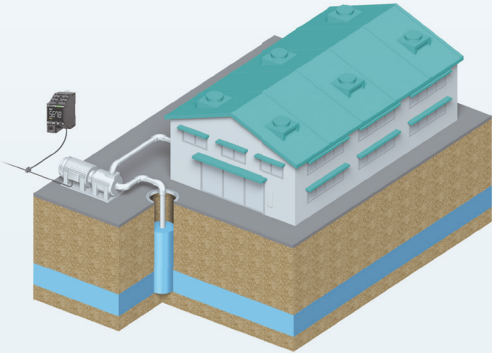# OMRON

Motor Condition Monitoring Devices
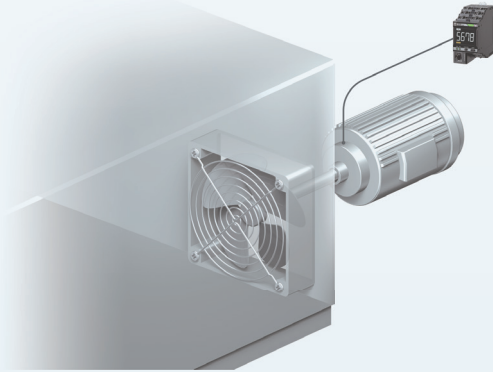
K6CM series

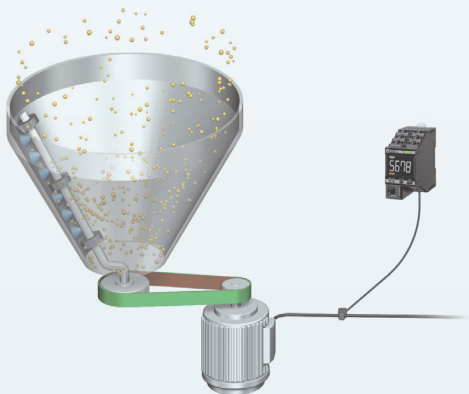# Application Guide

Fan system application

Pump system application

Stirring system application

Transport system application

omron
K6CM-CI2M

C1
PV

16

MON

MS NS   ALM RST   DISP
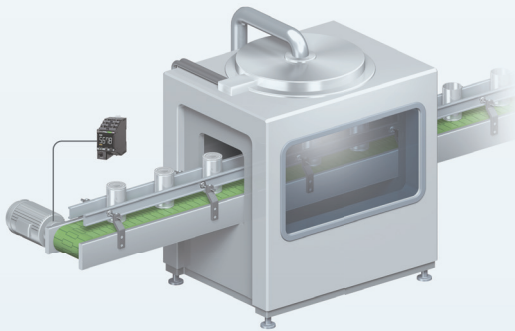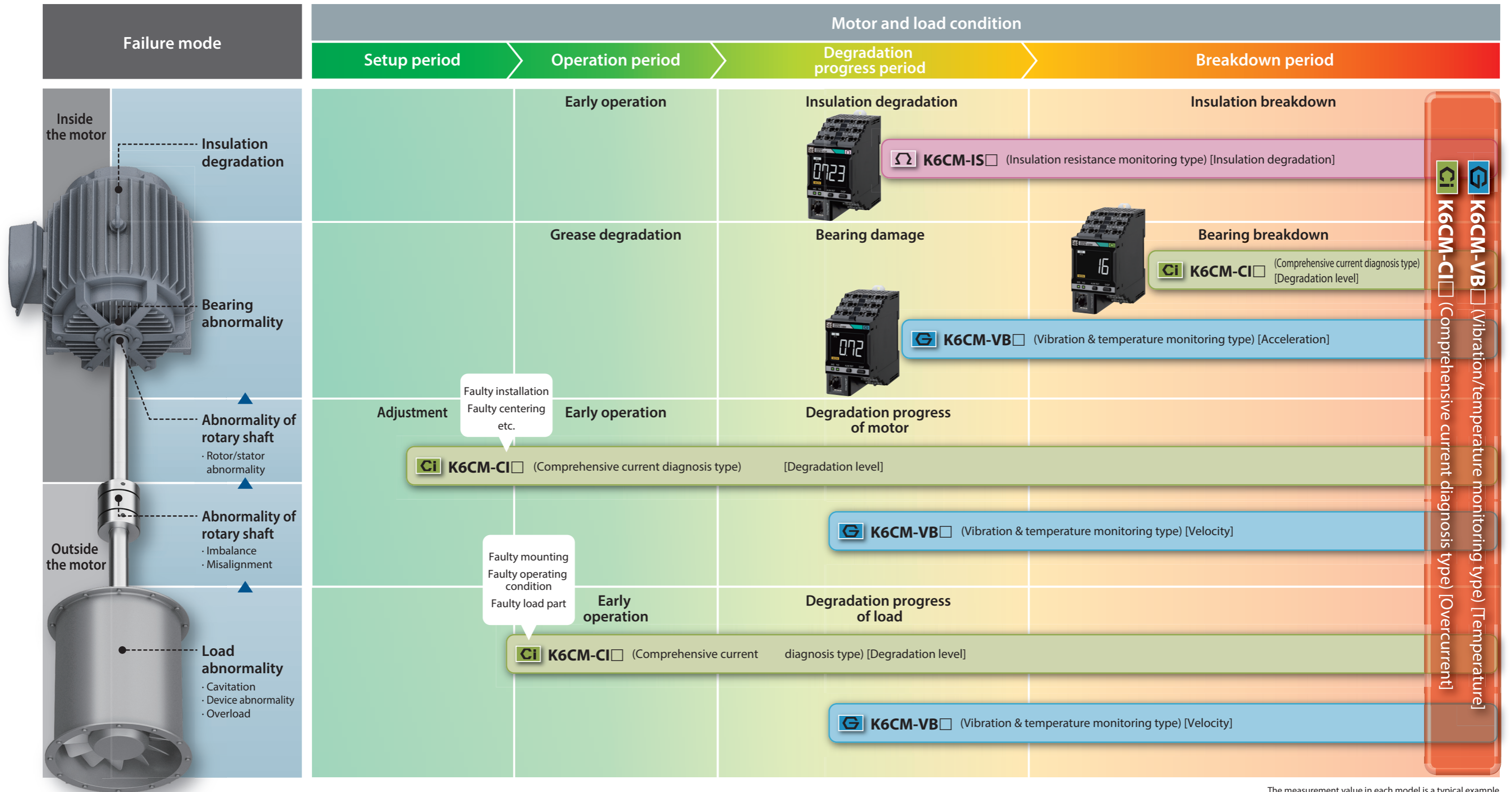
Degradation Progress and Failure Mode

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

Failure mode	Motor and load condition			
	Setup period	Operation period	Degradation progress period	Breakdown period

Inside the motor

Insulation degradation

Early operation — Insulation degradation — Insulation breakdown

Ω **K6CM-IS□** (Insulation resistance monitoring type) [Insulation degradation]

Bearing abnormality

Grease degradation — Bearing damage — Bearing breakdown

Ci **K6CM-CI□** (Comprehensive current diagnosis type) [Degradation level]

G **K6CM-VB□** (Vibration & temperature monitoring type) [Acceleration]

Abnormality of rotary shaft
· Rotor/stator abnormality

Adjustment — Early operation — Degradation progress of motor

Faulty installation
Faulty centering
etc.

Ci **K6CM-CI□** (Comprehensive current diagnosis type) [Degradation level]

Abnormality of rotary shaft
· Imbalance
· Misalignment

G **K6CM-VB□** (Vibration & temperature monitoring type) [Velocity]

Outside the motor

Load abnormality
· Cavitation
· Device abnormality
· Overload

Faulty mounting
Faulty operating condition
Faulty load part

Early operation — Degradation progress of load

Ci **K6CM-CI□** (Comprehensive current diagnosis type) [Degradation level]

G **K6CM-VB□** (Vibration & temperature monitoring type) [Velocity]

Ci **K6CM-CI□** (Comprehensive current diagnosis type) [Overcurrent]

G **K6CM-VB□** (Vibration/temperature monitoring type) [Temperature]

The measurement value in each model is a typical example.

INDEX

Pump system

Fan system

Transport system

Stirring system

Pump system

K6CM Target Application
Washing pumps for automotive components

Facility details

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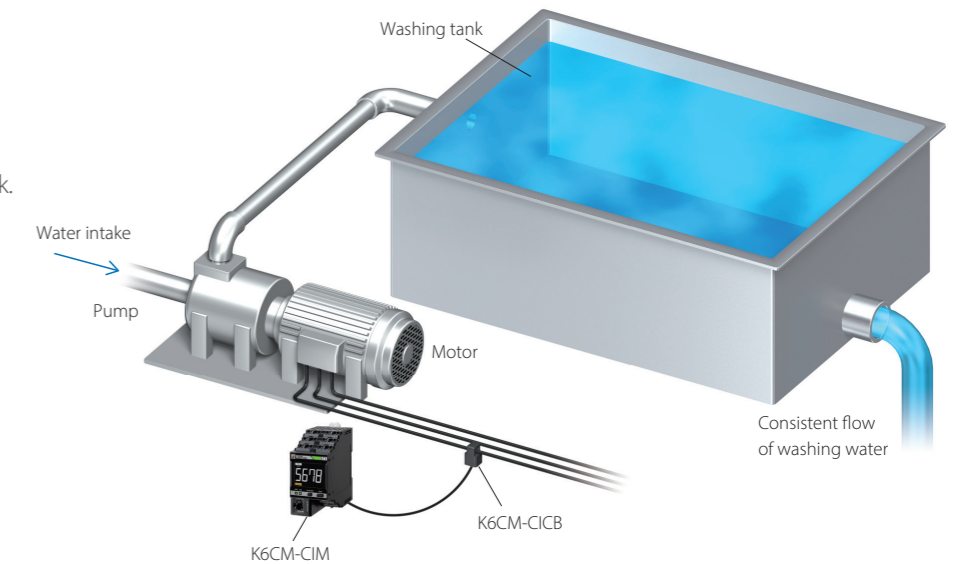washing water to the washing tank.

Motor operation conditions

11kw/200V/4poles
Inverter drive frequency: 60Hz
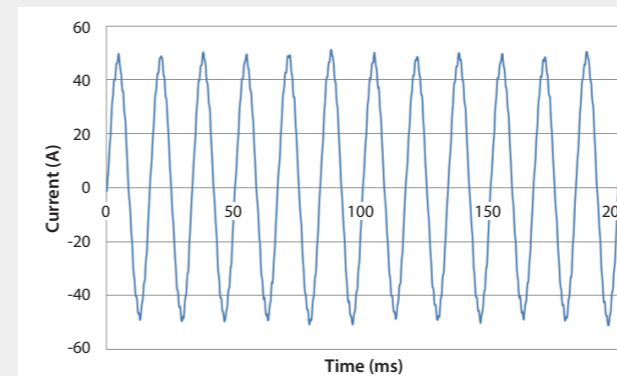
Failure mode

Load abnormality (Cavitation)

Detection parameters

Degradation level 1

Washing tank

Water intake

Pump

Motor

Consistent flow
of washing water
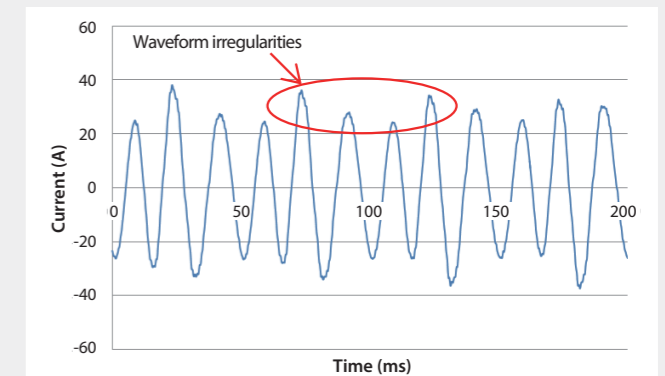
K6CM-CICB

K6CM-CIM

Degradation level 1 measurement results obtained from K6CM-CI□

The current waveform data *

Normal Condition

Measurement value under normal operation: 20

* K6CM does not output electric current waveform data.

Waveform irregularities

Abnormal Condition

Measurement value under abnormal operation: 75

**Abnormal operation:** Air bubble has entered the pump, causing an air lock

Alarm threshold degradation level 1 for this application (examples)

Alarm threshold (Warning)	30
Alarm threshold (Critical)	50

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.
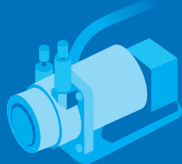
Pump system

K6CM Target Application
Cooling water circulation pumps

Facility details

Pump for circulating water throughout the facility.
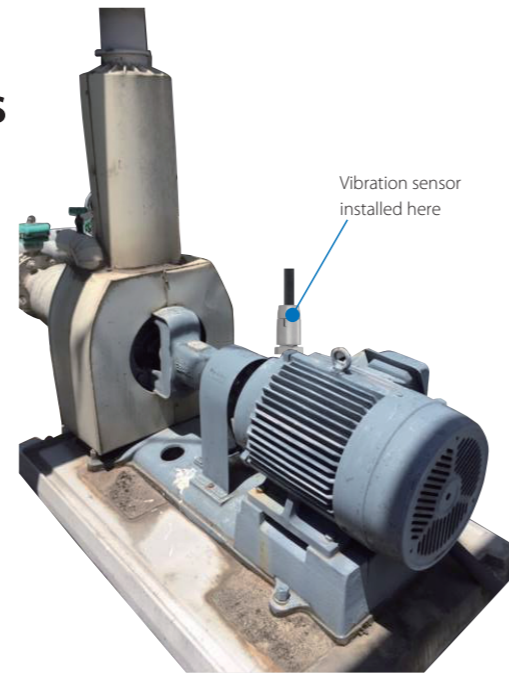
Motor operation conditions

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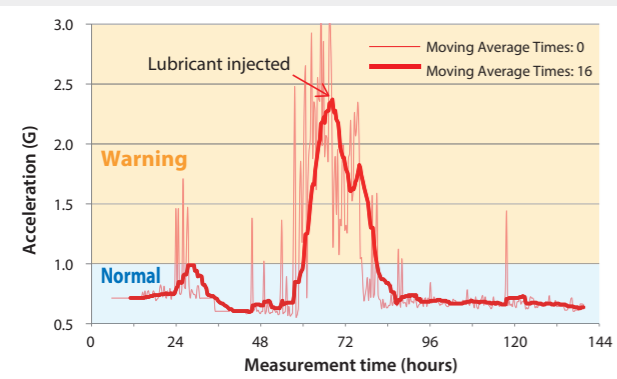Inverter drive frequency: 52Hz

Failure mode

Bearing anomalies

Detection parameters

Acceleration

Vibration sensor installed here

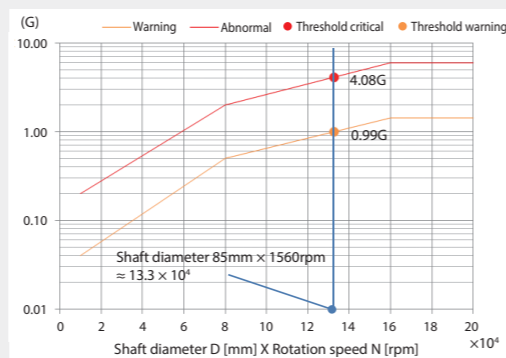### Acceleration measurement results obtained from K6CM-VBM

Moving Average Times: 0
Moving Average Times: 16

Lubricant injected

Warning
Normal

Acceleration (G)
Measurement time (hours)

Measurement value under abnormal operation:

1.5 G or more

Bearing not sufficiently lubricated

**Measurement value under normal operation: around 0.6 G**

(G)
Warning — Abnormal ● Threshold critical ● Threshold warning
10.00
1.00
0.10
0.01
4.08G
0.99G
Shaft diameter 85mm × 1560rpm ≈ 13.3 × 10⁴
Shaft diameter D [mm] X Rotation speed N [rpm] ×10⁴

Alarm threshold acceleration for this application (examples)

Alarm threshold (Warning)	**0.99G**
Alarm threshold (Critical)	**4.08G**

Expected implementation effects

Detects when bearing grease has degraded or dried up, or when foreign matter has entered the system.
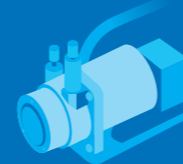
Pump system

K6CM Target Application
Hydraulic pumps

Hydraulic cylinder
Piston
Directional control valve
Pump
Oil tank

Facility details

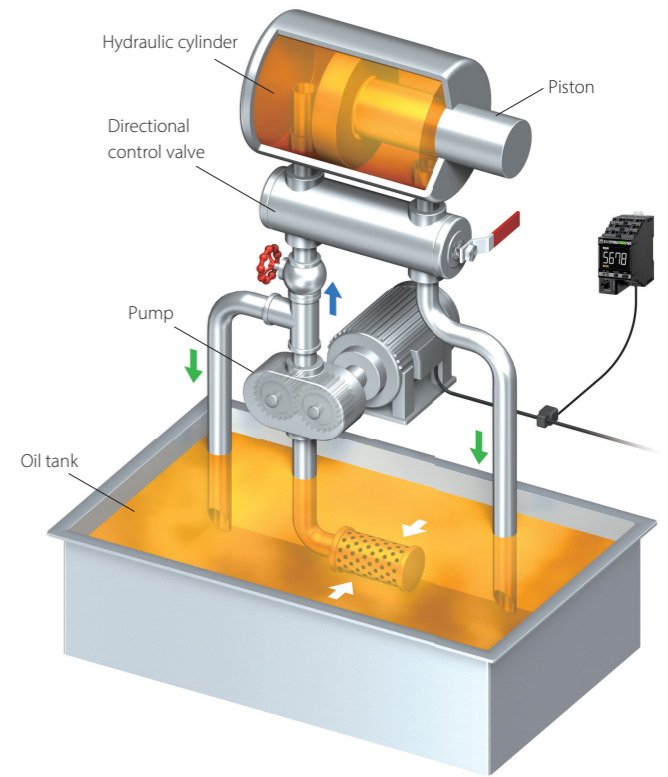Motors for hydraulic pumps in hydraulic facilities

Motor operation conditions

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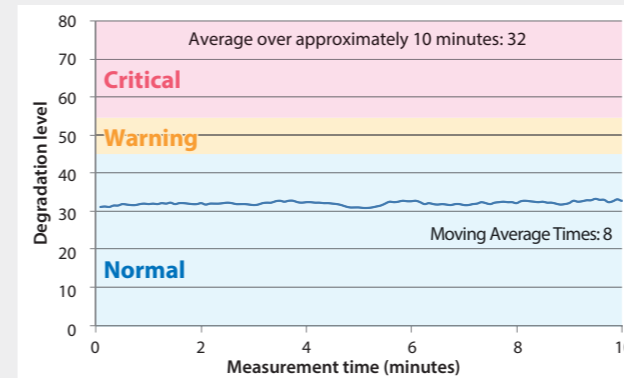
Failure mode

Deterioration over time

Detection parameters

Degradation level 1

### Degradation level 1 measurement results obtained from K6CM-CI□

Degradation level log data

Average over approximately 10 minutes: 32
Critical
Warning
Normal
Moving Average Times: 8
Degradation level
Measurement time (minutes)

Average over approximately 10 minutes: 47
Critical
Warning
Normal
Moving Average Times: 8
Degradation level
Measurement time (minutes)

Normal Condition	Warning Condition

Measurement value under normal operation: 32

Pump initial installation
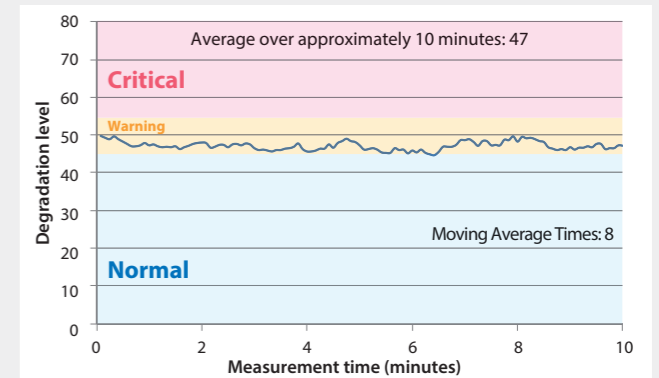
Measurement value under warning operation: 47

Pump installed over 10 years ago

Alarm threshold degradation level 1 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.

I. Pump system application

II. Fan system application

Pump system

K6CM Target Application
Well pumps

| Facility details |

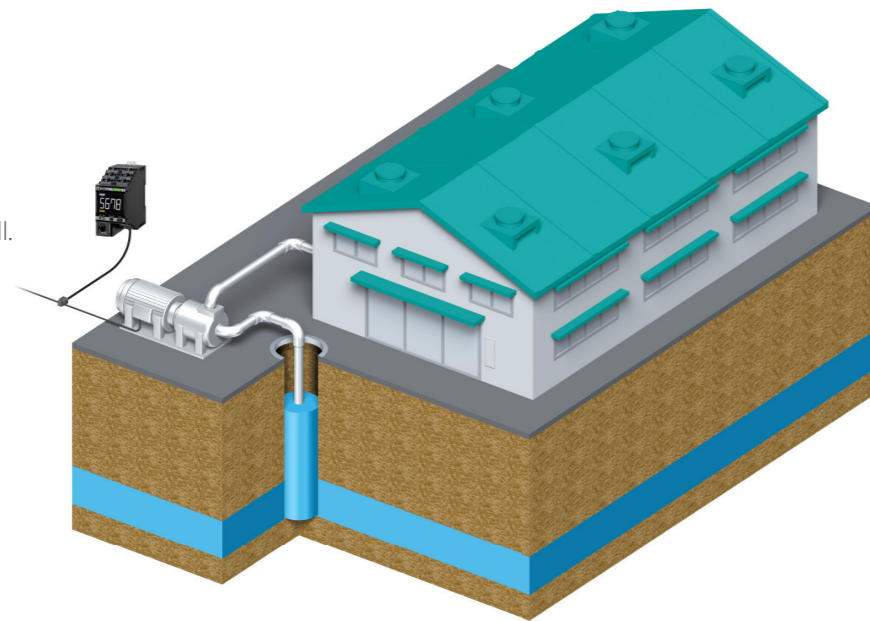Pump for extracting water from a well.

| Motor operation conditions |

7.5kw/200V/4poles
Inverter drive frequency: 25Hz

| Failure mode |

Deterioration over time

| Detection parameters |

Degradation level 1

Fan system

K6CM Target Application
Oven cooler fan motors

| Facility details |

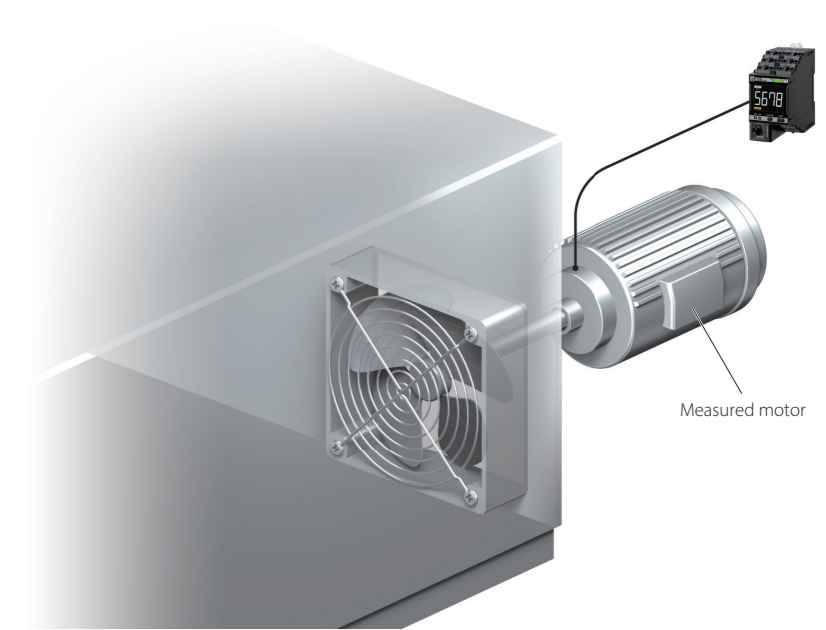Cooling fan for metal can drying oven.

| Motor operation conditions |

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

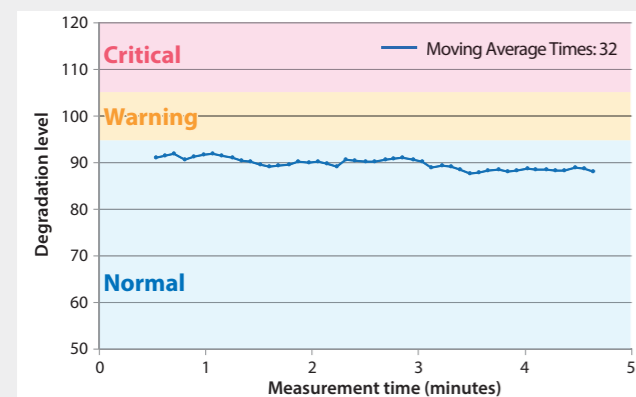| Failure mode |

Deterioration over time

| Detection parameters |

Acceleration

Measured motor

Degradation level 1 measurement results obtained from K6CM-CI□
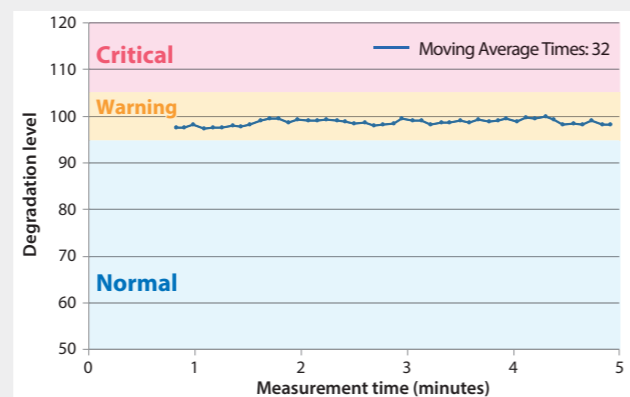
Degradation level log data

Normal Condition

Measurement value under normal operation: **90**

Pump installed 2 years ago

Warning Condition

Measurement value under warning operation: **99**

Pump installed over 10 years ago

Alarm threshold degradation level 1 for this application (examples)

| Alarm threshold (Warning) | 95 |
| Alarm threshold (Critical) | 105 |

Expected implementation effects

Enables preventative maintenance for facilities that cannot be visually inspected and also the users 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.

Acceleration measurement results obtained from K6CM-VBM
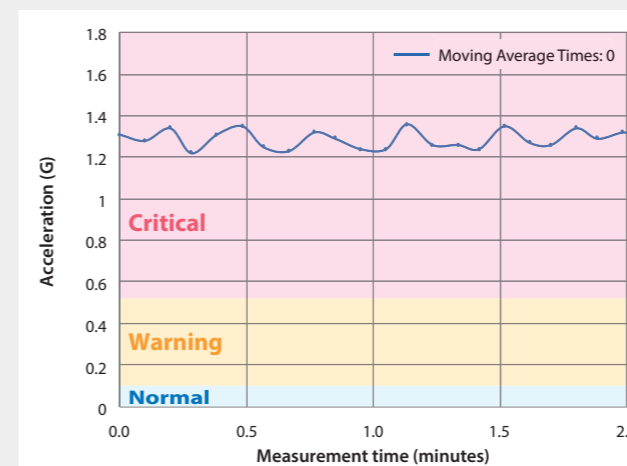
Measurement value of motor that has not been maintained for seven years

1.25 G
Abnormal condition value

Shaft diameter 48mm × 900rpm
≈4.3 × 10⁴

Threshold for this application (examples)

| Alarm threshold (Warning) | 0.13G |
| Alarm threshold (Critical) | 0.57G |

Expected implementation effects

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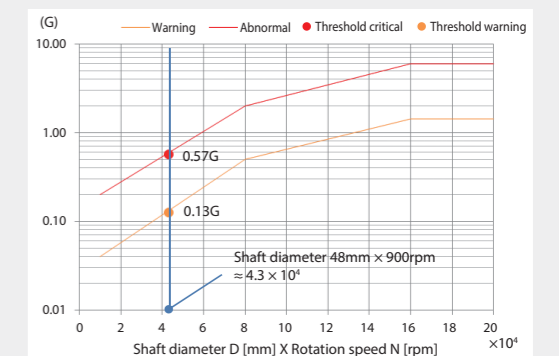Automatically notifies the user when to perform maintenance.

Fan system

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
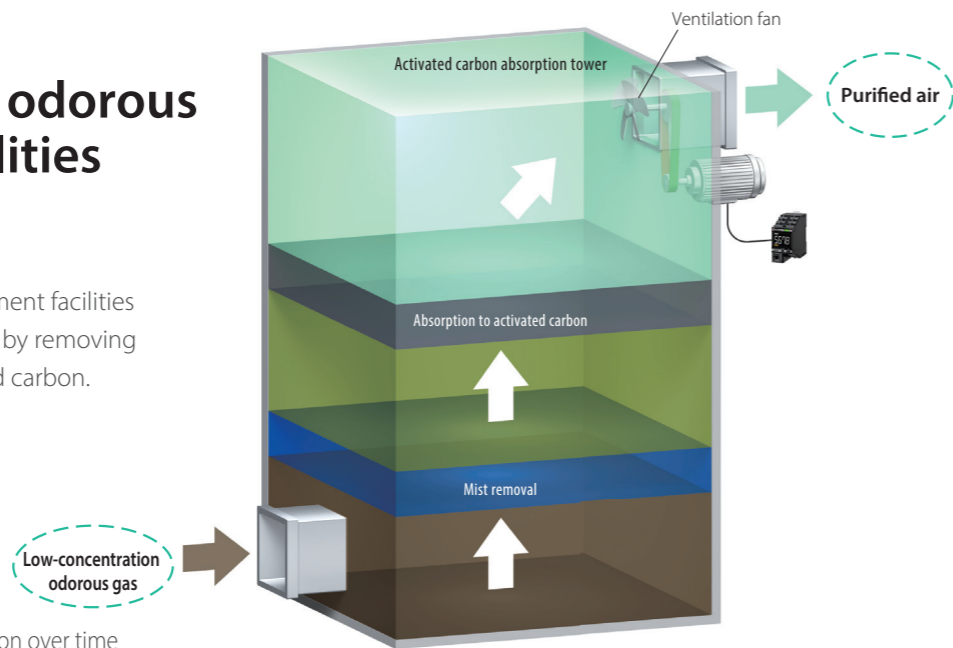odorous components using activated carbon.

Motor operation conditions

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

Failure mode   Deterioration over time

Detection parameters   Acceleration/Verlocity

Ventilation fan
Activated carbon absorption tower
Purified air
Absorption to activated carbon
Mist removal
Low-concentration odorous gas

Acceleration/Velocity measurement results obtained from K6CM-VBM

Acceleration measurement results

Measurement value under normal operation:
0.15G
Normal

Measurement value under abnormal operation:
1.30G
motor making abnormal noise

Velocity measurement results

Measurement value under normal operation:
1.9mm/s
Normal

Measurement value under abnormal operation:
2.9mm/s
motor making abnormal noise

Warning — Abnormal ● Threshold critical ● Threshold warning
(G)
10.00 / 1.00 / 0.10 / 0.01
1.54G
0.37G
Shaft diameter 48mm × 1500rpm ≈ 7.2 × 10^4
Shaft diameter D [mm] X Rotation speed N [rpm]
0 2 4 6 8 10 12 14 16 18 20 ×10^4

Threshold for this application (examples)

Example of Acceleration alarm threshold

Alarm threshold (Warning)	0.37G
Alarm threshold (Critical)	1.54G

Example of Verocity alarm threshold

Alarm threshold (Warning)	2.8mm/s
Alarm threshold (Critical)	7.1mm/s
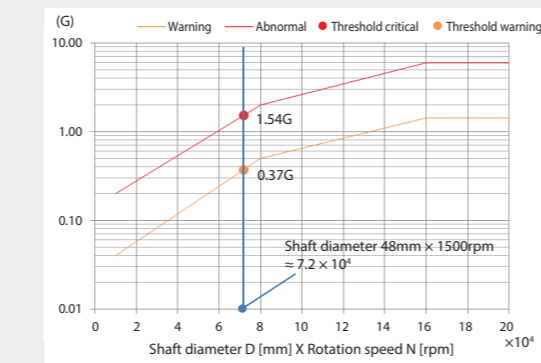
Rmsvalue of vibration velocity	Small-sized machines / motor with output less than 15 kW	Medium-sized machine motor with output of 15 kW to 75 kW	Large-sized machines: machine installed on a heavy foundation with high rigidity.	Large-sized machines: machine installed on a foundation with soft rigidity.	Judgement
0.71mm/s	A	A	A	A	Normal
1.12mm/s	B				
1.80mm/s		B	B		
2.80mm/s	C	Threshold warning C		B	
4.50mm/s		Threshold warning D	C		
7.10mm/s				C	Warning
11.20mm/s	D		D		
18.00mm/s				D	Abnormal

Expected implementation effects

Enables remote detection of motor failure.
Detects degradation of bearings so users can replace them before they lock up.

Fan system

K6CM Target Application

Fan motors for air handling units

Facility details

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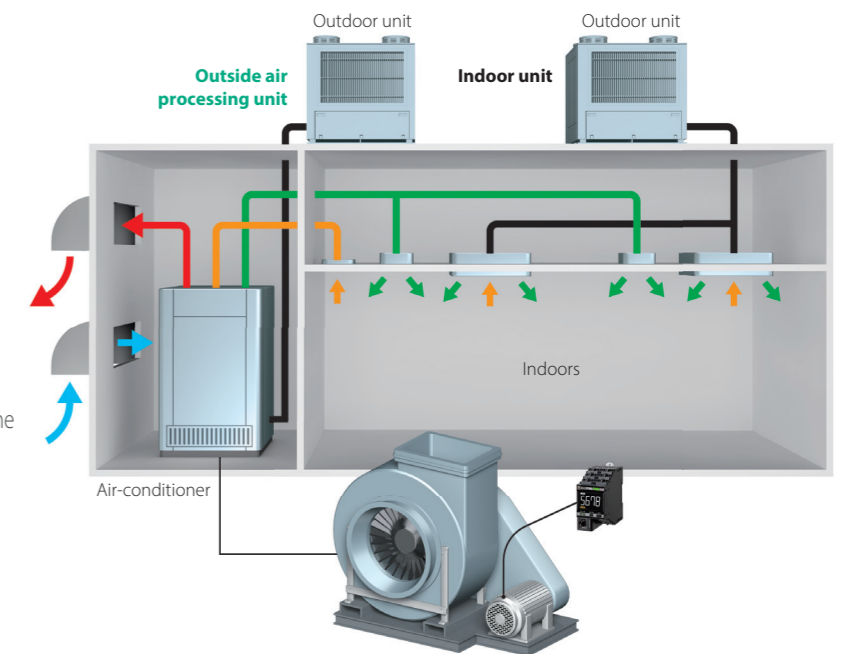levels before sending it inside.

Motor operation conditions

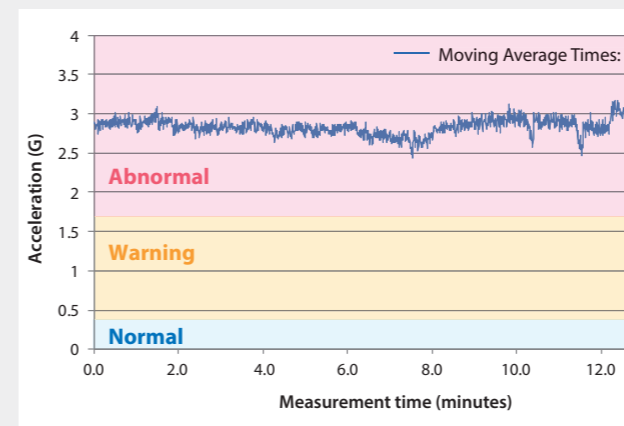22kW/200V/4poles
Inverter drive frequency: 50Hz

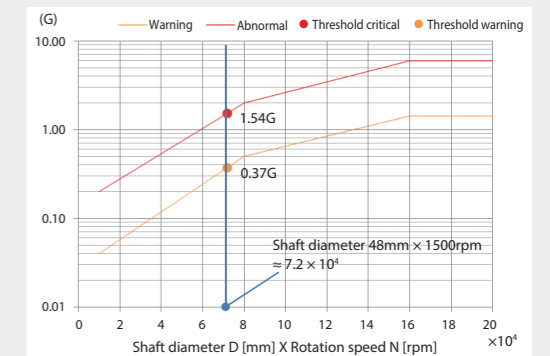**Failure mode**   Deterioration over time

Detection parameters   Acceleration

Outside air processing unit
Outdoor unit   Outdoor unit
Indoor unit
Indoors
Air-conditioner

Acceleration measurement results obtained from K6CM-VBM

Moving Average Times: 0
Acceleration (G)
4 / 3.5 / 3 / 2.5 / 2 / 1.5 / 1 / 0.5 / 0
Abnormal
Warning
Normal
Measurement time (minutes)
0.0 2.0 4.0 6.0 8.0 10.0 12.0

Measurement value under abnormal operation: 2.84G

motor making abnormal noise

Warning — Abnormal ● Threshold critical ● Threshold warning
(G)
10.00 / 1.00 / 0.10 / 0.01
1.54G
0.37G
Shaft diameter 48mm × 1500rpm ≈ 7.2 × 10^4
Shaft diameter D [mm] X Rotation speed N [rpm]
0 2 4 6 8 10 12 14 16 18 20 ×10^4

Alarm threshold accelerationo for this application (examples)

Alarm threshold (Warning)	0.37G
Alarm threshold (Critical)	1.54G

Expected implementation effects

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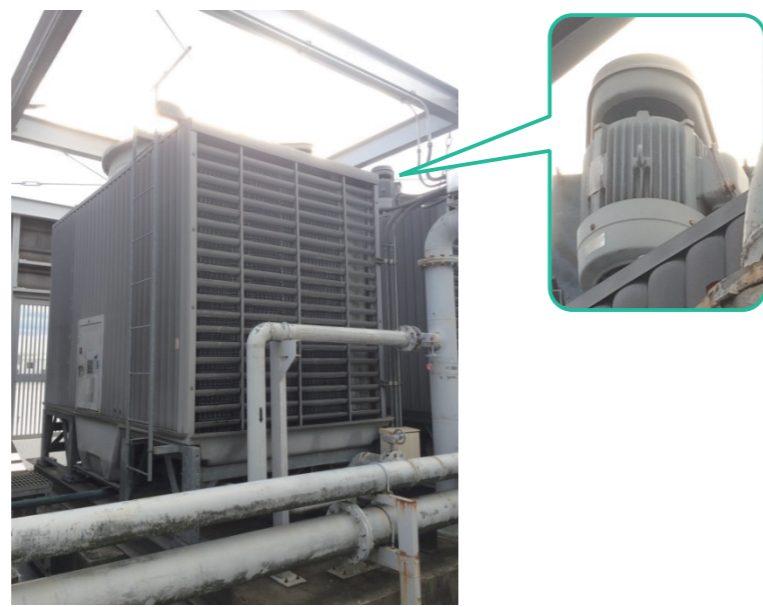Detects degradation of bearings so users can replace them before they lock up.
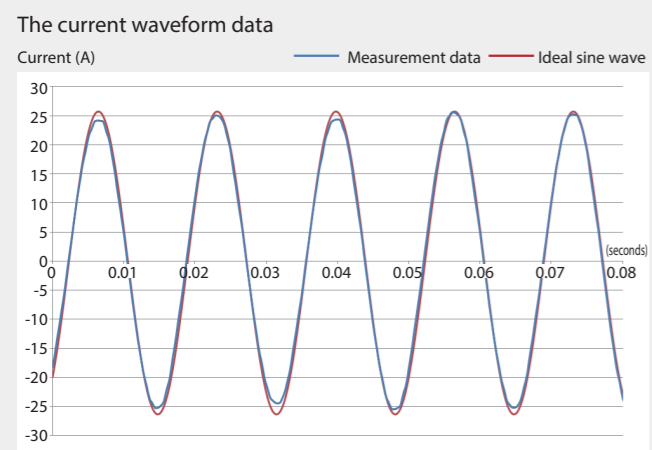
II. Fan system application

Comprehensive current diagnosis type

Vibration/Temperatue monitoring type

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 1 measurement results obtained from K6CM-CI□

The current waveform data

Current (A) — Measurement data — Ideal sine wave

Current (A) — Measurement data — Ideal sine wave

The current waveform deviates largely from the ideal sine wave.

Normal Condition	
Unit 2	**Measurement value under normal operation 29**
	After maintenance
Unit 1	**Measurement value under normal operation 32**
	After maintenance
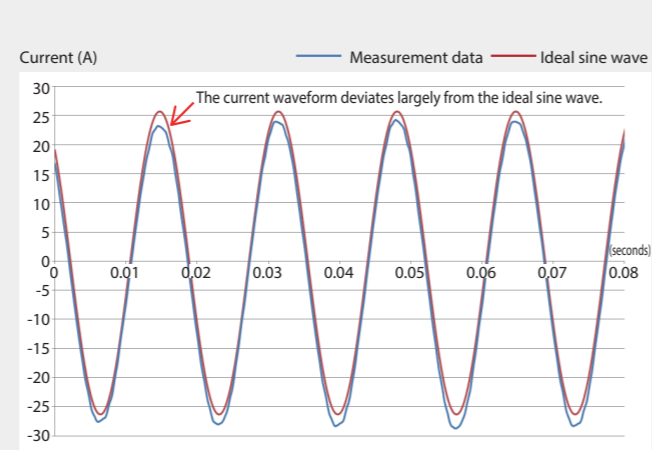
Abnormal Condition	
Unit 2	**Measurement value under abnormal operation 71**
	Before maintenance
Unit 1	**Measurement value under abnormal operation 44**
	Before maintenance

Alarm threshold degradation level 1 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.

Acceleration measurement results obtained from K6CM-VBM

Unit 1

Unit 2

Unit1 Acceleration measurement results obtained from K6CM-VBM

Before maintenance
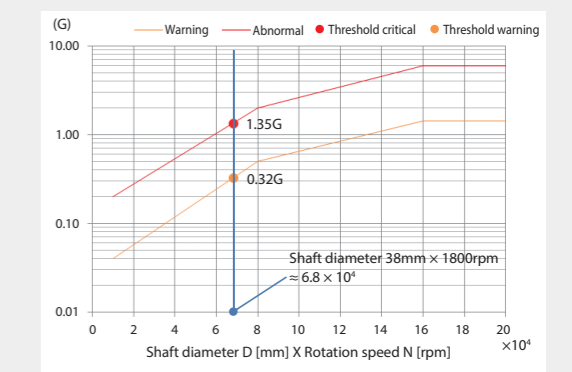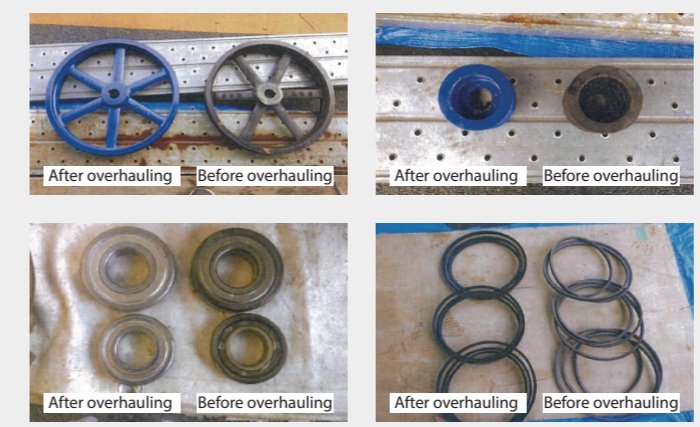Measurement value under normal operation **0.25G**

➤ **After maintenance**
Measurement value under normal operation **0.11G**

Unit2 Acceleration measurement results obtained from K6CM-VBM

Before maintenance
Measurement value under warning operation **0.44G**

➤ **After maintenance**
Measurement value under normal operation **0.08G**

Regularly replace pulleys, bearings, belts, etc.

After overhauling   Before overhauling

After overhauling   Before overhauling

After overhauling   Before overhauling

After overhauling   Before overhauling

(G) — Warning — Abnormal ● Threshold critical ● Threshold warning

1.35G

0.32G

Shaft diameter 38mm × 1800rpm
≈ 6.8 × 10⁴

Shaft diameter D [mm] X Rotation speed N [rpm]

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.

Alarm threshold acceleration for this application (examples)

Alarm threshold (Warning)	0.32G
Alarm threshold (Critical)	1.35G

Expected implementation effects

Detects degradation of bearings so users can replace them before
they lock up.

II. Fan system application

Comprehensive current diagnosis type

K6CM Target Application

Heat exhaust fan

Facility details

Fan for exhausting heat generated from indoors facilities to the outdoors
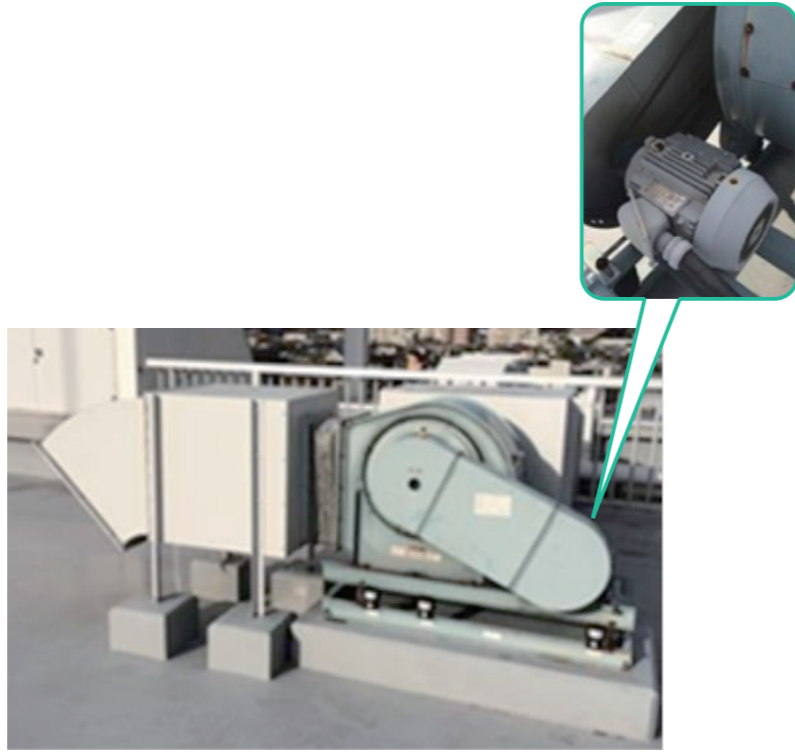
Motor operation conditions

2.2kW/200V/4 poles
Direct connection to commercial power supply: 60Hz

Failure mode

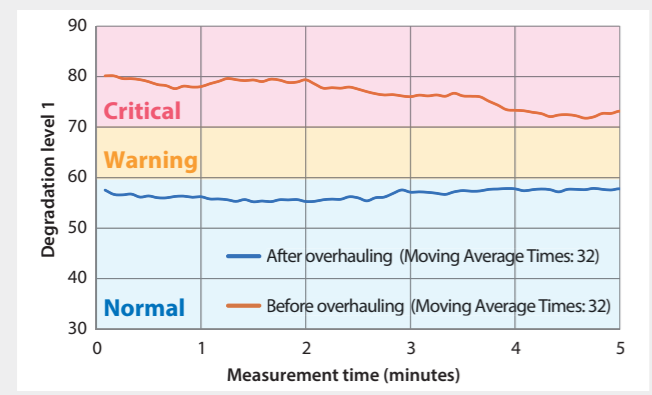Pulley wear
(V-belt slips; abnormal noise)
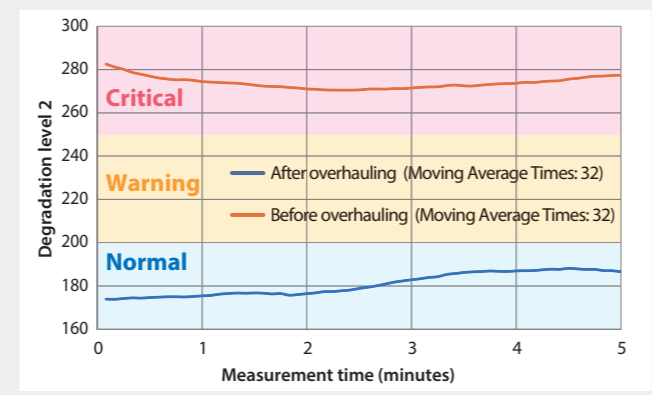
Detection parameters

Degradation level 1, 2

Degradation level 1,2 measurement results obtained from K6CM-CI□

Degradation level 1 log data

After overhauling (Moving Average Times: 32)
Before overhauling (Moving Average Times: 32)

Degradation level 2 log data

After overhauling (Moving Average Times: 32)
Before overhauling (Moving Average Times: 32)

Measurement value under abnormal operation: **75**

Measurement value under normal operation: **57**

Measurement value under abnormal operation: **275**

Measurement value under normal operation: **180**

Alarm threshold degradation level 1,2 for this application (examples)

Example of degradation level 1 alarm threshold

Alarm threshold (Warning)	60
Alarm threshold (Critical)	70

Example of degradation level 2 alarm threshold

Alarm threshold (Warning)	200
Alarm threshold (Critical)	250

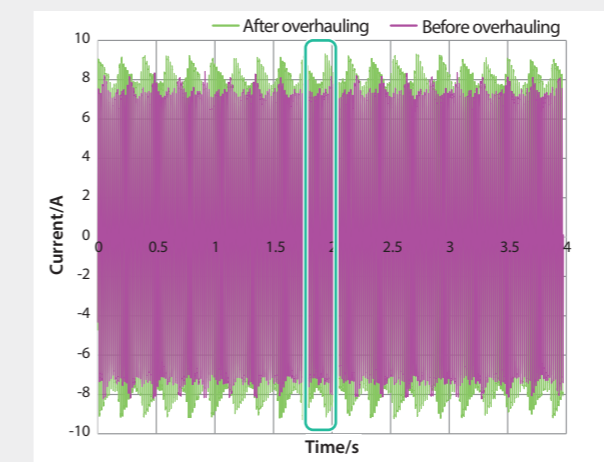## Degradation level 1 measurement results obtained from K6CM-CI2M

Before overhauling

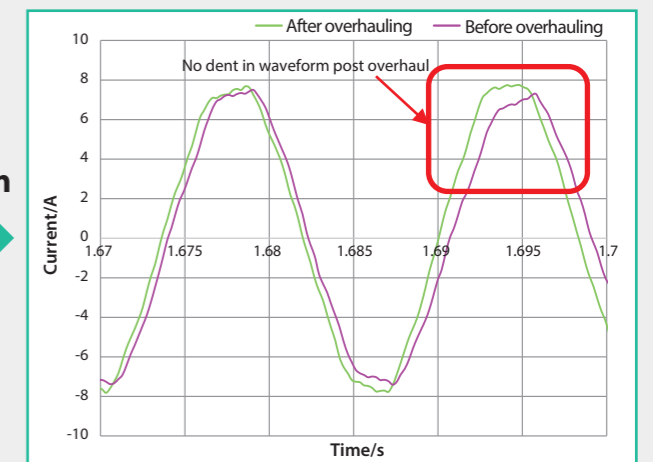Belt and pulley worn down by friction

After overhauling

Correct positioning of belt and pulley

Current waveform data over 4 seconds

After overhauling   Before overhauling

Zoom

After overhauling   Before overhauling

No dent in waveform post overhaul

Expected implementation effects

Detects the degradations in V-belts, pulleys and automatically notifies the user when to perform maintenance.

Fan system

K6CM Target Application

Pressure adjustment blower

| Facility details |

Blower for adjusting pressure
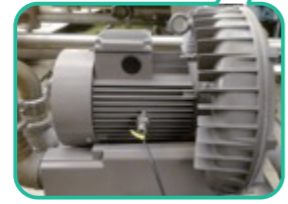within a storage tank

| Motor operation conditions |

3.4kW/200V/2 poles
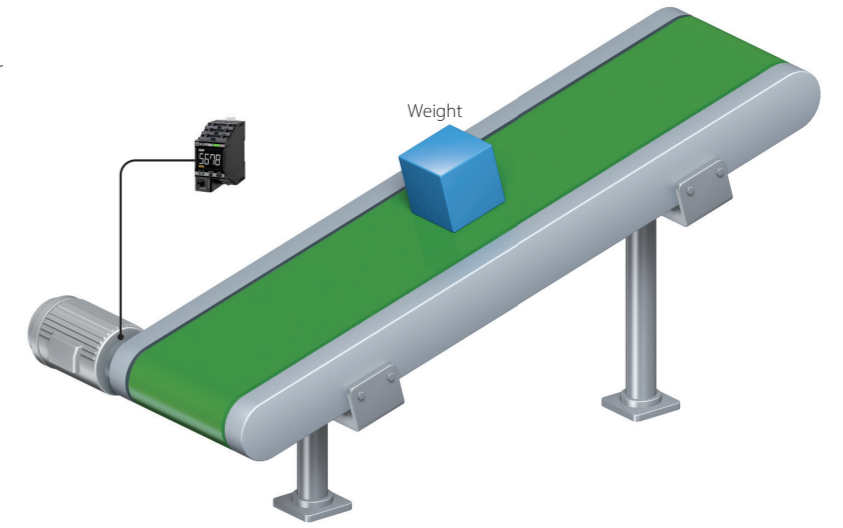Inverter drive frequency : 65Hz

| Failure mode |

Deterioration over time

| Detection parameters |

Acceleration/Velocity

Acceleration/Velocity measurement results obtained from K6CM-VBM

Acceleration measurement results

**Measurement value
under normal operation:**

0.79G
Newly installed blower

**Measurement value
under warning operation:**

0.96G
Blower installed after 6 years
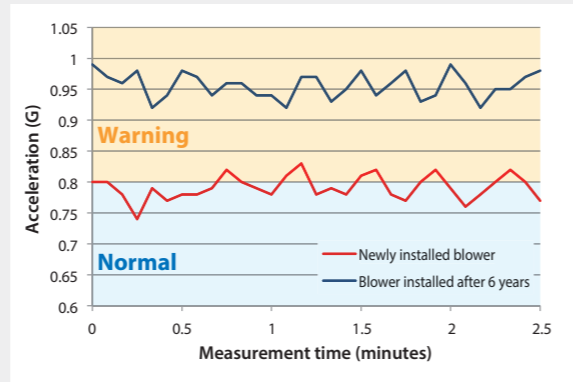
Velocity measurement results

**Measurement value
under normal operation:**

1.18mm/s
Newly installed blower

**Measurement value
under normal operation:**

1.70mm/s
Blower installed after 6 years
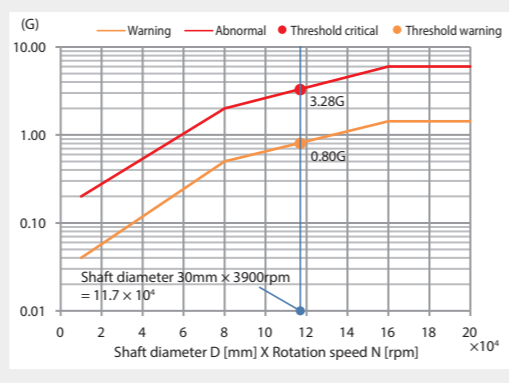
Shaft diameter 30mm × 3900rpm
= 11.7 × 10⁴

Threshold for this application (examples)

Example of Acceleration alarm threshold

Alarm threshold (Warning)	0.80G
Alarm threshold (Critical)	3.28G

Example of Velocity alarm threshold

Alarm threshold (Warning)	1.8mm/s
Alarm threshold (Critical)	4.5mm/s

Expected implementation effects

Enables remote detection of motor failure.
Detects the degradation of the bearings and fan blades,
so the user can replace them before they lockup and fail.

Transport system

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 1

Weight

Degradation level 1 measurement results obtained from K6CM-CI□
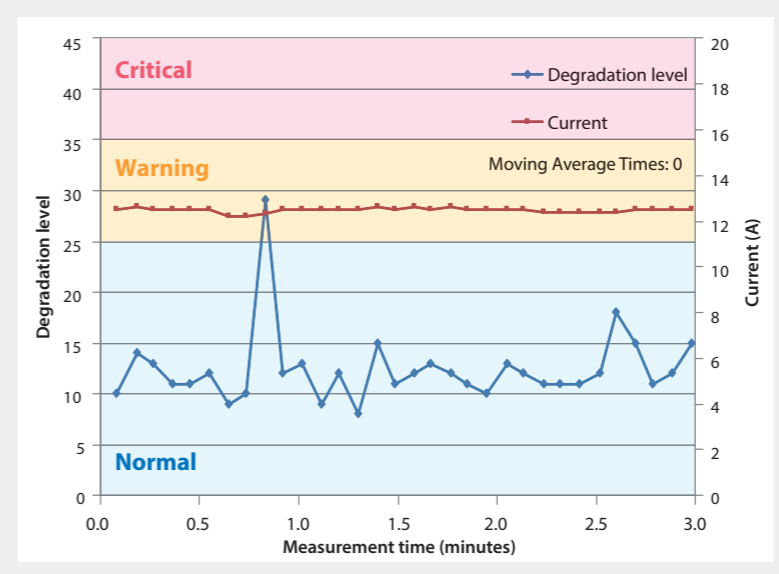
Measurement value under critical operation

29

With weight mounted

Measurement value under normal operation

12

Without weight mounted (average value)

Alarm threshold degradation level 1 for this application (examples)

Alarm threshold (Warning)	25
Alarm threshold (Critical)	35

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.

K6CM Target Application
Transport conveyor

Facility details

Conveyor for transporting completed products, which use belts that are powered by motors carrying products to their shipment sites.
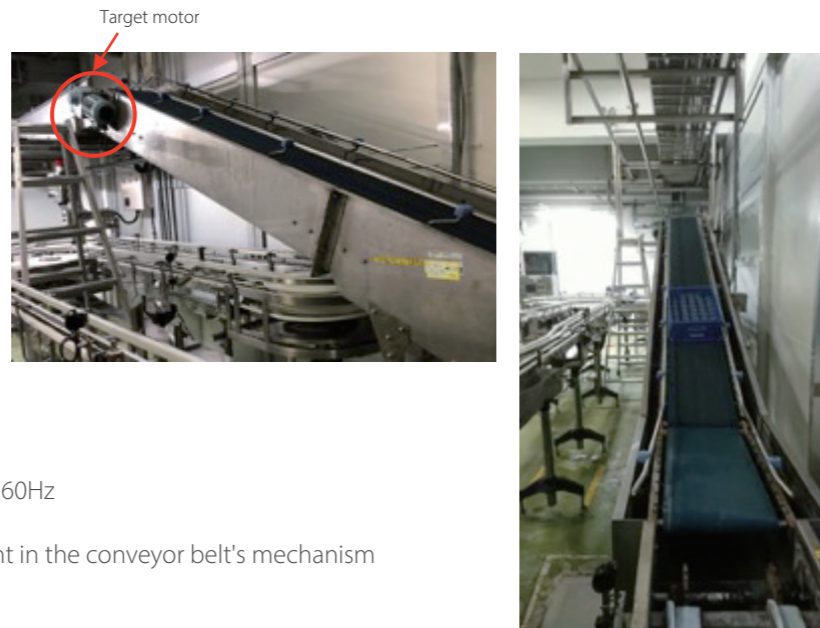
Target motor

Motor operation conditions

0.75kW/200V/4 poles
Direct connection to commercial power supply: 60Hz

Failure mode	Foreign object caught in the conveyor belt's mechanism

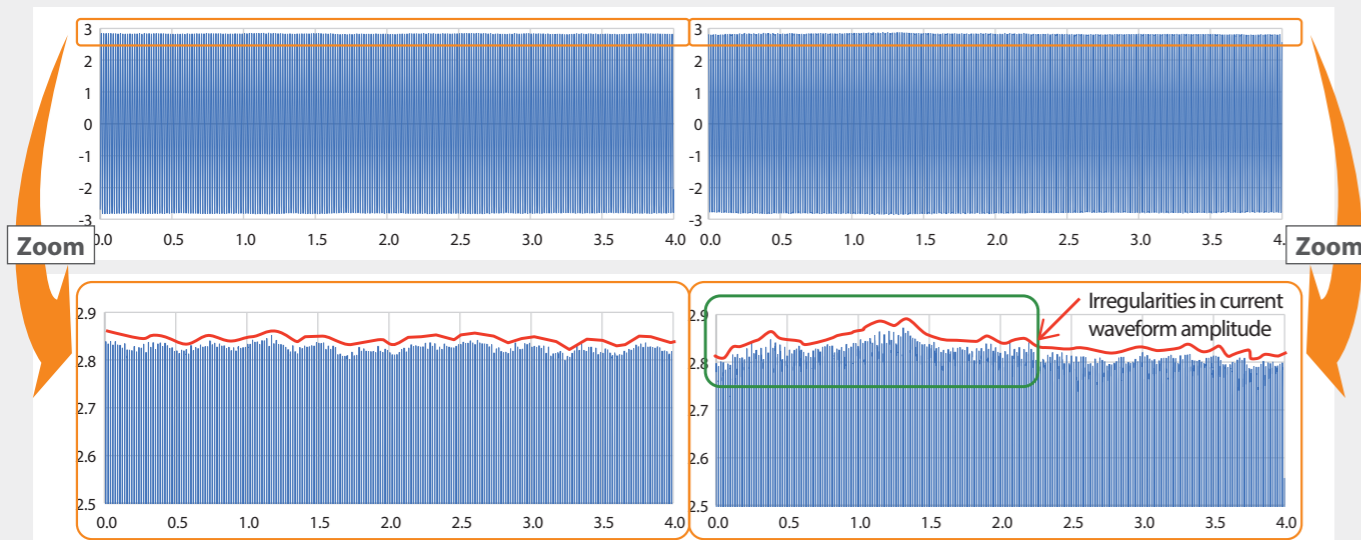| Detection parameters	Degradation level 1

Degradation level 1 measurement results obtained from K6CM-CI□

Degradation level 1 measurement results

Measurement value under normal operation: 4

Measurement value under abnormal operation: 25

Conveyor is transporting products

Belt cannot move along smoothly because a foreign object has been caught in its mechanism

Current waveform data over 4 seconds

Zoom

Zoom

Irregularities in current waveform amplitude

Normal Condition	Abnormal Condition

Alarm threshold degradation level 1 for this application (examples)

Alarm threshold (Warning)	10
Alarm threshold (Critical)	20

Expected implementation effects
Enables users to repair/replace conveyor before it stops due to deterioration, a foreign object attached on the back side of its belt, etc.

Transport system

K6CM Target Application
Dryers (for spray-drying powders)

Facility details

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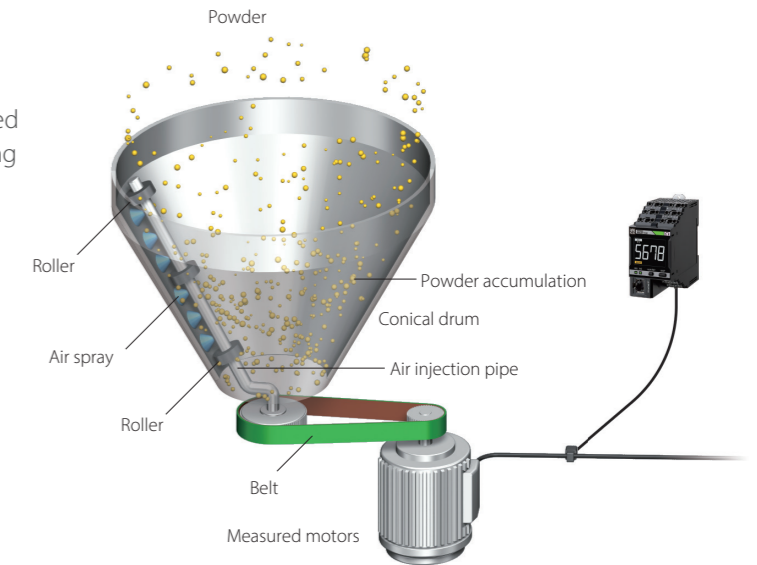Rollers are installed along the inner wall of the conical drum.

Powder
Roller
Powder accumulation
Conical drum
Air spray
Air injection pipe
Roller
Belt
Measured motors

Motor operation conditions

1.5kW/200V/4 poles
Direct connection to commercial power supply: 50Hz
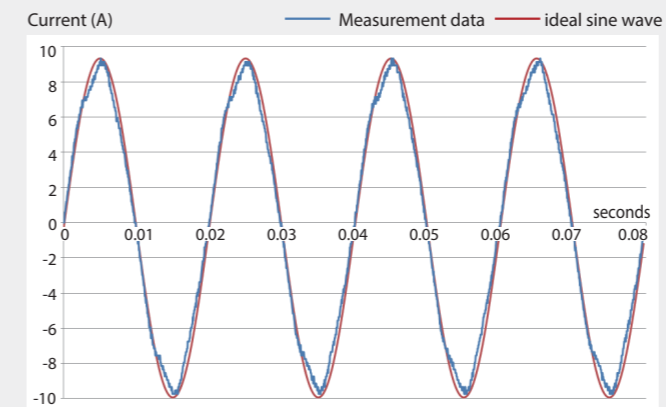
Failure mode	Load abnormality

Detection parameters	Degradation level 1

Degradation level 1 measurement results obtained from K6CM-CI□

Current waveform data

Current (A)   Measurement data   ideal sine wave

Current (A)   Measurement data   ideal sine wave

The current waveform deviates largely from the ideal sine wave.

Normal Condition	Abnormal Condition

Value for a normal working motor: 21

Roller is rotating normally
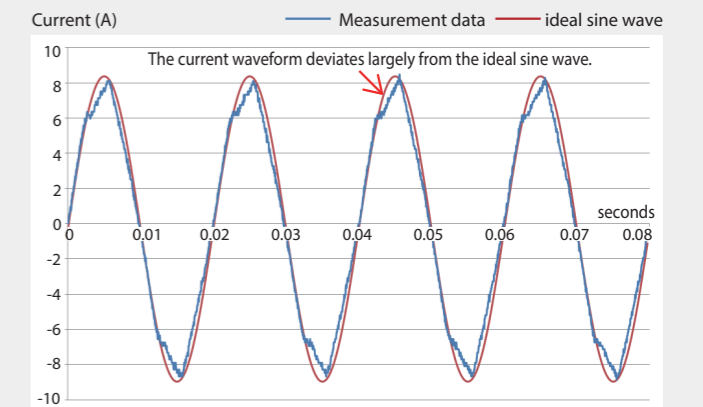
Value for motor not working normally: 32

Roller is not rotating due to powder lodged in its mechanism

Alarm threshold degradation level 1 for this application (examples)

Alarm threshold (Warning)	25
Alarm threshold (Critical)	30

Expected implementation effects
When the guide roller's diameter decreases due to wear, the contact area between the roller and the dryer wall decreases as well, causing the air injection pipe to oscillate significantly. This increases the load on the pipe and the dryer axis, which in turn can lead to damage.
K6CM series products can prevent such problems from happening.

Stirring system

Stirring system

Stirring system

K6CM Target Application
Homogenizers

Material (liquid/powder)

Pulley

Facility details

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

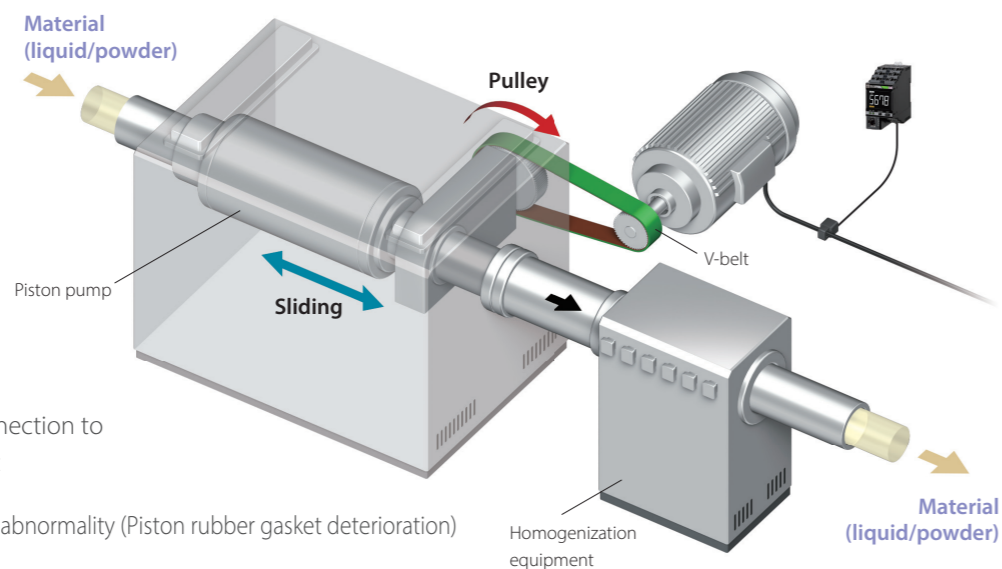Piston pump

Sliding

V-belt

Motor operation conditions

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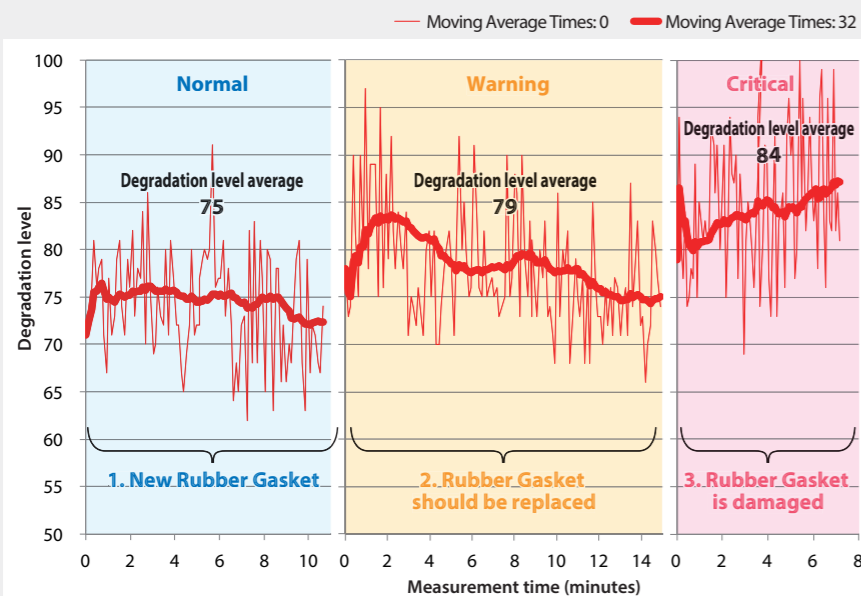Driving the motor by direct connection to commercial power supply: 50Hz

Failure mode
Load abnormality (Piston rubber gasket deterioration)

Homogenization equipment

Material (liquid/powder)

Detection parameters
Degradation level 1

Degradation level 1 measurement results obtained from K6CM-CI□

— Moving Average Times: 0 — Moving Average Times: 32

| Normal | Warning | Critical |

Degradation level average **84**

Degradation level average **75**

Degradation level average **79**

Degradation level

1. New Rubber Gasket
2. Rubber Gasket should be replaced
3. Rubber Gasket is damaged

Measurement time (minutes)

1. Value for a normal working motor:
74
New Rubber Gasket

2. Value for motor whose operation requires caution:
79
Rubber Gasket should be replaced

3. Value for motor not working normally:
84
Rubber Gasket is damaged

Alarm threshold degradation level 1 for this application (examples)

| Alarm threshold (Warning) | 77 |
| Alarm threshold (Critical) | 85 |

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

K6CM Target Application
Storage tank mixer

Facility details

Equipment for mixing storage tank content
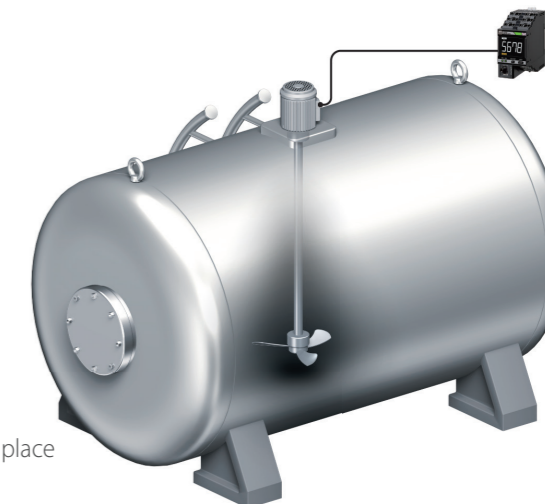
Motor operation conditions

0.4kW/200V/4 poles
Direct connection to commercial power supply: 60Hz

Failure mode
Mixing blade not securely fixed in place

Detection parameters
Degradation level 1, 2

Degradation level 1,2 measurement results obtained from K6CM-CI2M

Degradation level 1 measurement results

— Blade fixed — Blade dropped
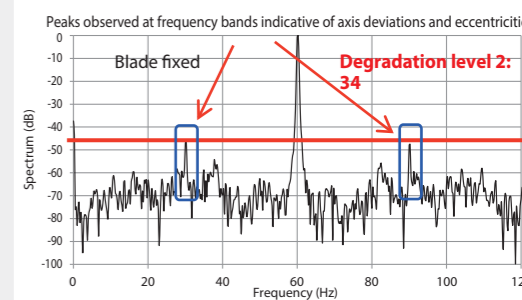
Measurement value under warning operation:
36
Axial deviation

Measurement value under abnormal operation:
42
Blade has fallen to the tank bottom (axial deviation loosened its fastening screws)

Critical Degradation level 1: 42

Degradation level

Moving Average Times Degradation level 1: 36

Warning

Measurement time (minutes)
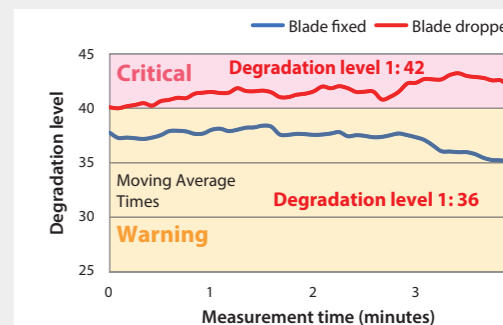
Degradation level 2 measurement results

Measurement value under warning operation:
34
Axial deviation

Measurement value under abnormal operation:
92
Blade has fallen to the tank bottom (axial deviation loosened its fastening screws)

Peaks observed at frequency bands indicative of axis deviations and eccentricities

Spectrum (dB)

Blade fixed

Degradation level 2: 34

Frequency (Hz)

Spectrum (dB)

Blade dropped

Degradation level 2: 92

Frequency (Hz)

The dropping of the blade causes the center of gravity to shift, consequently exacerbating the effects of axial deviation and eccentricity
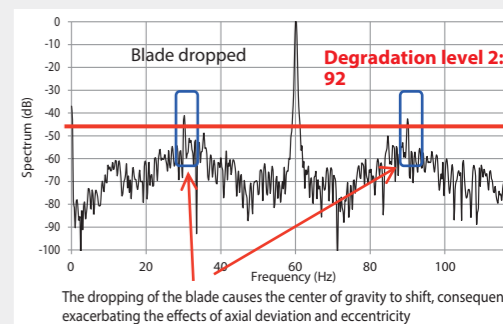
Alarm threshold degradation level 1,2 for this application (examples)

Example of degradation level 1 alarm threshold

| Alarm threshold (Warning) | 25 |
| Alarm threshold (Critical) | 40 |

Example of degradation level 2 alarm threshold

| Alarm threshold (Warning) | 20 |
| Alarm threshold (Critical) | 50 |

Expected implementation effects
Enables the detection of anomalies and load changes in parts of the axis that are far from the motor.

K6CM Target Application
Can seamer

Facility details

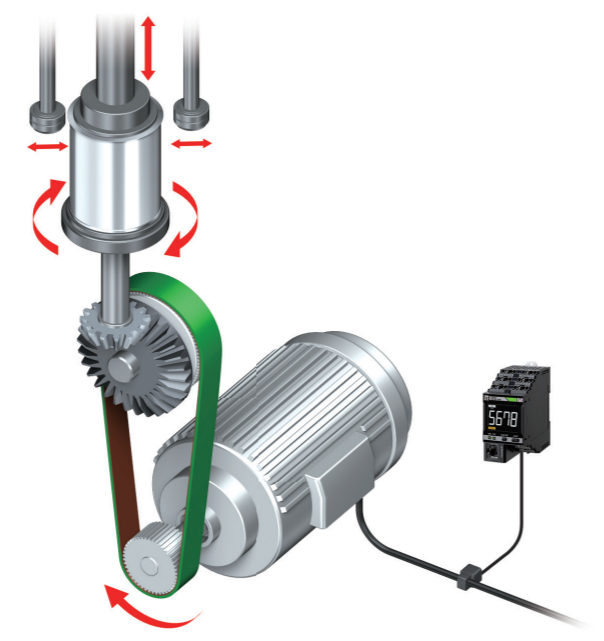Device for binding lids on cans (e.g.drink cans)

Motor operation conditions

30kW/400V/4 poles
Inverter drive frequency: 60Hz
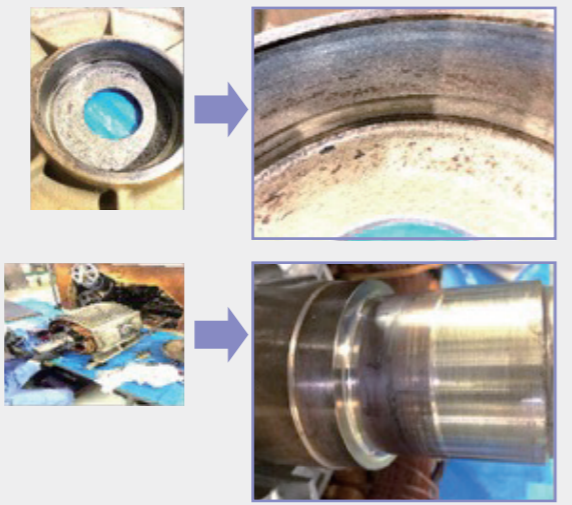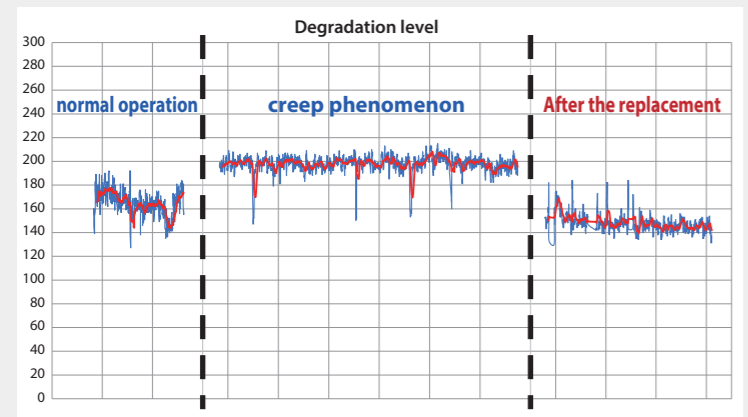Rotation speed: 1800rpm

Failure mode | Creep phenomenon

Detection parameters | Degradation level 1

Degradation level 1 measurement results obtained from K6CM-CI□

Measurement value under normal operation: 148

After bearing, bearing case and shaft being replaced

Measurement value under abnormal operation: 198

With creep phenomenon

Alarm threshold degradation level 1 for this application (examples)

| Alarm threshold (Warning) | 180 |
| Alarm threshold (Critical) | 195 |

Expected implementation effects

The creep phenomenon may be caused by the following, and if left unaddressed, can lead to major problems. K6CM series products can prevent such problems from happening.
- Abnormal rise in temperature   - Excessive load
- Insufficient interference where parts are engaged