

OPERATING PARAMETERS - LOW TEMPERATURE ROBOTICS

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Polar Dynamics Robotics, Inc.

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1. SCOPE AND APPLICATION

1 This Operating Parameters document ("Parameters") establishes the

2 These Parameters apply to all Series LT-2000 and LT-3000 AMR un

2. DEFINITIONS

1 "Operating Temperature Range" means the environmental temperature

2 "Critical Systems" includes, but is not limited to, the BlueCore(TM) n

3 "Standard Operating Cycle" refers to a continuous operational period

3. ENVIRONMENTAL SPECIFICATIONS

1 Temperature Parameters

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Minimum Operating Temperature: -40 C (-40 F)

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Maximum Operating Temperature: +10 C (+50 F)

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Optimal Performance Range: -30 C to +5 C (-22 F to +41 F)

2 Humidity Parameters

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Relative Humidity Range: 15% to 90% non-condensing

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Maximum Condensation Exposure: 30 minutes per 24-hour period

3 Environmental Transitions

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Maximum Temperature Change Rate: 15 C per hour

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Minimum Acclimation Period: 45 minutes when transitioning >20 C

4. OPERATIONAL PARAMETERS

1 Power Systems

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Operating Voltage: 48V DC $\pm 5\%$

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Battery Chemistry: Proprietary Low-Temperature Lithium Iron Phosphate

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Minimum Operating Charge: 15%

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Maximum Continuous Operation: 12 hours

2 Navigation Systems

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Sensor Calibration Temperature: -25°C $\pm 5^{\circ}\text{C}$

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Maximum Navigation Speed: 2.0 m/s in temperatures above -30 C

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Reduced Speed Operation: 1.2 m/s in temperatures below -30 C

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Minimum Lighting Requirement: 50 lux at floor level

3 Load Specifications

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Maximum Payload: 1,500 kg at -30 C

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Reduced Payload: 1,200 kg below -30 C

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Maximum Incline: 5% at full load

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Surface Friction Coefficient: 0.3

5. SAFETY PROTOCOLS

1 Emergency Shutdown Parameters

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Battery Temperature: $<-45\text{ C}$ or $>60\text{ C}$

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Motor Temperature: $>80\text{ C}$

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System Voltage: $<42\text{V}$ or $>52\text{V}$

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Impact Detection: $>2.0\text{G}$

2 Automatic Safety Features

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Thermal Management Override

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Emergency Stop Protocol

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Anti-Slip Control System

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Collision Avoidance System

6. MAINTENANCE REQUIREMENTS

1 Scheduled Maintenance Intervals

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Level 1 Inspection: Every 500 operating hours

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Level 2 Service: Every 2,000 operating hours

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Full System Evaluation: Annually or 5,000 operating hours

2 Component Replacement Schedule

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Battery Pack: Every 18 months or 3,000 cycles

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Drive Train Components: Every 4,000 operating hours

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Sensor Array: Every 24 months

7. COMPLIANCE AND CERTIFICATION

1 The AMR units operating under these parameters maintain compliance

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ISO/TS 15066:2016

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ANSI/RIA R15.08-1-2020

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CE Marking Requirements

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UL 3300 First Edition

8. DISCLAIMER AND LIMITATIONS

1 These Operating Parameters are proprietary to Polar Dynamics Robotics, Inc.

2 Operation outside specified parameters voids all warranties and may cause damage to the robot.

3 The Company reserves the right to modify these parameters with 30 days notice.

9. AUTHORIZATION

IN WITNESS WHEREOF, these Operating Parameters have been duly
approved by Polar Dynamics Robotics, Inc.

By:

Dr. James Barrett

Chief Robotics Officer

Polar Dynamics Robotics, Inc.

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