Application Guide for Predictive Maintenance Solutions for manufacturing facility

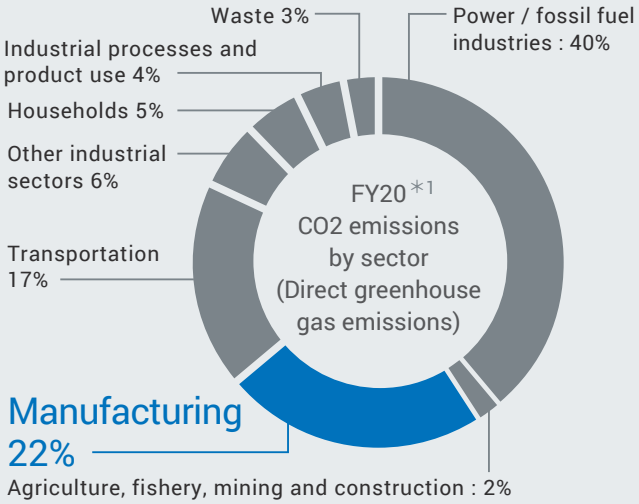
Solutions for Total Facility Condition and Trend Monitoring

Problems in Manufacturing Sector

Why the Manufacturing Sector Should Work Toward Carbon Neutrality

According to investigation by Japan's National Institute for Environmental Studies, manufacturing accounts for 22 % of the world's energy-related CO2 emissions.*1 This is a sizable share, indicating carbon neutrality efforts in the manufacturing sector can greatly impact total CO2 emission levels. Factories in particular, with their massive power consumption and industrial waste, are a major source of CO2 emissions, and in urgent need of improvement."Without initiatives taken to achieve carbon neutrality, there is a risk of corporate value being lost and negative impact on business. Therefore, achieving carbon neutrality is our corporate mission.

*1. Created based on the data from the Greenhouse Gas Inventory Office of Japan, National Institute for Environmental Studies



- Power / fossil fuel sector: Expand use of renewable energy
- Transportation sector: Use renewable energy, e.g. by using electric vehicles
- Manufacturing and building sectors: Implement rigorous energy conservation measures, use renewable energy

Conserving Energy Through Predictive Maintenance

Predictive maintenance allows you to effectively cut energy usage by reducing the frequency of failures and automating the equipment inspection process. According to "Economics of Manufacturing Machinery Maintenance" (June 2020) by Douglas S. Thomas and Brian A. Weiss, adopting predictive maintenance would be effective in reducing 0.8 billion USD of defects and 18.1 billion USD of downtime.*2 This improves machine throughput, profitability and reduces the impact on the environment

*2. References:NIST Advanced Manufacturing Series 100-34, Economics of Manufacturing Machinery Maintenance , Douglas S. Thomas, Brian A. Weiss, June 2020
https://www.nist.gov/el/applied-economics-office/manufacturing/topics-manufacturing/manufacturing-machinery-maintenance
https://nvlpubs.nist.gov/nistpubs/ams/NIST.AMS.100-34.pdf

Importance of facility equipment

Factory facilities are facing a variety of challenges. In addition to expansion/reduction of factories and production equipment to deal with changes in the business environment, and appropriate application/maintenance of facilities, other issues in recent years have included cutbacks on the cost of electric power, need to reduce CO2 emissions, and preparation for large-scale natural disasters. Maintenance of facility equipment that is essential for production floor operation is often outsourced, resulting in a complete lack of maintenance know-how. Therefore, when sudden failure occurs, it takes a long time to achieve recovery and there is also the possibility that production activities floor-wide will need to be stopped.

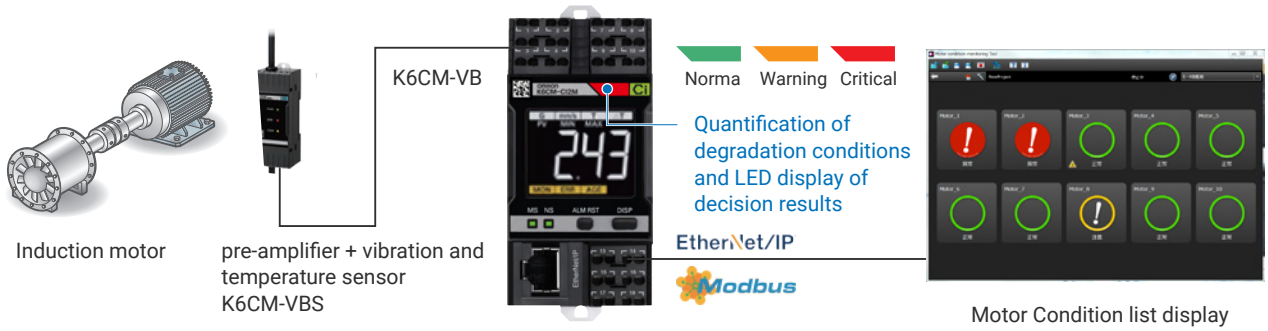
Failure of facility equipment

Production maintenance will become impossible

Omron's Predictive Maintenance Solutions

Equipment condition analysis can be achieved by new maintenance personnel through predictive maintenance

OMRON's solutions convert information collected by sensors into easy-to-understand numerical values and parameters that show clear changes, even providing support for determining the necessity of maintenance through comparison with threshold values. This will enable decision-making that was previously only possible with equipment manufacturers or experts.



Improvement example

BEFORE **When facility equipment suddenly stops, is becomes impossible to maintain not only equipment but the entire floor**

Facility equipment maintenance is outsourced and handled externally. Even if local personnel want to carry out maintenance, they lack the know-how to do so. Therefore, there is a risk that equipment will suddenly fail, and production will not be able to continue.

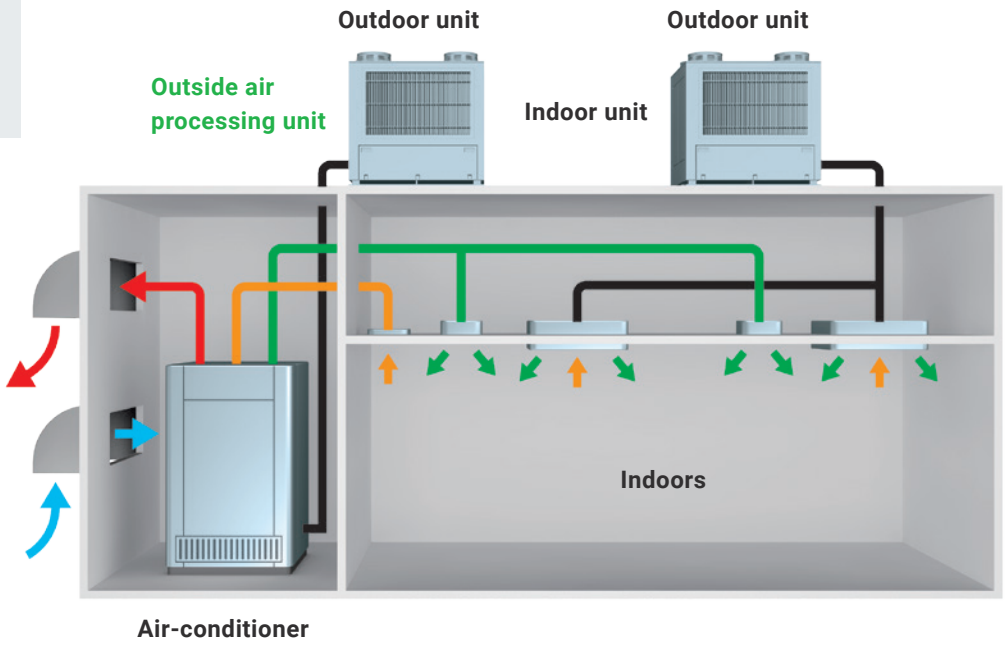
AFTER **By digitalizing maintenance, degradation of facility equipment can be monitored and scheduled maintenance that does not affect the production floor can be performed**

By digitalizing maintenance activities that could previously only be performed by equipment manufacturers or experts, even new maintenance personnel can carry out maintenance. Maintenance activities can be carried out without having to outsource. Knowledge of equipment condition ensures that scheduled maintenance can be performed before sudden stoppage ever occurs.

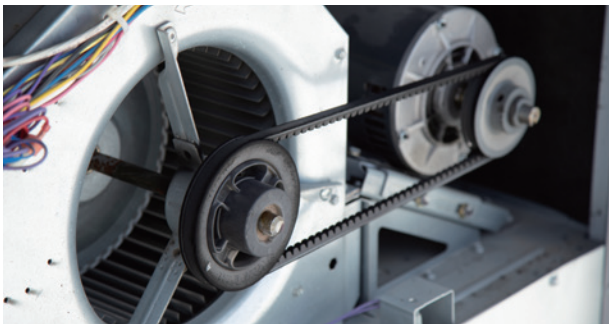
Total condition monitoring for air-conditioning equipment

Large-scale air conditioning helps maintain pleasant environments in multi-story buildings, commercial complexes, factories, and other places, leading to improved work performance, better health, and safety of workers. Moreover, air conditioning management is often directly linked to the quality of the produced goods, requiring stable operation for optimal results.

Monitoring Target
Cooling fan,
DC power supply,
control panel



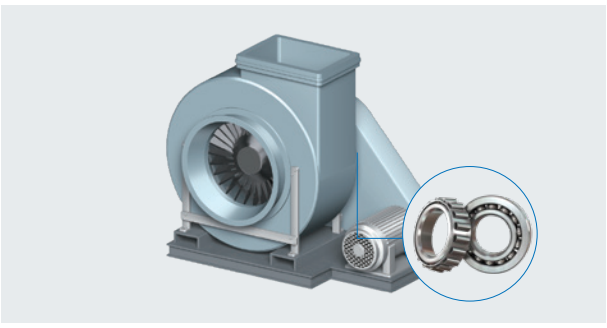
Air-conditioning fan V-belt degradation monitoring



Motor Condition Monitoring Device
Comprehensive current diagnosis
K6CM-CItype

Error Mode	Air-conditioning stoppage due to V-belt degradation/breakage
Detection principle	Irregular load changes occur due to V-belt warping with age, and the electric current waveform becomes distorted. The distortion can be detected by capturing with motor condition monitoring devices (comprehensive current diagnosis type)
Implementation effects	V-belt abnormalities that cannot be captured through oscillation can be monitored. Contributes to scheduled maintenance by enabling replacing before V-belt snaps

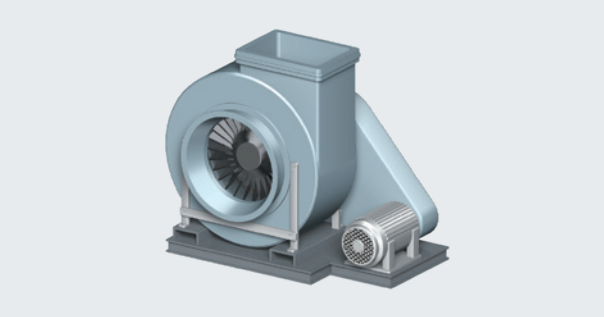
Air-conditioning fan bearing degradation monitoring



Motor Condition Monitoring Device
Vibration/Temperature type
K6CM-VB

Error Mode	Equipment stoppage due to bearing failure (grease degradation or scratches)
Detection principle	When there is abnormal load applied on bearings, the orbital plane is separates, producing roughness, and smooth rotation is no longer possible, resulting in high-frequency oscillation. Since oscillation in the order of kHz can be measured, this can be detected with motor condition monitoring devices (oscillation and temperature monitoring devices)
Implementation effects	The skills of maintenance personnel with a stethoscope rod an the like can be digitalized to enable simple trend monitoring. Contributes to prevention of sudden motor failure by enabling scheduled maintenance with the visualization of bearing degradation condition

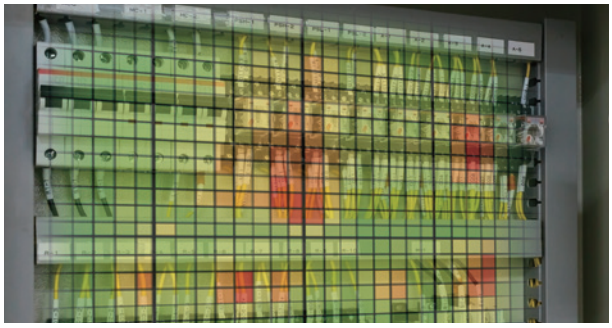
Air-conditioning fan motor insulation degradation monitoring



Insulation Resistance Monitoring Device
K6CM-VB

Error Mode	Equipment stoppage due to fan motor insulation degradation
Detection principle	When there is heat or environmental impact, motor insulation resistance values change, so this can be detected with insulation resistance monitoring devices
Implementation effects	Trend monitoring in insulation, which are difficult to ascertain purely by human intuition, can be monitored by periodically measuring motor insulation resistance values. Contributes to reduced person-hours thanks to automation of periodic inspections using insulation tester

Control panel temperature monitoring



Thermal Condition Monitoring Device
K6PM-TH

Error Mode	Failure due to abnormal heat of devices in a panel
Detection principle	Surface-wide temperature monitoring of abnormal heat generation due to loose screws inside in-panel equipment and machinery or machinery defects can be achieved using contact-free infrared sensors
Implementation effects	Frequency of inspections can be reduced by using a thermo viewer. Constant surface temperature monitoring contributes to reduced fire risk thanks to ability to take measures before abnormal heat generation occurs

Monitoring of replacement timing for sensors and control device DC power supplies

Switching Power Supply
S8VK-X

Error Mode	DC power supply failure due to age-related degradation
Detection principle	DC power supplies often reach the end of their life due to a decline in the capacity of internal condensers, and the speed of capacity decline changes significantly depending on the temperature of the usage environment. Timing for replacement can be detected by measuring internal condenser temperature and calculating capacity decline
Implementation effects	Output condition of power supply load can be ascertained, which makes it possible to reduce verification workload. Contributes to prevention of sudden equipment stoppage by enabling scheduled replacement with visualization of timing for replacement

Air-conditioning fan blade degradation monitoring

Motor Condition Monitoring Device
Comprehensive current diagnosis type
K6CM-CI

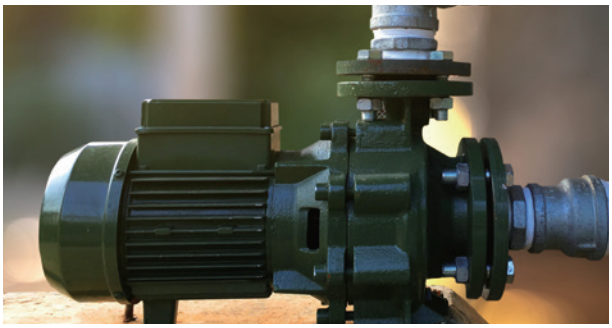
Error Mode	Air-conditioning fan blade breakage
Detection principle	When blades break, the balance of rotation collapses. Rotational balance collapses, causing distortion in electric current waveforms, and this can be detected with motor condition monitoring devices (comprehensive current diagnosis type) that can capture such distortion
Implementation effects	Equipment that is difficult to inspect on a periodic basis can be constantly monitored and the fan condition can be visualized. Also contributes to preventing sudden equipment failure, since scheduled maintenance can be performed

Total condition monitoring for water supply and drainage equipment

Water supply and drainage equipment is an essential part of our daily lives and has a significant impact on our health, so it must be managed properly. In factories, this equipment is also critical for product/equipment cooling, cleaning, and temperature/humidity control, among other important functions; any malfunction can lead to a complete halt in production.

Monitoring Target
Water supply and drainage pump, control panel, DC power supply

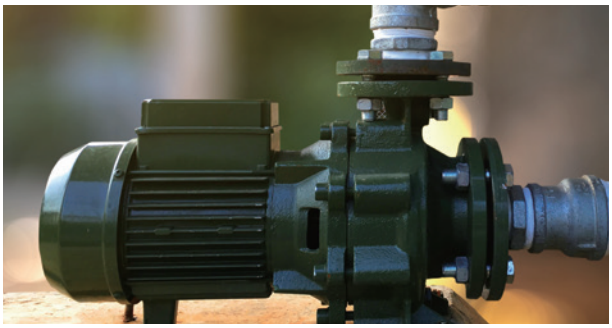
Cavitation monitoring for water supply and drainage pumps



Motor Condition Monitoring Device Comprehensive current diagnosis K6CM-CI

Error Mode	Failure due to cavitation of water supply and drainage pumps
Detection principle	Abnormal impact occurs in the pump due to cavitation, and this causes load change. This load change causes distortion in electric current waveforms, and this can be detected with motor condition monitoring devices (comprehensive current diagnosis type) that can capture such distortion
Implementation effects	Equipment that is difficult to inspect on a periodic basis can be constantly monitored and the pump condition can be visualized. Also contributes to preventing sudden equipment failure, since scheduled maintenance can be performed

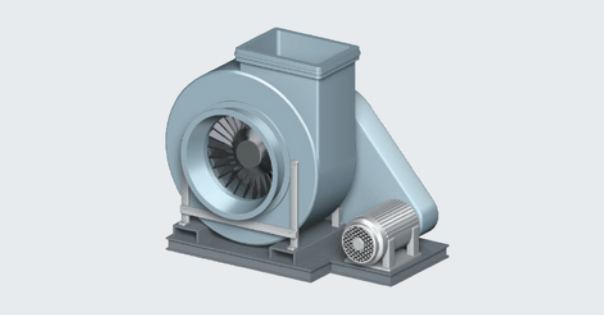
Supply and drainage pump motor Insulation degradation monitoring



Insulation Resistance Monitoring Device K7GE-MG

Error Mode	Equipment stoppage and short circuit due to degradation of water supply and drainage pump motor insulation
Detection principle	When there is heat or environmental impact, motor insulation resistance values change, so this can be detected with insulation resistance monitoring devices
Implementation effects	Trend monitoring in insulation, which are difficult to ascertain purely by human intuition, can be monitored by periodically measuring motor insulation resistance values. Contributes to reduced person-hours thanks to automation of periodic inspections using insulation tester

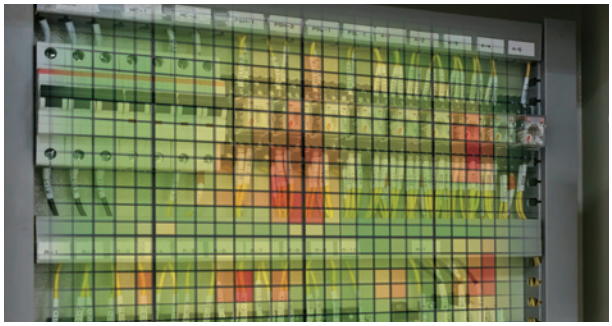
Water supply and drainage pump bearing defect detection



Motor Condition Monitirong Device
Vibration/Temperature type
K6CM-VB

Error Mode	Equipment stoppage due to bearing failure (grease degradation or scratches)
Detection principle	When there is abnormal load applied on bearings, the orbital plane is separates, producing roughness, and smooth rotation is no longer possible, resulting in high-frequency oscillation. Since oscillation in the order of kHz can be measured, this can be detected with motor condition monitoring devices (oscillation and temperature monitoring devices)
Implementation effects	The skills of maintenance personnel with a stethoscope rod an the like can be digitalized to enable simple trend monitoring. Contributes to prevention of sudden motor failure by enabling scheduled maintenance with the visualization of bearing degradation condition

Control panel temperature monitoring



Thermal Condition
Monitoring Device
K6PM-TH

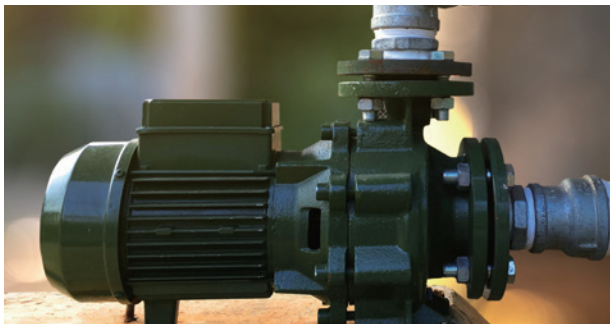
Error Mode	Failure due to abnormal heat of devices in a panel
Detection principle	Surface-wide temperature monitoring of abnormal heat generation due to loose screws inside in-panel equipment and machinery or machinery defects can be achieved using contact-free infrared sensors
Implementation effects	Frequency of inspections can be reduced by using a thermo viewer. Constant surface temperature monitoring contributes to reduced fire risk thanks to ability to take measures before abnormal heat generation occurs

Monitoring of replacement timing for sensors and control device DC power supplies

Switching Power Supply
S8VK-X

Error Mode	DC power supply failure due to age-related degradation
Detection principle	DC power supplies often reach the end of their life due to a decline in the capacity of internal condensers, and the speed of capacity decline changes significantly depending on the temperature of the usage environment. Timing for replacement can be detected by measuring internal condenser temperature and calculating capacity decline
Implementation effects	Output condition of power supply load can be ascertained, which makes it possible to reduce verification workload. Contributes to prevention of sudden equipment stoppage by enabling scheduled replacement with visualization of timing for replacement

Water supply and drainage pump motor degradation monitoring



Motor Condition
Monitoring Device
Comprehensive current
diagnosis type
K6CM-CI

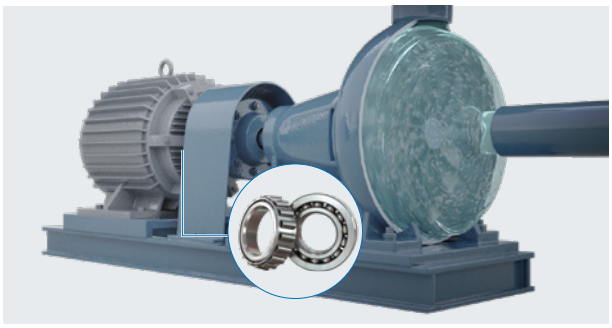
Error Mode	Equipment stoppage due to drainage pump misalignment
Detection principle	Misalignment causes rotational balance to collapse. Rotational balance collapses, causing distortion in electric current waveforms, and this can be detected with motor condition monitoring devices (comprehensive current diagnosis type) that can capture such distortion
Implementation effects	Equipment that is difficult to inspect on a periodic basis can be constantly monitored and the pump condition can be visualized. Also contributes to preventing sudden equipment failure, since scheduled maintenance can be performed

Total condition monitoring for cooling tower

In cooling towers, foreign matter from outside or scale buildup inside pipes and towers due to dirty coolant can lead to damage if neglected. This can manifest in blocked pipes and wear. Additionally, air in the pump can cause coolant to cease circulation, making constant monitoring essential.

Monitoring Target
Cooling fans, water circulation pumps

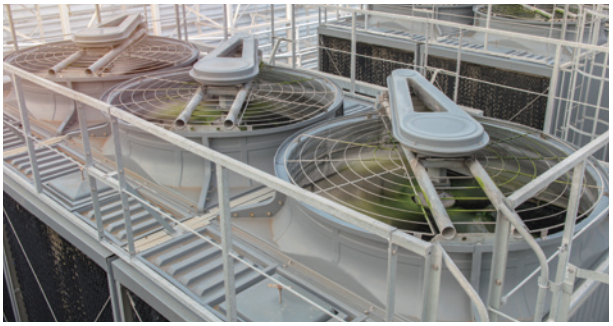
Cooling water circulation pump bearing degradation monitoring



Motor Condition
Monitoring Device
Vibration/Temperature type
K6CM-VB

Error Mode	Equipment stoppage due to bearing failure (grease degradation or scratches)
Detection principle	When there is abnormal load applied on bearings, the orbital plane is separates, producing roughness, and smooth rotation is no longer possible, resulting in high-frequency oscillation. Since oscillation in the order of kHz can be measured, this can be detected with motor condition monitoring devices (oscillation and temperature monitoring devices)
Implementation effects	The skills of maintenance personnel with a stethoscope rod an the like can be digitalized to enable simple trend monitoring. Contributes to prevention of sudden motor failure by enabling scheduled maintenance with the visualization of bearing degradation condition

Cooling fan V-belt degradation monitoring



Motor Condition
Monitoring Device
Comprehensive current diagnosis type
K6CM-CI

Error Mode	Equipment stoppage due to cooling fan V-belt degradation/breakage
Detection principle	Irregular load changes occur due to V-belt warping with age, and the electric current waveform becomes distorted. The distortion can be detected by capturing with motor condition monitoring devices (comprehensive current diagnosis type)
Implementation effects	V-belt abnormalities that cannot be captured through oscillation can be monitored. Contributes to scheduled maintenance by enabling replacing before V-belt snaps

Cooling fan misalignment monitoring

Motor Condition
Monitoring Device
Comprehensive current diagnosis type
K6CM-CI

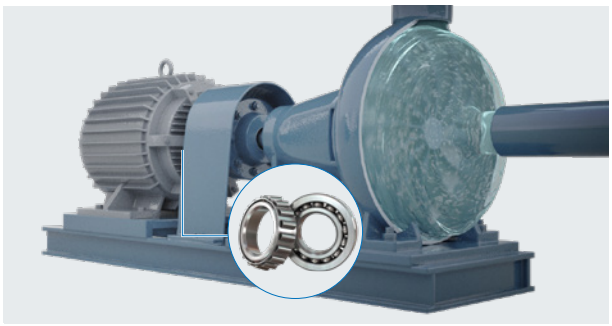
Error Mode	Equipment stoppage due to cooling fan misalignment
Detection principle	Misalignment causes rotational balance to collapse. Rotational balance collapses, causing distortion in electric current waveforms, and this can be detected with motor condition monitoring devices (comprehensive current diagnosis type) that can capture such distortion
Implementation effects	Equipment that is difficult to inspect on a periodic basis can be constantly monitored and the pump condition can be visualized. Also contributes to preventing sudden equipment failure, since scheduled maintenance can be performed

Total condition monitoring for compressed air supply equipment

Compressed air is widely used as a convenient source of motive power. When there is a lack of compressed air, this can lead to problems such as malfunction and stoppage of equipment designed to convert compressed air into power, so it is important to prevent sudden equipment failure. Here we will introduce condition monitoring solutions for compressed air supply equipment.

Monitoring Target
Compressor

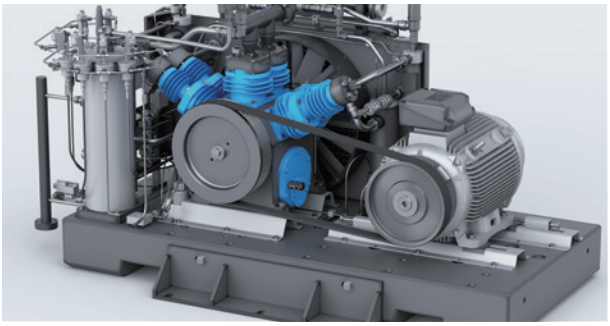
High-pressure compressor motor insulation degradation monitoring



Insulation Resistance Monitoring Device
K7GE-MG

Error Mode	Equipment stoppage due to bearing failure (grease degradation or scratches)
Detection principle	When there is heat or environmental impact, motor insulation resistance values change, so this can be detected with insulation resistance monitoring devices
Implementation effects	Trend monitoring in insulation, which are difficult to ascertain purely by human intuition, can be monitored by periodically measuring motor insulation resistance values. Contributes to reduced person-hours thanks to automation of periodic inspections using insulation tester

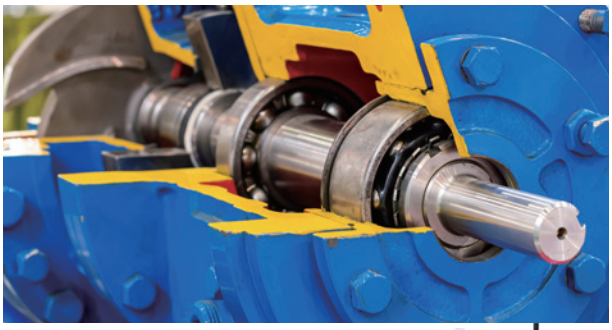
Compressor V-belt degradation monitoring



Motor Condition Monitoring Device
Comprehensive current diagnosis type
K6CM-CI

Error Mode	Equipment stoppage due to compressor V-belt degradation/breakage
Detection principle	Irregular load changes occur due to V-belt warping with age, and the electric current waveform becomes distorted. The distortion can be detected by capturing with motor condition monitoring devices (comprehensive current diagnosis type)
Implementation effects	V-belt abnormalities that cannot be captured through oscillation can be monitored. Contributes to scheduled maintenance by enabling replacing before V-belt snaps

Compressor bearing defect monitoring



Motor Condition Monitoring Device
Vibration/Temperature type
K6CM-VB

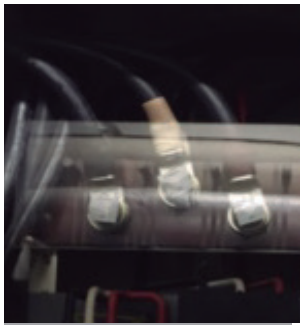
Error Mode	Equipment stoppage due to compressor bearing failure (grease degradation or scratches)
Detection principle	When there is abnormal load applied on bearings, the orbital plane is separates, producing roughness, and smooth rotation is no longer possible, resulting in high-frequency oscillation. Since oscillation in the order of kHz can be measured, this can be detected with motor condition monitoring devices (oscillation and temperature monitoring devices)
Implementation effects	The skills of maintenance personnel with a stethoscope rod an the like can be digitalized to enable simple trend monitoring. Contributes to prevention of sudden motor failure by enabling scheduled maintenance with the visualization of bearing degradation condition

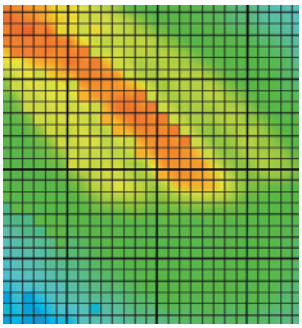
Total condition monitoring for stacker crane

Cranes, which are used at all kinds of sites, handle extremely heavy materials and always carry large loads. Therefore, the condition of degradation will vary significantly depending on the situation in which they are used, since consumption of motors and bearings, etc. is unavoidable. Crane failure leads not only to a drop in work efficiency but also brings a risk of human disaster and secondary damage to other equipment, so it is extremely important to accurately ascertain the condition.

Monitoring Target
Crane motor, terminal block

Monitoring of terminal blocks





Thermal Condition
Monitoring Device
K6PM-TH

Error Mode	Thermal fatigue due to abnormal heat generation in terminal block
Detection principle	Surface-wide temperature monitoring of abnormal heat generation in terminal blocks can be achieved using contact-free infrared sensors
Implementation effects	Frequency of inspections can be reduced by using a thermo viewer. Constant surface temperature monitoring contributes to reduced fire risk thanks to ability to take measures before abnormal heat generation occurs

Crane motor degradation monitoring

Motor Condition
Monitoring Device
Comprehensive current
diagnosis type
K6CM-CI

Error Mode	Motor failure due to bearing adherence
Detection principle	Bearings become difficult to rotate due to adherence of viscous or caustic substances. When this happens, it can be ascertained through signs appearing in the rated current frequency, so this can be detected with motor condition monitoring devices (comprehensive current diagnosis type)
Implementation effects	V-belt abnormalities that cannot be captured through oscillation can be monitored. Contributes to scheduled maintenance by enabling replacing before V-belt snaps

Crane motor bearing degradation monitoring

Motor Condition
Monitoring Deivce
Vibration/Temperature type
K6CM-VB

Error Mode	Equipment stoppage due to bearing failure (grease degradation or scratches)
Detection principle	When there is abnormal load applied on bearings, the orbital plane is separates, producing roughness, and smooth rotation is no longer possible, resulting in high-frequency oscillation. Since oscillation in the order of kHz can be measured, this can be detected with motor condition monitoring devices (oscillation and temperature monitoring devices)
Implementation effects	The skills of maintenance personnel with a stethoscope rod an the like can be digitalized to enable simple trend monitoring. Contributes to prevention of sudden motor failure by enabling scheduled maintenance with the visualization of bearing degradation condition

Total condition monitoring for lifter

Also known as elevators, lifters are available in various forms such as stationary, moving, automatic and manual, and are essential equipment in a modern warehouse. If they were to fail, goods under long-term storage would no longer be transportable, so condition monitoring is important.

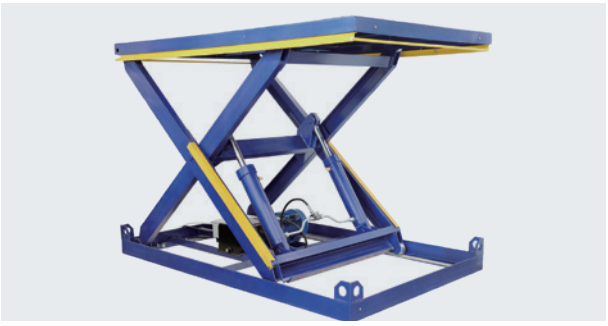
Monitoring Target
Lifter, DC power supply

Monitoring of replacement timing for sensors and control device DC power supplies

Switching Power Supply
S8VK-X

Error Mode	DC power supply failure due to age-related degradation
Detection principle	DC power supplies often reach the end of their life due to a decline in the capacity of internal condensers, and the speed of capacity decline changes significantly depending on the temperature of the usage environment. Timing for replacement can be detected by measuring internal condenser temperature and calculating capacity decline
Implementation effects	Output condition of power supply load can be ascertained, which makes it possible to reduce verification workload. Contributes to prevention of sudden equipment stoppage by enabling scheduled replacement with visualization of timing for replacement

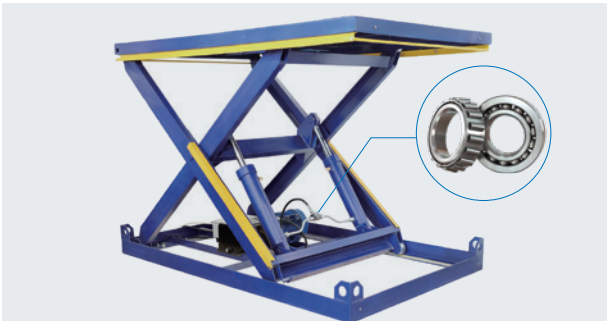
Lifter degradation monitoring



Motor Condition
Monitoring Device
Comprehensive current
diagnosis type
K6CM-CI

Error Mode	Equipment stoppage due to lifter degradation
Detection principle	When lifter movement deteriorates, load change causes distortion in electric current waveforms, and this can be detected with motor condition monitoring devices (comprehensive electric current diagnosis type) that can capture such distortion
Implementation effects	Equipment that is difficult to inspect on a periodic basis can be constantly monitored and the pump condition can be visualized. Also contributes to preventing sudden equipment failure, since scheduled maintenance can be performed

Lifter motor bearing degradation monitoring



Motor Condition
Monitoring Device
Vibration/Temperature type
K6CM-VB

Error Mode	Equipment stoppage due to bearing failure (grease degradation or scratches)
Detection principle	When there is abnormal load applied on bearings, the orbital plane is separates, producing roughness, and smooth rotation is no longer possible, resulting in high-frequency oscillation. Since oscillation in the order of kHz can be measured, this can be detected with motor condition monitoring devices (oscillation and temperature monitoring devices)
Implementation effects	The skills of maintenance personnel with a stethoscope rod an the like can be digitalized to enable simple trend monitoring. Contributes to prevention of sudden motor failure by enabling scheduled maintenance with the visualization of bearing degradation condition

Product Lineup for Omron's Predictive Maintenance Solutions

Advanced Motor Condition Monitoring Device
K7DD

Cat. No.N235-E1

Motor Condition Monitoring Device
K6CM Series

Cat. No.N220-E1

Insulation Resistance Monitoring Device
K7GE

Cat. No.N226-E1

Thermal Condition Monitoring Device
K6PM

Cat. No.H232-E1

Heater Condition Monitoring Device
K7TM

Cat. No.N229-E1

Switching Power Supply
S8VK-X

Cat. No.T211-E1

Note: Do not use this document to operate the Unit.

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