

# EQUIPMENT SPECIFICATIONS - FROSTCHAIN ROBOTICS

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## 1. GENERAL SPECIFICATIONS

### 1.1 Scope

This document sets forth the technical specifications and operational requirements for Polar Dynamics Robotics, Inc.'s ("Company") FrostChain Series autonomous mobile robots ("Equipment"), including models FC-1000, FC-2000, and FC-3000, designed for cold storage and temperature-controlled environments.

### 1.2 Applicable Standards

All Equipment shall conform to:

- (a) ANSI/RIA R15.06-2012 Safety Requirements
- (b) ISO 10218-1:2011 Robot Safety Standards
- (c) UL 1740 Robot Safety Standards
- (d) IP65 Environmental Protection Rating
- (e) FDA 21 CFR Part 110 (where applicable for food-grade environments)

## 2. TECHNICAL SPECIFICATIONS

### 2.1 Physical Characteristics

(a) Dimensions:

- FC-1000: 1200mm x 800mm x 450mm
- FC-2000: 1500mm x 1000mm x 500mm
- FC-3000: 1800mm x 1200mm x 550mm

(b) Load Capacity:

- FC-1000: Up to 500kg
- FC-2000: Up to 1000kg
- FC-3000: Up to 1500kg

## **2.2 Environmental Operating Parameters**

- (a) Temperature Range: -40 C to +45 C
- (b) Humidity: 5% to 95% non-condensing
- (c) Floor Condition: Operates on industrial concrete, epoxy, or similar surfaces
- (d) Maximum Slope: 3% grade

## **2.3 Power Systems**

- (a) Battery Type: Proprietary ColdCell(TM) Lithium Iron Phosphate
- (b) Operating Time: 12-16 hours continuous operation
- (c) Charging Time: 2 hours to 80% capacity
- (d) Charging Temperature: -30 C to +40 C

## **3. NAVIGATION AND CONTROL SYSTEMS**

### **3.1 IceNav(TM) Navigation Platform**

- (a) Sensor Configuration:
  - LiDAR: 360 scanning, 30m range
  - 3D Time-of-Flight cameras
  - Thermal imaging sensors
  - Proprietary frost detection system
- (b) Positioning Accuracy:
  - Linear: 10mm
  - Angular: 1
  - Repeatability: 5mm

### **3.2 Safety Systems**

- (a) Emergency Stop Systems:
  - Hardware E-stop buttons
  - Remote E-stop capability
  - Automatic collision avoidance
  - Personnel detection zones
- (b) Fail-Safe Mechanisms:

- Redundant control systems
- Automatic safe-state engagement
- Battery monitoring and protection
- Temperature monitoring and shutdown protection

## **4. COMMUNICATION AND CONNECTIVITY**

### **4.1 Network Requirements**

- (a) Wireless: IEEE 802.11ac/ax
- (b) Ethernet: 1000BASE-T
- (c) Protocols: TCP/IP, MQTT, OPC-UA
- (d) Security: WPA3-Enterprise, TLS 1.3

### **4.2 Integration Capabilities**

- (a) WMS Integration: REST API, SOAP
- (b) ERP Systems: SAP, Oracle, Microsoft Dynamics
- (c) Custom Integration: Available through SDK

## **5. MAINTENANCE AND SERVICE**

### **5.1 Scheduled Maintenance**

- (a) Daily Inspection Requirements
- (b) Weekly Maintenance Protocol
- (c) Quarterly Service Requirements
- (d) Annual Certification Process

### **5.2 Service Intervals**

- (a) Basic Service: Every 2000 operating hours
- (b) Major Service: Every 6000 operating hours
- (c) Battery Replacement: Every 24 months or 10,000 cycles

## **6. COMPLIANCE AND CERTIFICATION**

### **6.1 Required Certifications**

- (a) CE Marking (European Union)

(b) UL Certification (North America)

(c) RoHS Compliance

(d) IP65 Rating Certification

## **6.2 Quality Control**

All Equipment undergoes factory acceptance testing (FAT) including:

(a) Full range motion testing

(b) Load capacity verification

(c) Environmental chamber testing

(d) Navigation system validation

## **7. WARRANTY AND DISCLAIMER**

### **7.1 Limited Warranty**

Equipment is warranted against defects in materials and workmanship under normal use for a period of twenty-four (24) months from the date of installation.

### **7.2 Disclaimer**

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/s/ Dr. James Barrett

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Polar Dynamics Robotics, Inc.

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