

# THERMAL PERFORMANCE MONITORING PROTOCOL

**Polar Dynamics Robotics, Inc.**

*Effective Date: January 15, 2024*

*Document ID: TPM-2024-001*

## 1. PURPOSE AND SCOPE

1. This Thermal Performance Monitoring Protocol ("Protocol") establishes the standardized procedures and requirements for monitoring, measuring, and documenting the thermal performance of Polar Dynamics Robotics, Inc.'s ("Company") autonomous mobile robots ("AMRs") and their component systems.
2. This Protocol applies to all Company AMR products, including but not limited to the ColdNav Series, Arctic Runner platform, and IceNav-enabled units operating in temperature-controlled environments below 0 C (32 F).

## 2. DEFINITIONS

1. "Thermal Operating Range" means the specified temperature range within which an AMR unit is designed to maintain full operational capabilities.
2. "Critical Components" means any mechanical, electrical, or computational systems whose performance is materially affected by temperature variations.
3. "Performance Degradation Point" means the temperature threshold at which any Critical Component experiences a measurable decline in operational efficiency.
4. "IceNav System" means the Company's proprietary cold-environment navigation and operation platform.

## 3. MONITORING REQUIREMENTS

1. Temperature Sensors
  - a) Each AMR unit shall be equipped with minimum four (4) calibrated temperature sensors.
  - b) Sensors must be positioned at: (i) actuator assemblies, (ii) main control board, (iii) battery compartment, and (iv) external housing.
  - c) Sensor accuracy must be maintained within 0.5 C.

## 2. Data Collection

- a) Thermal performance data shall be recorded at intervals not exceeding 60 seconds during operation.
- b) Data logs must include: timestamp, sensor locations, temperature readings, operational status, and ambient conditions.
- c) All data shall be encrypted and transmitted to Company's secure cloud infrastructure.

## 4. PERFORMANCE THRESHOLDS

### 1. Standard Operating Parameters

- a) Primary Operating Range: -30 C to +45 C
- b) Extended Operating Range: -40 C to +50 C (with activated thermal management)
- c) Maximum Rate of Temperature Change: 15 C per hour

### 2. Critical Component Thresholds

- a) Actuator Systems: -45 C minimum
- b) Battery Systems: -35 C minimum
- c) Control Electronics: -40 C minimum
- d) IceNav Sensors: -50 C minimum

## 5. TESTING AND VALIDATION

### 1. Regular Testing Requirements

- a) Full thermal performance testing required every 1,000 operating hours
- b) Calibration verification of all sensors every 3 months
- c) Stress testing at temperature extremes quarterly

### 2. Documentation Requirements

- a) Test results must be recorded in Company's Quality Management System
- b) Deviations exceeding 2 C from specified thresholds require immediate investigation
- c) Testing records retained for minimum 5 years

## 6. COMPLIANCE AND REPORTING

- 1. The Chief Robotics Officer shall maintain oversight of this Protocol's implementation.

2. Quarterly compliance reports shall be submitted to the Technology Committee.
3. Any thermal performance anomalies must be reported within 24 hours to Quality Control.

## **7. PROPRIETARY INFORMATION**

1. All thermal performance data collected pursuant to this Protocol constitutes Company Confidential Information as defined in the Company's Master Confidentiality Agreement.
2. Access to thermal performance data is restricted to authorized personnel with signed confidentiality agreements.

## **8. PROTOCOL MODIFICATIONS**

1. This Protocol may be modified only with written approval from both the Chief Technology Officer and Chief Robotics Officer.
2. Protocol revisions must be documented and distributed to all relevant personnel.

## **9. GOVERNING LAW**

1. This Protocol shall be governed by and construed in accordance with the laws of the State of Delaware.

## **AUTHORIZATION**

IN WITNESS WHEREOF, the undersigned hereby implements this Protocol as of the Effective Date.

POLAR DYNAMICS ROBOTICS, INC.

**By:**

Name: Dr. James Barrett

Title: Chief Robotics Officer

**By:**

Name: Marcus Chen

Title: Chief Technology Officer

Date: January 15, 2024