Application Guide for Predictive
Maintenance Solutions
For Automotive production

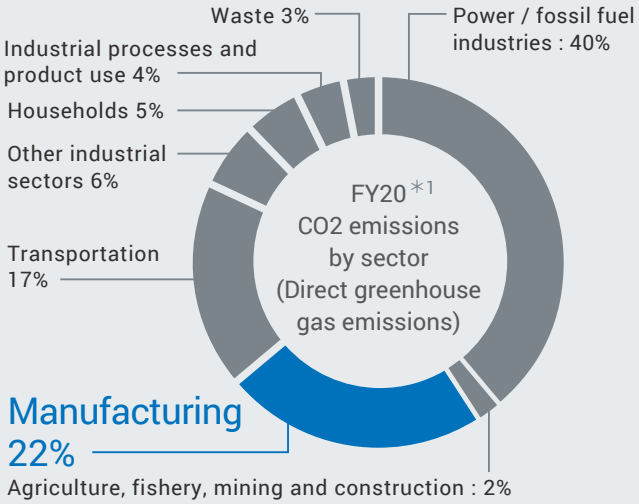
Solutions for Total Facility Condition and Trend Monitoring

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

Labor shortage and increased risk of equipment failure

In recent years, increased environmental awareness on a global scale has led to sudden acceleration of NEV demand. There has been concentration of personnel for the early launch of new NEV production lines, leading to labor shortages on existing gasoline vehicle production lines. On the other hand, there is increasing risk of failure due to progressive degradation of equipment as a result of increased operating rates of production lines used both for NEVs and gasoline vehicles as the number of vehicles being produced continues to increase. Shared lines with excessive operational load require an even higher level of maintenance than before, but because of the diversity of equipment being used, maintenance is difficult for anyone but experienced maintenance personnel to perform, and in the short term it is extremely difficult for maintenance knowledge to be passed down to trainees. If maintenance is not optimized soon, maintenance activities will be unable to keep up with vehicle manufacturing processes, and there is a real risk that it will become impossible to maintain production.

Maintenance in spite of a labor shortage

Production maintenance will become impossible

Omron's Predictive Maintenance Solutions

Maintenance reforms that can be implemented for the Future

Omron's predictive maintenance solutions monitor and analyze real world data, automatically

Predictive Maintenance- take action when neccesary

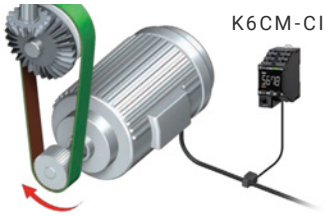
Equipment monitoring
Digitization

Abnormality Alarm
Remote Monitoring

On-site maintenance
Maintain as necessary

Improvement example

Digitization



Experienced maintenance personnel can determine motor degradation condition by checking sound, vibration, and temperature, etc.

▼

Enabling even inexperienced maintenance personnel to determine degradation condition by quantifying from motors' electric current data

Remote Monitoring

Heavy maintenance workload due to regular site visits to check conditions at each stage

▼

Enabling confirmation of current equipment condition from an office without having to visit sites

Implementation of appropriate maintenance

While the equipment requiring maintenance is increasing, labor shortages and declining numbers of experienced maintenance personnel are resulting in more and more equipment not being adequately maintained, and maintenance knowledge is not being passed on

▼

Enabling suitable maintenance support even by small numbers of inexperienced maintenance personnel through digitalization and remote monitoring

Total condition monitoring of metal processing machinery

All machines and parts are made by machine tools. Therefore, machine tools are also known as “mother machines” as they support all manufacturing, and these important tools are required to provide excellent precision and stable operation.

Monitoring Target
Cutting tools,
machining motor,
machining stage,
control panel,
DC power supply,
pump

Machining tool degradation monitoring

Advanced Motor Condition Monitoring Device
K7DD

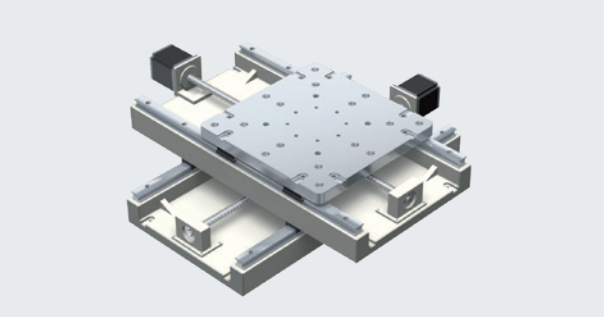
Error Mode	Deterioration of machining precision due to cutting tool degradation
Detection principle	Load changes vary depending on abnormality mode, such as bearing abnormalities, cutting tool wear, and sawdust biting, etc. By capturing these load change abnormalities, this can be detected with a single advanced motor condition monitoring device
Implementation effects	Also contributes to preventing occurrence of defective products, since scheduled maintenance can be performed in line with condition of cutting tool degradation

Machining motor insulation degradation monitoring

Insulation Resistance Monitoring Device
K7GE-MG

Error Mode	Electric shock accidents and fire caused by short circuit due to degradation of machining motor insulation
Detection principle	When coolant or sawdust penetrate the inside of a motor, the insulation resistance value of the motor changes, so it is possible to detect this 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

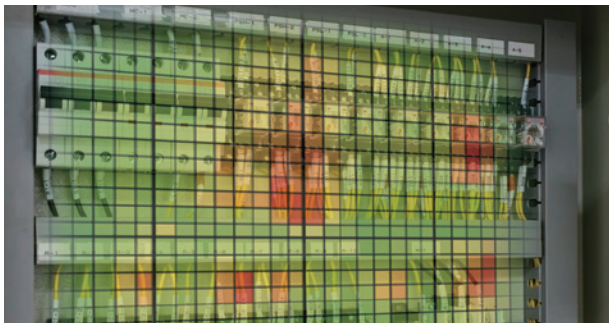
Machining stage metal chip jamming monitoring



Advanced Motor Condition Monitoring Device
K7DD

Error Mode	Operational failure due to foreign matter in ball screws or grease running out
Detection principle	Load change varies depending on abnormality mode, such as foreign matter biting or grease running out, etc. By capturing these load change abnormalities, this can be detected with a single advanced motor condition monitoring device
Implementation effects	Even failure modes can be specified, so maintenance workload can be reduced. Also contributes to preventing occurrence of defective products, since stable operating condition of machining stage can be monitored

Control panel temperature monitoring



Thermal Condition Monitoring Device
K6PM-TH

Error Mode	Fire due to abnormal heat generation of firing furnace panel transformer
Detection principle	Surface-wide temperature monitoring of abnormal heat generation of a device (transformer) inside the panel 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

Coolant pump degradation monitoring

Motor Condition Monitoring Device
Vibration and Temperature type
K6CM-VB

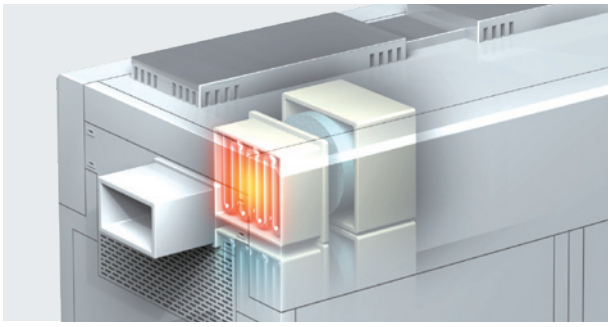
Error Mode	Coolant supply abnormality due to bearing failure (grease degradation or scratches)
Detection principle	When there is abnormal load applied on bearings, the orbital plane is separates, producing roughness, and smooth rotation is no longer possible, resulting in high-frequency oscillation. 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 rechargeable battery production equipment

Lithium-ion battery development has progressed to the extent that these batteries are now used not only in mobile devices, but also in electric vehicles and smart grids. Production equipment for rechargeable batteries is set to become an essential part of the automotive industry.

Monitoring Target
Heater,
chiller compressor,
electrode winder,
control panel,
dust collector,
drying furnace

Monitoring for signs of heater burn-out in drier-dehumidifiers



Heater Condition
Monitoring Device
K7TM

Error Mode	Desiccation defects in electrolytic foil due to heater burn-out
Detection principle	Drying electrode foil takes a long time because it must be performed both for the cathodes and anodes. This means that heater degradation due to oxidization is accelerated and resistances values increase, which can be detected with heater condition monitoring devices
Implementation effects	Downtime resulting from sudden heater burn-out can be reduced. Also contributes to prevention of electrode foil quality defects resulting from uneven drying caused by heater burn-out

Chiller compressor insulation degradation monitoring

Insulation Resistance
Monitoring Device
K7GE-MG

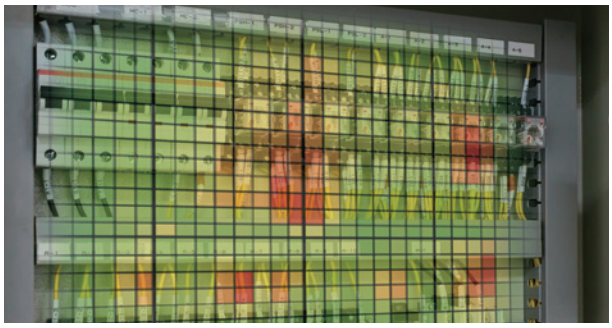
Error Mode	Electric shock accidents due to degradation of compressor insulation
Detection principle	When there is heat or environmental impact, motor insulation resistance values change, so this can be detected with insulation resistance monitoring devices
Implementation effects	Trend monitoring in insulation, 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

Electrode winder monitoring

Advanced Motor Condition Monitoring Device
K7DD

Error Mode	Electrode material winding defects (snaking) due to degradation of thermo motors and machine parts
Detection principle	If snaking occurs when winding, there will be a change in torque in the winding motor and this will appear as variation in power, so this can be detected with advanced motor condition monitoring devices
Implementation effects	Even failure modes can be specified, so maintenance workload can be reduced. Also contributes to reduction of electrode material winding defects

Control panel temperature monitoring



Thermal Condition Monitoring Device
K6PM-TH

Error Mode	Fire due to abnormal heat generation of firing furnace panel transformer
Detection principle	Surface-wide temperature monitoring of abnormal heat generation of a device (transformer) inside the panel 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

Dust collector degradation monitoring

Motor Condition Monitoring Device
Vibration and Temperature type
K6CM-VB

Error Mode	Diminished dust collector functionality 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

Drying furnace fan degradation monitoring

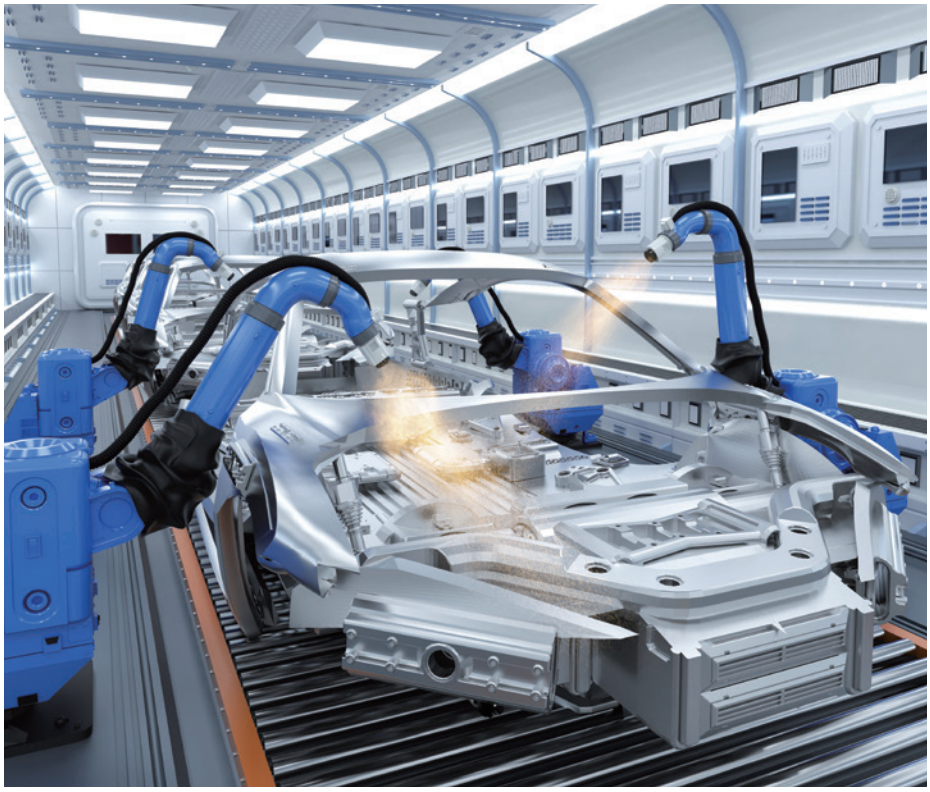
Motor Condition Monitoring Device
Comprehensive current diagnosis type
K6CM-CI

Error Mode	Fan 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	Fan abnormalities that cannot be captured through oscillation can be monitored. Detects degradation of bearings so users can replace them before they lock up, contributing to scheduled maintenance.

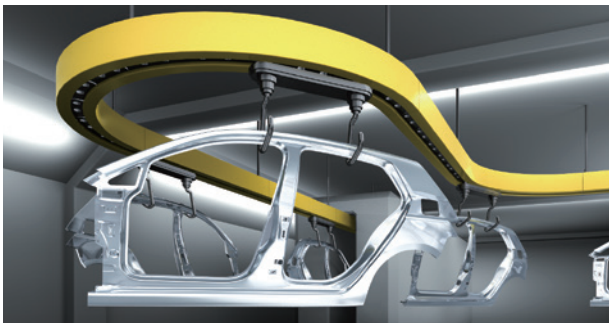
Total condition monitoring for coating equipment

Coating processes are essential for finishing bodies, and there is immeasurable opportunity loss when a line stops due to equipment failure. This is also dangerous work in which poisonous gas is emitted, hence automation is desirable in this process.

Monitoring Target
Transport chain conveyor,
exhaust fan motor,
compressor, work,
DC power supply,
exhaust fan



Transport chain conveyor degradation detection



Advanced Motor Condition Monitoring Device
K7DD

Error Mode	Grease running out or presence of foreign matter in transport chain conveyor gears
Detection principle	Load changes fluctuate with the presence of foreign matter and grease running out. Multiple load change patterns for each motor can be detected with a single advanced motor condition monitoring device
Implementation effects	Even failure modes can be specified, so maintenance workload can be reduced. Also contributes to preventing sudden equipment stoppages or defective coating, since scheduled maintenance can be performed in line with the condition of chain conveyor degradation

Exhaust fan motor insulation degradation monitoring

Insulation Resistance Monitoring Device
K7GE-MG

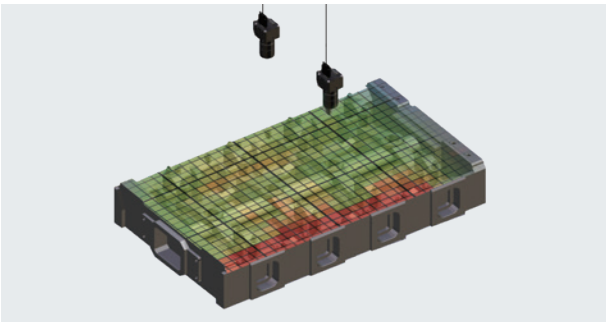
Error Mode	Electric shock accidents and fire caused by short circuit due to degradation of exhaust fan insulation
Detection principle	When mist penetrates the inside of a motor, the insulation resistance value of the motor changes, so it is possible to detect this with insulation resistance monitoring 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

Air spray compressor degradation monitoring

Motor Condition Monitoring Device
Vibration/Temperatue type
K6CM-VB

Error Mode	Defective coating due to bearing failure (grease degradation or scratches)
Detection principle	If snaking occurs when winding, there will be a change in torque in the winding motor and this will appear as variation in power, so this can be detected with advanced motor condition monitoring devices
Implementation effects	Even failure modes can be specified, so maintenance workload can be reduced. Also contributes to reduction of electrode material winding defects

Work temperature monitoring



Thermal Condition
Monitoring Device
K6PM-TH

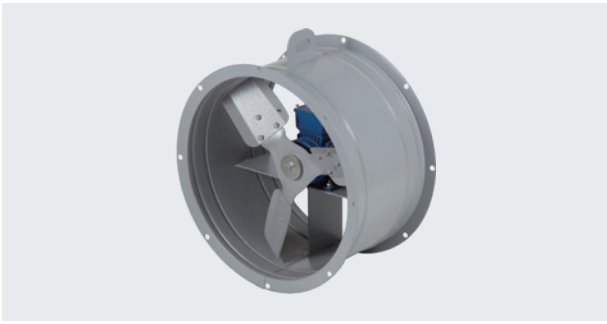
Error Mode	Burns due to high temperature of work
Detection principle	Surface-wide temperature monitoring of work surface temperature when left after coating/drying can be achieved using contact-free infrared sensors
Implementation effects	Constant monitoring of work temperature condition contributes to ensuring work safety and optimum cooling time management

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

Exhaust fan degradation monitoring



Motor Condition
Monitoring Device
Comprehensive current
diagnosis type
K6CM-CI

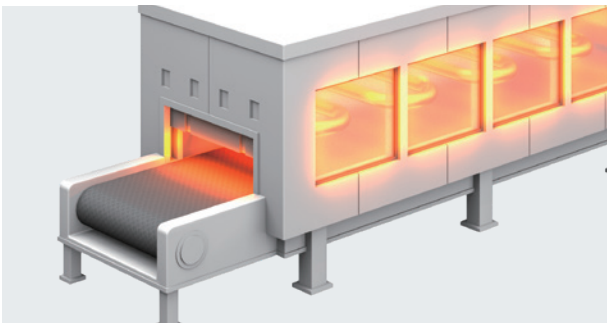
Error Mode	Equipment stoppage due to exhaust fan failure
Detection principle	Mist sticks to the fan and causes rotational balance to collapse. When this happens, it can be ascertained through signs appearing in the rated current frequency, so this can be detected with motor condition monitoring devices (comprehensive current diagnosis type)
Implementation effects	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 drying equipment

With complex objects for coating, such as vehicle bodies, each part needs to be raised to the same temperature and each part must also meet the prescribed baking conditions. If the temperature drops or there is a change in conveyor speed, uneven drying will occur and quality defects will arise.

Monitoring Target
Heater, work, transport chain, duct, DC power supply, fan motor

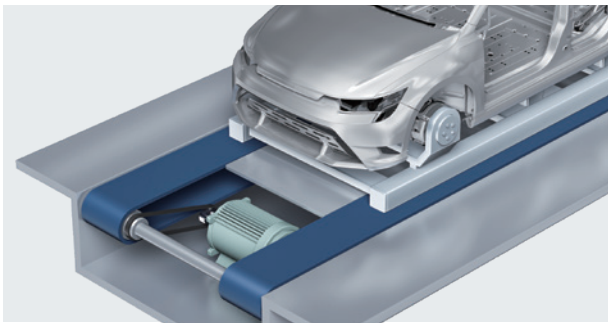
Monitoring for signs of heater burn-out



Heater Condition Monitoring Device
K7TM

Error Mode	Work desiccation defects due to heater burn-out
Detection principle	When a heater is used for many years, oxidization progresses and fragility ensues, leading to increased resistance values, so this can be detected with heater condition monitoring devices
Implementation effects	Scheduled maintenance is enabled by visualization of heater degradation condition. Therefore, downtime resulting from sudden heater burn-out can be reduced. Also contributes to prevention of work quality defects resulting from uneven drying caused by heater burn-out

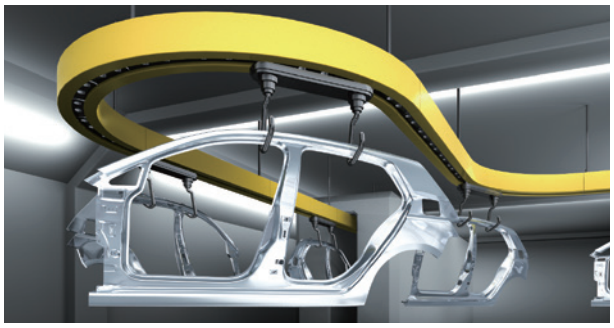
Transport conveyor motor insulation degradation monitoring



Insulation Resistance Monitoring Device
K7GE-MG

Error Mode	Equipment stoppage due to 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

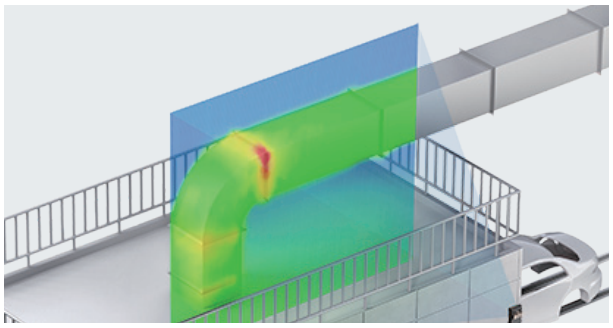
Transport chain conveyor degradation monitoring



Advanced Motor Condition Monitoring Device
K7DD

Error Mode	Grease running out or presence of foreign matter in transport chain conveyor gears
Detection principle	Load changes fluctuate with the presence of foreign matter and grease running out. Multiple load change patterns for each motor can be detected with a single advanced motor condition monitoring device
Implementation effects	Even failure modes can be specified, so maintenance workload can be reduced. Also contributes to preventing sudden equipment stoppages or defective coating, since scheduled maintenance can be performed in line with the condition of chain conveyor degradation

Duct hot air leakage monitoring



Thermal Condition Monitoring Device
K6PM-TH

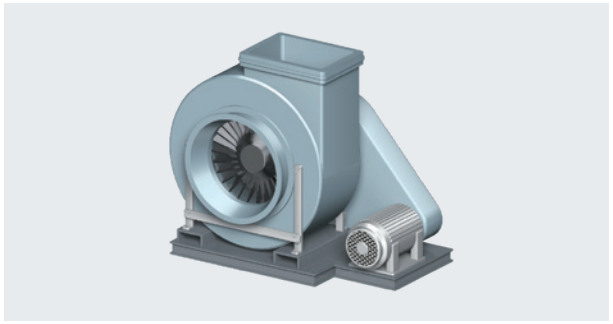
Error Mode	Work quality defects and equipment stoppage due to duct hot air leakage
Detection principle	Using a wide-viewing-angle contactless infrared sensor makes it possible to measure duct surface temperature surface-wide rather than at a particular point, enabling wide-range temperature measurement
Implementation effects	Frequency of inspections can be reduced by using a thermo viewer. Constant monitoring of ducts, which are in places that are difficult to frequently inspect and which have an impact on safety, contributes to early detection of heat leakage and reduction of fire risk

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

Fan motor degradation monitoring



Motor Condition Monitoring Device
Vibration and Temperature type
K6CM-VB

Error Mode	Motor breakdown due to bearing failure (grease degradation or scratches)
Detection principle	High-frequency oscillation occurs when load acts on bearings, causing detachment and preventing smooth rotation. With K6CM, oscillation in the order of kHz can be measured, so this can be detected
Implementation effects	Even failure modes can be specified, so maintenance workload can be reduced. Also contributes to reduction of electrode material winding defects

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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