COLD-WEATHER MATERIALS SELECTION GUIDE

Polar Dynamics Robotics, Inc.

Document No.: PDR-MAT-2024-001

Effective Date: January 15, 2024

Version: 3.0

1. PURPOSE AND SCOPE

1. This Cold-Weather Materials Selection Guide ("Guide") establishes mandatory requirements and specifications for materials used in Polar Dynamics Robotics, Inc. ("Company") autonomous mobile robots designed for operation in cold-weather environments below 0 C (32 F).

2. This Guide applies to all engineering, procurement, and manufacturing activities related to the Company's cold-environment robot platforms, including but not limited to the Arctic Series(TM) and CryoBot(TM) product lines.

2. DEFINITIONS

1. "Cold-Weather Operation" means sustained functionality in ambient temperatures between -40 C (-40 F) and 0 C (32 F).

2. "Critical Components" means any materials or assemblies essential to maintaining robot operational status in Cold-Weather Operation conditions.

3. "Thermal Cycling" means repeated exposure to temperature variations between ambient and Cold-Weather Operation conditions.

3. MATERIAL SELECTION REQUIREMENTS

1. **Base Materials**

- All structural components must utilize cold-rated aluminum alloys (6061-T6 or 7075-T6)
- Prohibited materials: Standard ABS plastics, non-cold-rated elastomers
- Required documentation: Material certification showing temperature rating

2. **Actuator Components**

- Bearings must be specified for operation at -40 C

- Lubricants must maintain viscosity rating at minimum operating temperature
- Seals must utilize proprietary CryoSeal(TM) technology or equivalent

3. **Electronic Enclosures**
- Material: Cold-rated polycarbonate or equivalent
- Minimum impact resistance: 15 ft-lbs at -40 C
- Required testing: Thermal shock cycling per Company Standard TS-201

4. VALIDATION REQUIREMENTS

1. **Material Testing**
- Cold impact testing per ASTM D256
- Thermal cycling: 1000 cycles minimum
- Stress-strain analysis at minimum operating temperature

2. **Documentation Requirements**
- Material certifications from approved suppliers
- Test reports for all Critical Components
- Deviation requests must be approved by Chief Robotics Officer

5. PROPRIETARY MATERIALS

1. **CryoSeal(TM) Technology**
- Patent No. US 11,XXX,XXX
- Restricted to approved manufacturing partners
- Subject to additional security protocols per Doc. SEC-2023-005

2. **Arctic-Grade Composites**
- Proprietary formulation PDR-COMP-201
- Manufacturing restricted to Company facilities
- Export controlled under EAR classification

6. SUPPLIER REQUIREMENTS

1. **Approved Suppliers**

- Must maintain ISO 9001:2015 certification
- Required to provide batch-specific test documentation
- Subject to annual audit by Company Quality team

2. **Material Changes**
- Material substitutions require 90-day advance notice
- Engineering approval required for all changes
- Validation testing at supplier expense

7. COMPLIANCE AND ENFORCEMENT

1. This Guide is maintained by the Company's Engineering Department and enforced by Quality Assurance.

2. Violations may result in:
- Product quarantine
- Supplier disqualification
- Manufacturing hold orders

8. CONFIDENTIALITY

1. This document contains confidential and proprietary information of Polar Dynamics Robotics, Inc. and is protected under applicable intellectual property laws.

2. Distribution limited to authorized personnel and approved suppliers under valid NDAs.

9. DOCUMENT CONTROL

Version History:
- 3.0: Current version (January 15, 2024)
- 2.1: Superseded (March 10, 2023)
- 2.0: Superseded (June 15, 2022)
- 1.0: Retired (January 20, 2021)

Approved by:
```
```

_

Dr. James Barrett

Chief Robotics Officer

Date: January 15, 2024

_

Marcus Chen

Chief Technology Officer

Date: January 15, 2024

```

*End of Document*
```