2024-003: SUB-ZERO QUALITY CONTROL STANDARDS FOR POLAR MANUFA

PDR-QC-2024-003: SUB-ZERO QUALITY CO

Effective Date: January 15, 2024

Document Version: 1.2

Classification: Confidential

Department: Operations

Owner: Quality Control Division

1. PURPOSE AND SCOPE

1. This Quality Control Standard ("Standard") establishes mandatory c

2. This Standard applies to all manufacturing, assembly, and testing c

2. DEFINITIONS

1. "Sub-Zero Environment" means any controlled testing or operating

2. "Critical Components" means all BlueCore(TM) platform componen

3. "Quality Control Test Protocol" or "QCTP" means the series of stan

3. GENERAL REQUIREMENTS

1. Manufacturing Environment

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3.1.1. All sub-zero AMR assembly must occur in temperature-controlle

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3.1.2. Component acclimation periods of minimum 24 hours required

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3.1.3. Humidity levels must be maintained between 35-45% during as

2. Personnel Requirements

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3.2.1. All assembly technicians must complete PDR-TC-101 cold oper

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3.2.2. Quality control inspectors must maintain current PDR-QC-Inspe

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3.2.3. Minimum two certified inspectors must be present during all col

4. QUALITY CONTROL TEST PROTOCOLS

1. Component-Level Testing

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4.1.1. All Critical Components must undergo individual cold-soak testi

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4.1.2. Power systems must demonstrate >95% rated capacity at -25 C

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4.1.3. Navigation sensors must achieve <2cm positioning accuracy at

2. System Integration Testing

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4.2.1. Assembled units must pass 72-hour continuous operation test a

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4.2.2. Navigation accuracy validation through standardized obstacle c

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4.2.3. Emergency stop systems tested at 2-hour intervals during cold

3. Stress Testing Requirements

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4.3.1. Thermal cycling: 20 cycles between +20 C and -25 C over 120

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4.3.2. Maximum load testing at -20 C for 4 hours.

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4.3.3. Impact resistance testing at -15 C per ISO 13482:2014.

5. DOCUMENTATION AND REPORTING

1. Required Documentation

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5.1.1. Complete test logs for each QCTP stage.

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5.1.2. Component serial number tracking and cold-test history.

5.1.3. Environmental condition logs for all testing periods.

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5.1.4. Calibration records for all test equipment.

2. Non-Conformance Reporting

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5.2.1. All test failures must be documented in NCR system within 4 ho

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5.2.2. Root cause analysis required for any critical component failure.

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5.2.3. Corrective action plans must be approved by Quality Director.

6. QUALITY ASSURANCE MEASURES

1. Regular Audits

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6.1.1. Monthly internal audits of cold-testing procedures.

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6.1.2. Quarterly external validation by certified testing laboratory.

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6.1.3. Annual review of all QC documentation and procedures.

2. Continuous Improvement

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6.2.1. Monthly review of test data trends and patterns.

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6.2.2. Quarterly updates to test protocols based on field performance.

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6.2.3. Integration of customer feedback into QC procedures.

7. COMPLIANCE AND ENFORCEMENT

1. This Standard is mandatory for all manufacturing operations involvi

2. Violations may result in production suspension and mandatory retra

3. Exceptions require written approval from Quality Director and CTO.

8. REVISION HISTORY

Version 1.2 - January 15, 2024: Updated thermal cycling requirements

Version 1.1 - July 1, 2023: Added navigation accuracy specifications

Version 1.0 - January 1, 2023: Initial release

APPROVALS

APPROVED BY:

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Date: January 15, 2024

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Date: January 15, 2024

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