliance

2. Quality Management

- ISO 9001:2015 certified manufacturing process
- IPC-A-610 Class 3 electronic assembly standards
- IATF 16949:2016 compliance for automotive applications

7. PROPRIETARY NOTICE

8. REVISION HISTORY

Version 3.2 - January 15, 2024

- Updated thermal management specifications
- Added new safety protocols
- Revised testing requirements

Version 3.1 - July 10, 2023

- Modified operating temperature ranges
- Updated certification requirements

Version 3.0 - January 5, 2023

- Initial release of consolidated specification

APPROVED BY:

/s/ Dr. James Barrett

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Chief Robotics Officer

Polar Dynamics Robotics, Inc.

Date: January 15, 2024

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Date: January 15, 2024