

Predictive Maintenance Knowledge Base Generic Reference for Industrial Rotating Equipment (Decision-Trace Aligned, Retrieval-Only Document)

1. Purpose of This Document

This document provides standardized maintenance recommendations for industrial rotating equipment based on pre-determined system decisions.

It is designed to be used by a non-intelligent maintenance agent that:

- does not reason,
- does not infer,
- does not override decisions,

only retrieves documented guidance.

This document does not perform failure detection or diagnosis.

All decisions are assumed to be finalized before consulting this document.

2. Equipment Covered

This knowledge base applies to the following equipment types:

- Industrial electric motors
- Rolling and journal bearings
- Rotating shafts and couplings
- Reciprocating compressors
- Sensor-instrumented rotating assemblies

3. Severity Levels and Action Philosophy

All maintenance actions fall into one of four urgency levels:

- Low – observe and monitor
- Medium – inspect and plan maintenance
- High – schedule intervention

- Critical – immediate shutdown required

Unless explicitly stated, early-stage conditions do not require immediate shutdown.

4. Early Bearing Degradation

4.1 Description

Early bearing degradation refers to the initial wear phase of a bearing where:

- mechanical integrity is intact,
- failure has not occurred,
- continued operation is still possible.

This condition is preventive in nature, not corrective.

4.2 Typical Indicators

Common indicators include:

- sustained increase in vibration over time
- moderate temperature rise
- stable or normal load conditions

These indicators must be persistent, not momentary.

4.3 Recommended Maintenance Actions

When early bearing degradation is identified:

- Perform a visual inspection of bearing housing
- Check lubrication condition and quantity
- Inspect for shaft misalignment or imbalance
- Plan preventive maintenance within 5–10 operating days if indicators persist

4.4 Urgency Level

- Medium priority
- Continued operation is allowed with monitoring
- Immediate shutdown is not required

4.5 Safety Precautions

- Power down equipment before inspection
- Apply lock-out / tag-out procedures
- Wear appropriate protective equipment

4.6 Edge Cases (When NOT to Act Immediately)

Do not escalate if:

- vibration increase occurred only once
- temperature rise is within ambient fluctuation range
- lubrication was recently changed
- equipment is newly installed and settling

In these cases, monitor before acting.

5. Vibration-Dominant Anomalies

5.1 Description

Sustained vibration without temperature rise may indicate:

- mechanical imbalance
- loose mounting
- early misalignment

This does not always indicate bearing wear.

5.2 Recommended Actions

- Inspect mounting bolts and base
- Verify shaft alignment
- Monitor vibration trend over subsequent cycles

5.3 Urgency Level

- Low priority
- Observation and monitoring recommended

5.4 Common False Positives

- Loose sensor mounting
- External vibration sources
- Nearby machinery operation
- Validate before scheduling maintenance.

6. Temperature-Dominant Anomalies

6.1 Description

A gradual temperature rise without corresponding vibration increase may be caused by:

- lubrication degradation
- cooling inefficiency
- ambient temperature effects

6.2 Recommended Actions

- Inspect lubrication pathways
- Verify cooling airflow
- Check temperature sensor calibration

6.3 Urgency Level

- Medium priority
- Inspection recommended before escalation

7. Combined Vibration and Temperature Increase

7.1 Interpretation

When vibration and temperature increase together, this indicates confirmed mechanical degradation, not sensor noise.

7.2 Recommended Actions

- Schedule maintenance during planned downtime
- Prepare spare components if available
- Continue monitoring until maintenance is performed

7.3 Urgency Level

Medium to High, depending on trend progression

8. Reciprocating Compressor – Early Degradation

8.1 Common Indicators

- irregular vibration patterns
- moderate temperature rise
- unstable pressure behavior

8.2 Recommended Actions

- Inspect piston and bearing assemblies
- Verify lubrication flow
- Inspect valve clearances
- Schedule partial maintenance

8.3 Urgency Level

Medium priority

9. Sensor Error vs Real Mechanical Fault (Critical Edge Case)

9.1 Common Sensor Issues

- signal noise
- drift over time
- calibration loss
- loose sensor attachment

9.2 Indicators of Sensor-Related Issues

- sudden step changes in readings
- conflicting sensor signals
- lack of physical corroboration

9.3 Recommended Response

- Validate sensor readings
- Cross-check with secondary sensors
- Do not escalate maintenance prematurely

10. Human Error and Operational Context

10.1 Human-Induced Conditions

- over-lubrication
- improper assembly
- ignored early warnings
- incorrect maintenance procedures

10.2 Recommended Actions

- Review maintenance history
- Reinforce standard procedures
- Provide operator training if required

11. Maintenance Decision Mapping Table

Condition	Recommended Action	Urgency
Early bearing degradation	Inspect and lubricate	Medium
Sustained vibration only	Alignment check	Low
Temperature rise only	Lubrication and cooling check	Medium

Vibration + temperature	Schedule maintenance	Medium
Confirmed progression	Replace component	High
Sensor inconsistency	Validate sensor	Low

12. Global Safety Guidelines

- Always isolate power before inspection
- Follow lock-out / tag-out procedures
- Use appropriate personal protective equipment
- Do not bypass safety interlocks

13. Limitations of This Document

- This document provides advisory guidance only
- Final decisions rest with qualified engineers
- Site-specific conditions may require deviation

14. Closing Statement

This knowledge base exists to ensure:

- consistent maintenance actions,
- reduced ambiguity,
- transparent, documented guidance.

It supports execution, not decision-making.