

PDR-2023-556 THERMAL INSULATION PERFORMANCE DATA

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CONFIDENTIAL AND PROPRIETARY

Polar Dynamics Robotics, Inc.

Document Reference: PDR-2023-556

Effective Date: January 11, 2024

1. OVERVIEW AND SCOPE

1 This Technical Performance Data Report ("Report") documents the

2 This Report is considered confidential and proprietary information of

2. TECHNICAL SPECIFICATIONS

1 Thermal Insulation System Components:

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Primary chassis thermal barrier (TC-850 composite)

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Multi-layer dynamic insulation matrix

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Proprietary thermal junction interfaces

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Advanced ceramic polymer coating (Patent Pending: US 2023/014576)

2 Operating Temperature Range:

- - 2 -

Minimum: -40 C (-40 F)

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Maximum: +25 C (+77 F)

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Optimal performance range: -30 C to +15 C

3 Thermal Resistance Values:

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R-value (composite system): 45.8 ft F h/BTU

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K-value: 0.022 W/(m K)

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Overall thermal conductivity: 0.019 W/(m K)

3. PERFORMANCE TESTING METHODOLOGY

1 Testing Standards Compliance:

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ASTM C518-21 (Standard Test Method for Steady-State Thermal Tra

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ISO 8301:1991 (Thermal Insulation - Determination of Steady-State T

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Internal Protocol PDR-TP-2023-112 (Extreme Environment Durability

2 Test Conditions:

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Duration: 2,000 hours continuous operation

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Temperature cycling: 4-hour intervals

- - 4 -

Humidity range: 15% to 95% RH

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Atmospheric pressure: 101.325 kPa ± 1%

3 Testing Facilities:

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Primary: Polar Dynamics Advanced Research Laboratory (Minneapolis, MN)

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Secondary: ThermalTech Independent Testing Facility (Boulder, CO)

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Validation: Arctic Research Station (Tromsø, Norway)

4. PERFORMANCE RESULTS

1 Thermal Stability:

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Temperature differential maintenance: 0.5 C

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Internal component temperature variance: <2 C

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Thermal bridge efficiency: 98.5%

2 Energy Efficiency:

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Power consumption reduction: 32% vs. baseline

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Heat loss coefficient: 0.15 W/m K

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Thermal cycling recovery time: <180 seconds

3 Durability Metrics:

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Insulation degradation rate: <0.1% per 1,000 hours

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Impact resistance: Meets MIL-STD-810H

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Chemical resistance: Class A (all standard industrial coolants)

5. CERTIFICATION AND COMPLIANCE

1 The thermal insulation system described herein has been tested and

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UL 746C (Polymeric Materials - Industrial Equipment)

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IEC 60068-2-1 (Environmental Testing - Cold)

- - 7 -

CE Marking requirements for industrial equipment

2 Quality Assurance:

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ISO 9001:2015 certified manufacturing process

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Batch testing protocol: PDR-QA-2023-089

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Statistical process control implementation

6. LIMITATIONS AND DISCLAIMERS

1 This Report represents performance data collected under controlled

2 The Company makes no warranties, express or implied, regarding t

3 Performance metrics are subject to variation based on environmental

7. AUTHENTICATION

This Technical Performance Data Report is hereby certified as accurate and complete by the undersigned authorized representatives of Polar Dynamics Robotics, Inc.

APPROVED AND CERTIFIED:

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8. DOCUMENT CONTROL

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