Motor Condition Monitoring Devices
K6CM series

Application Guide

Fan system application

Pump system application

Stirring system application

Transport system application
# Degradation Progress and Failure Mode

Please select the optimal model for the type of failure mode you want to detect.

<table>
<thead>
<tr>
<th>Failure mode</th>
<th>Setup period</th>
<th>Operation period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inside the motor</td>
<td>Insulation degradation</td>
<td>Early operation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Grease degradation</td>
</tr>
<tr>
<td>Outside the motor</td>
<td>Bearing abnormality</td>
<td>Adjustment</td>
</tr>
<tr>
<td></td>
<td>Abnormality of rotary shaft</td>
<td>Faulty installation</td>
</tr>
<tr>
<td></td>
<td>- Rotor/stator abnormality</td>
<td>Faulty centering etc.</td>
</tr>
<tr>
<td></td>
<td>Abnormality of rotary shaft</td>
<td>Faulty mounting</td>
</tr>
<tr>
<td></td>
<td>- Imbalance</td>
<td>Faulty operating condition</td>
</tr>
<tr>
<td></td>
<td>- Misalignment</td>
<td>Faulty load part</td>
</tr>
<tr>
<td></td>
<td>Load abnormality</td>
<td>Early operation</td>
</tr>
<tr>
<td></td>
<td>- Cavitation</td>
<td>K6CM-CIM (Comprehensive current diagnosis type)</td>
</tr>
<tr>
<td></td>
<td>- Device abnormality</td>
<td>Overcurrent</td>
</tr>
<tr>
<td></td>
<td>- Overload</td>
<td></td>
</tr>
</tbody>
</table>

K6CM-VBM (Vibration & temperature monitoring type) | K6CM-CIM (Comprehensive current diagnosis type) | K6CM-VBM (Vibration & temperature monitoring type) | K6CM-CIM (Comprehensive current diagnosis type)
**Degradation period**

<table>
<thead>
<tr>
<th>Motor and load condition</th>
<th>Breakdown period</th>
</tr>
</thead>
<tbody>
<tr>
<td>Insulation degradation</td>
<td>Insulation breakdown</td>
</tr>
<tr>
<td>K6CM-ISM</td>
<td>(Insulation resistance monitoring type) [Insulation degradation]</td>
</tr>
<tr>
<td>Bearing damage</td>
<td>Bearing breakdown</td>
</tr>
<tr>
<td>K6CM-CIM</td>
<td>(Comprehensive current diagnosis type) [Degradation level]</td>
</tr>
<tr>
<td>K6CM-VBM</td>
<td>(Vibration &amp; temperature monitoring type) [Velocity/Acceleration]</td>
</tr>
<tr>
<td>Degradation progress of motor</td>
<td></td>
</tr>
<tr>
<td>[Degradation level]</td>
<td></td>
</tr>
<tr>
<td>Degradation progress of load</td>
<td></td>
</tr>
<tr>
<td>[Degradation level]</td>
<td></td>
</tr>
</tbody>
</table>

**Faulty installation**

- Faulty installation
- Faulty centering
- etc.
- Faulty mounting
- Faulty operating condition
- Faulty load part

**Degradation Progress and Failure Mode**

Please select the optimal model for the type of failure mode you want to detect.
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I. Pump system application

K6CM Target Application

Washing pumps for automotive components

Facility details
Pump for washing.
Motor-driven pump sends washing water to the washing tank.

Motor operation conditions
11kw/200V/4poles
Inverter drive frequency: 60Hz

Failure mode
Load abnormality (Cavitation)

Detection parameters
Degradation level

Degradation level measurement results obtained from K6CM-CIM

<table>
<thead>
<tr>
<th>The current waveform data *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Condition</td>
</tr>
<tr>
<td>Measurement value under normal operation: 20</td>
</tr>
<tr>
<td>Abnormal operation: Air bubble has entered the pump, causing an air lock</td>
</tr>
<tr>
<td>Alarm threshold (Warning) 30</td>
</tr>
<tr>
<td>Alarm threshold (Critical) 50</td>
</tr>
</tbody>
</table>

* K6CM does not output electric current waveform data.

Expected implementation effects
Detects air locks in pumps and other abnormal conditions so that the system can be maintained before degradation causes it to shut down.
I. Pump system application

K6CM Target Application

Cooling water circulation pumps

Facility details
Pump for circulating water throughout the facility.

Motor operation conditions
110kW/380V/4poles
Inverter drive frequency: 52Hz

Failure mode
Bearing anomalies

Detection parameters
Acceleration

Acceleration measurement results obtained from K6CM-VBM

Measurement value under abnormal operation: 1.5 G or more
Bearing not sufficiently lubricated

Measurement value under normal operation: around 0.6 G

Alarm threshold acceleration for this application (examples)

<table>
<thead>
<tr>
<th>Alarm threshold (Warning)</th>
<th>0.99G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alarm threshold (Critical)</td>
<td>4.08G</td>
</tr>
</tbody>
</table>

Expected implementation effects
Detects when bearing grease has degraded or dried up, or when foreign matter has entered the system.
I. Pump system application

K6CM Target Application
Hydraulic pumps

Facility details
Motors for hydraulic pumps in hydraulic facilities

Motor operation conditions
37kW/200V/6poles
Direct connection to commercial power supply: 60Hz
* Measured at fixed hydraulic pressure

Failure mode
Deterioration over time

Detection parameters
Degradation level

Degradation level measurement results obtained from K6CM-CIM

Degradation level log data

Normal Condition
Measurement value under normal operation: 32
Pump initial installation

Warning Condition
Measurement value under warning operation: 47
Pump installed over 10 years ago

Alarm threshold degradation levels for this application (examples)

- Alarm threshold (Warning): 45
- Alarm threshold (Critical): 55

Expected implementation effects
Enables the user to assess the right timing for maintenance based on the degree of deterioration instead of elapsed time. Automatically notifies the user when to perform maintenance.
II. Fan system application

K6CM Target Application
Oven cooler fan motors

Facility details
Cooling fan for metal can drying oven.

Motor operation conditions
18.5kW/200V/4poles
Inverter drive frequency: 30Hz

Failure mode
Deterioration over time

Detection parameters
Acceleration

Acceleration measurement results obtained from K6CM-VBM

Measurement value of motor that has not been maintained for seven years
1.25 G
Abnormal condition value

Threshold for this application (examples)

<table>
<thead>
<tr>
<th>Alarm threshold (Warning)</th>
<th>0.13G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alarm threshold (Critical)</td>
<td>0.57G</td>
</tr>
</tbody>
</table>

Expected implementation effects
Enables the user to assess the right timing for maintenance based on the degree of deterioration instead of elapsed time.
Automatically notifies the user when to perform maintenance.
II. Fan system application

K6CM Target Application

Ventilation fans in odorous gas treatment facilities

Facility details
Ventilation fans in odorous gas treatment facilities Purifies air before releasing it outside by removing odorous components using activated carbon.

Motor operation conditions
22kW/400V
Driving the motor by direct connection to commercial power supply: 50Hz

Failure mode
Deterioration over time

Detection parameters
Acceleration/Velocity

Acceleration/Velocity measurement results obtained from K6CM-VBM

**Measurement value**
- under normal operation:
  - **G**: 0.15G
  - **Warning**

**Measurement value**
- under abnormal operation:
  - **G**: 1.30G
  - **Critical**

**Motor making abnormal noise**

**Measurement value**
- under normal operation:
  - **mm/s**: 1.9mm/s
  - **Normal**

**Measurement value**
- under abnormal operation:
  - **mm/s**: 2.9mm/s
  - **Abnormal**

**Motor making abnormal noise**

Threshold for this application (examples)

**Example of Acceleration alarm threshold**
- **Alarm threshold (Warning)**: 0.37G
- **Alarm threshold (Critical)**: 1.54G

**Example of Velocity alarm threshold**
- **Alarm threshold (Warning)**: 2.8mm/s
- **Alarm threshold (Critical)**: 7.1mm/s

Expected implementation effects
Enables remote detection of motor failure. Detects degradation of bearings so users can replace them before they lock up.
II. Fan system application

K6CM Target Application

Cooling tower fans

Facility details
Cools cooling water sent to production facilities. If temperatures rise during the day, fans are turned on to cool the fins, which in turn cool the cooling water.

Motor operation conditions
5.5kW/200V/4poles
Driving the motor by direct connection to commercial power supply: 60Hz

Failure mode
Deterioration over time

Detection parameters
Degradation level, Acceleration

Degradation level measurement results obtained from K6CM-CIM

<table>
<thead>
<tr>
<th>Unit 2</th>
<th>Measurement value under normal operation</th>
<th>32</th>
<th>Measurement value under abnormal operation</th>
<th>44</th>
</tr>
</thead>
<tbody>
<tr>
<td>After maintenance</td>
<td></td>
<td></td>
<td>Before maintenance</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Unit 1</th>
<th>Measurement value under normal operation</th>
<th>29</th>
<th>Measurement value under abnormal operation</th>
<th>71</th>
</tr>
</thead>
<tbody>
<tr>
<td>After maintenance</td>
<td></td>
<td></td>
<td>Before maintenance</td>
<td></td>
</tr>
</tbody>
</table>

Alarm threshold degradation levels for this application (examples)

- **Alarm threshold (Warning)**: 40
- **Alarm threshold (Critical)**: 50

Expected implementation effects
Enables the user to assess the right timing for maintenance based on the degree of deterioration instead of elapsed time. Automatically notifies the user when to perform maintenance.
### Fan system application

#### K6CM Target Application

Cooling tower fans

#### Degradation level measurement results obtained from K6CM-CIM

Alarm threshold degradation levels for this application (examples)

<table>
<thead>
<tr>
<th>Current (A) Measurement data Ideal sine wave</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unit 1</td>
</tr>
<tr>
<td>Measurement value under normal operation</td>
</tr>
<tr>
<td>29</td>
</tr>
<tr>
<td>Measurement value under abnormal operation</td>
</tr>
<tr>
<td>71</td>
</tr>
</tbody>
</table>

Normal Condition Abnormal Condition

- Before maintenance
  - Measurement value under normal operation: 32 G
  - Measurement value under abnormal operation: 44 G
- After maintenance
  - Measurement value under normal operation: 0.11 G

#### Fan system application

5.5kW/200V/4poles

Driving the motor by direct connection to commercial power supply: 60Hz

#### Facility details

Motor operation conditions

Failure mode

Deterioration over time

Detection parameters

Degradation level, Acceleration

#### Expected implementation effects

- Enables the user to assess the right timing for maintenance based on the degree of deterioration instead of elapsed time.
- Automatically notifies the user when to perform maintenance.

#### Alarm threshold acceleration for this application (examples)

- **Alarm threshold (Warning):** 0.32G
- **Alarm threshold (Critical):** 1.35G

#### Regularly replace pulleys, bearings, belts, etc.

#### Note: Bearing anomalies can be detected earlier by vibration than by comprehensive current diagnosis.

Load anomalies that cause bearing anomalies, however, are better detected using comprehensive current diagnosis.

#### Shaft diameter \( D \) [mm] × Rotation speed \( N \) [rpm]

<table>
<thead>
<tr>
<th>( D ) [mm]</th>
<th>( N ) [rpm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>4</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>8</td>
</tr>
<tr>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>10</td>
<td>12</td>
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<tr>
<td>12</td>
<td>14</td>
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<td>14</td>
<td>16</td>
</tr>
<tr>
<td>16</td>
<td>18</td>
</tr>
<tr>
<td>18</td>
<td>20</td>
</tr>
</tbody>
</table>

\( \approx 6.8 \times 10^4 \)

#### Acceleration measurement results obtained from K6CM-VBM

**Unit 1**

Before maintenance
- Measurement value under normal operation: 0.25G
- Measurement value under warning operation: 0.44G

After maintenance
- Measurement value under normal operation: 0.11G

**Unit 2**

Before maintenance
- Measurement value under warning operation: 0.44G

After maintenance
- Measurement value under normal operation: 0.08G

Note: Bearing anomalies can be detected earlier by vibration than by comprehensive current diagnosis.

Load anomalies that cause bearing anomalies, however, are better detected using comprehensive current diagnosis.

**Expected implementation effects**

Detects degradation of bearings so users can replace them before they lock up.
II. Fan system application

K6CM Target Application

Fan motors for air handling units

Facility details
Air conditioner that sets the temperature and humidity of the air to comfortable levels before sending it inside.

Motor operation conditions
22kW/200V/4poles
Inverter drive frequency: 50Hz

Failure mode
Deterioration over time

Detection parameters
Acceleration

Acceleration measurement results obtained from K6CM-VBM

Measurement value under abnormal operation: 2.84G
motor making abnormal noise

Alarm threshold accelerationo for this application (examples)

<table>
<thead>
<tr>
<th>Alarm threshold (Warning)</th>
<th>0.37G</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alarm threshold (Critical)</td>
<td>1.54G</td>
</tr>
</tbody>
</table>

Expected implementation effects
Enables remote detection of motor failure.
Detects degradation of bearings so users can replace them before they lock up.
### K6CM Target Application

#### Conveyor system

**Facility details**
Elevating device powered by a single motor that carries luggage, etc. up and down.

**Motor operation conditions**
5.5kW/200V/4poles
Driving the motor by direct connection to commercial power supply: 50Hz

**Failure mode**
Load abnormality

**Detection parameters**
Degradation level

### Degradation level measurement results obtained from K6CM-CIM

**Measurement value under normal operation**
12

**Measurement value under critical operation**
29

**With weight mounted**

**Measurement value under normal operation**
12

**Without weight mounted (average value)**

**Alarm threshold degradation levels for this application (examples)**

<table>
<thead>
<tr>
<th>Alarm threshold</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Warning)</td>
<td>25</td>
</tr>
<tr>
<td>(Critical)</td>
<td>35</td>
</tr>
</tbody>
</table>

**Expected implementation effects**
Prevents degradation by detecting anomalies that are not evident in electric current values.
Also detects load anomalies, e.g. when weight is too heavy.
IV. Other applications

K6CM Target Application

**Well pumps**

**Facility details**
Pump for extracting water from a well.

**Motor operation conditions**
7.5kw/200V/4poles
Inverter drive frequency: 25Hz

**Failure mode**
Deterioration over time

**Detection parameters**
Degradation level

**Expected implementation effects**
Enables the user to assess the right timing for maintenance based on the degree of deterioration instead of elapsed time.

Automatically notifies the user when to perform maintenance.

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**Seamers**

**Facility details**
Device for binding lids on cans (e.g. drink cans).

**Motor operation conditions**
2.2kw/200V/4poles
Inverter drive frequency: 15Hz

**Failure mode**
Bearing abnormality

**Detection parameters**
Acceleration

**Expected implementation effects**
Detects bearing damage.
IV. Other applications

K6CM Target Application

Homogenizers

**Facility details**

Device that mixes and stirs a liquid (such as milk) into a consistent emulsion so it does not separate.

**Motor operation conditions**

90kW/200V
Driving the motor by direct connection to commercial power supply: 50Hz

**Failure mode**

Load abnormality (Piston rubber gasket deterioration)

**Detection parameters**

Degradation level

**Expected implementation effects**

Enables early detection of facility anomalies to reduce production loss. Improves production quality by detecting facility anomalies.

K6CM Target Application

Dryers (for spray-drying powders)

**Facility details**

Air is sprayed while the air broom is rotated by a motor to prevent powder from accumulating on the inner wall of the conical drum. Rollers are installed along the inner wall of the conical drum.

**Motor operation conditions**

1.5kW/200V/4poles
Driving the motor by direct connection to commercial power supply: 50Hz

**Failure mode**

Load abnormality

**Detection parameters**

Degradation level

**Expected implementation effects**

Enables early detection of facility anomalies to reduce production loss. Improves production quality by detecting facility anomalies.