PDR-2023-334 COLD CLIMATE LUBRICATION STANDARDS

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EFFECTIVE DATE: January 15, 2024

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SUPERSEDES: PDR-2022-156

CLASSIFICATION: Technical Standards - Confidential

1. PURPOSE AND SCOPE

1. This document establishes mandatory lubrication standards and sp

2. These standards apply to all BlueCore(TM)-enabled AMR models,

2. DEFINITIONS

1. "Cold Climate Operation" refers to continuous AMR operation in am

2. "Critical Components" means all mechanical interfaces requiring lu

a) Drive train assemblies

b) Articulation joints

c) Bearing surfaces

d) Linear actuators

e) Gear systems

3. "Approved Lubricants" means those substances meeting the specif

3. LUBRICATION SPECIFICATIONS

1. Base Oil Requirements

-

Synthetic hydrocarbon base

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Pour point below -50 C (-58 F)

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Viscosity index > 140

-

Flash point > 200 C (392 F)

2. Additive Package Requirements

- Anti-wear additives (ZDDP concentration 800-1200 ppm)
- Pour point depressants
- Oxidation inhibitors
- Anti-foam agents
- Corrosion inhibitors

3. Performance Requirements

- Operating temperature range: -45 C to 85 C (-49 F to 185 F)
-

Minimum startup torque at -40 C

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Water separation index > 41

-

Copper corrosion test (ASTM D130): 1a maximum

4. APPLICATION PROCEDURES

1. Initial Application

-

Clean surfaces with approved solvent

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Apply primary lubricant layer per Technical Bulletin TB-2023-15

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Verify complete coverage of critical surfaces

- Document application date and batch numbers

2. Maintenance Intervals

- Inspect lubrication status every 200 operating hours
- Reapply lubricants every 600 operating hours or quarterly, whichever
- Maintain detailed lubrication logs per Form F-334-L

5. QUALITY CONTROL

1. Testing Requirements

-

Perform torque testing at -35 C quarterly

-

Conduct wear particle analysis monthly

-

Execute startup sequence verification weekly

-

Document all test results in BlueCore(TM) maintenance portal

2. Non-Conformance Procedures

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Immediately remove non-conforming AMRs from service

-

Issue Non-Conformance Report (NCR) per QC-PRO-112

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Implement corrective actions within 24 hours

Require QC sign-off before return to service

6. SAFETY AND ENVIRONMENTAL COMPLIANCE

1. All lubricants must comply with:

- EPA 40 CFR Part 110
- REACH Regulation (EC) No 1907/2006
- California Proposition 65 requirements
- OSHA 29 CFR 1910.1200

2. Safety Data Sheets (SDS) must be:

- Maintained in electronic and physical formats
- Available at all maintenance locations
- Updated annually or upon formulation changes
- Included in the BlueCore(TM) documentation system

7. DOCUMENTATION AND RECORDS

1. Required Documentation

- Lubrication logs

- Test results
- Non-conformance reports
- Corrective action records
- Training certifications
- Calibration records

2. Retention Requirements

- Maintain records for minimum 5 years
-

Store in Company's secure document management system

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Back up quarterly to secure cloud storage

-

Preserve all records related to warranty claims indefinitely

8. REVISION AND CONTROL

This document is controlled and maintained by the Technical Standar

Revisions require approval from:

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Chief Robotics Officer

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Director of Quality Assurance

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Senior Mechanical Systems Engineer

APPROVAL

APPROVED BY:

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Dr. James Barrett

Chief Robotics Officer

Date: January 15, 2024

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Victoria Wells

Chief Financial Officer

Date: January 15, 2024