ISO 10218-1:2011 Compliance Documentation

Polar Dynamics Robotics, Inc.

Document Reference: PDR-ISO-10218-2024-001

Date: January 11, 2024

1. Purpose and Scope

1. This document certifies that Polar Dynamics Robotics, Inc.'s ("PDR") autonomous mobile robot systems, specifically the IceBot Series (Models IB-2000, IB-3000, and IB-4000), comply with ISO 10218-1:2011 "Robots and robotic devices - Safety requirements for industrial robots - Part 1: Robots."

2. This compliance documentation covers all aspects of PDR's robotic systems, including:

a) Mechanical construction and design

b) Control systems and safety-related software

c) Emergency stop functions

d) Operating modes and speed controls

e) Protective measures and safety features

2. Technical Compliance Assessment

1. Safety-Related Control System Performance

- Implementation of Performance Level D (PLd) per ISO 13849-1
- Dual-channel safety architecture with continuous monitoring
- Redundant microprocessor-based safety controllers
- Regular validation testing at intervals not exceeding 12 months

2. Emergency Stop Functions

- Category 0 and Category 1 stop functions implemented
- Redundant emergency stop circuits with monitoring
- Emergency stop devices positioned at all operator interfaces
- Maximum stopping time: 0.8 seconds from activation

3. Speed Monitoring and Control

- Automatic speed reduction in collaborative operation mode
- Maximum speed in standard operation: 1.2 m/s
- Reduced speed in collaborative mode: 0.3 m/s
- Continuous real-time speed monitoring with safety-rated encoders

3. Safety Features and Protective Measures

1. Physical Safeguards

- IP65 rated enclosure for all electrical components
- Rounded edges with minimum 3mm radius
- Impact-resistant external panels (tested to withstand 2J impact)
- Thermal protection systems for -40 C to +50 C operation

2. Software Safety Features

- IceNav(TM) Safety Core v4.2 with SIL2 certification
- Real-time obstacle detection and avoidance
- Predictive path planning with safety zones
- Automatic fault detection and safe state transition

4. Testing and Validation

1. Safety Function Verification

- Complete functional testing of all safety systems
- Verification of response times and stopping distances
- Environmental testing in extreme temperature conditions
- EMC testing per IEC 61000-6-2

2. Third-Party Validation

- T V S D certification number: TU-RB-2023-12458
- NRTL certification for North American markets
- CE marking technical file reference: CE-PDR-2023-089

5. Risk Assessment

1. Hazard Analysis

- Comprehensive hazard identification per ISO 12100
- Risk assessment matrix application
- Residual risk evaluation and documentation
- Regular review and updates (minimum annually)

2. Risk Mitigation Measures

- Implementation of hierarchy of controls
- Documentation of safety function selection rationale
- Verification of risk reduction effectiveness
- Training requirements specification

6. Maintenance and Inspection Requirements

1. Scheduled Maintenance

- Monthly safety system functional checks
- Quarterly mechanical inspection requirements
- Semi-annual software safety function validation
- Annual comprehensive safety audit

2. Documentation Requirements

- Maintenance records retention period: 7 years
- Safety incident reporting procedures
- Change management documentation
- Calibration records maintenance

7. Declaration of Conformity

Polar Dynamics Robotics, Inc. hereby declares that the IceBot Series autonomous mobile robots comply with all relevant requirements of ISO 10218-1:2011. This declaration is based on technical documentation maintained at:

Polar Dynamics Robotics, Inc.

1250 Arctic Innovation Drive

Dover, Delaware 19901

8. Authorization

This compliance documentation is authorized by:

/s/ Dr. James Barrett

Dr. James Barrett

Chief Robotics Officer

Polar Dynamics Robotics, Inc.

Date: January 11, 2024

/s/ Marcus Chen

Marcus Chen

Chief Technology Officer

Polar Dynamics Robotics, Inc.

Date: January 11, 2024

9. Document Control

Document Number: PDR-ISO-10218-2024-001

Revision: 1.0

Effective Date: January 11, 2024

Next Review Date: January 11, 2025

Classification: Confidential