Fuji Electric

Innovating Energy Technology

S-Former Control Equipment

Recommendations of preventive maintenance and renewal

As a partner for maintaining credibility

04Z9-E-0004

Have you adopted all necessary measures for preventive maintenance and upgrades?

We, as the manufacturer, recommend you take all necessary measures.

S-Former control equipment contains a wide variety of mechanisms, electric and electronic parts. The parts may malfunction even before the end of their service life depending on the environment of the installation site as well as use conditions. Furthermore, with the lapse of time, it may be difficult to maintain the quipment because it will be difficult to secure the necessary parts and the number of competent maintenance personnel will decrease. Therefore, we propose that you actively promote “Preventive maintenance” and “Upgrades” as well as the “Updating of the complete set”.

- **Increase in maintenance costs**
  - Increase in repair costs
  - Difficulty of local repairs
  - Increase in the number of days required for repair
- **Decrease in the number of maintenance personnel**
  - Decrease in the number of maintenance personnel for the old models and difficulty in securing a sufficient number of such personnel (both for customers and manufacturer)
- **Difficulty in obtaining replacement parts**
  - Production discontinued
  - Custom-made parts
- **Secular deterioration and wear of parts**
  - Durable period and service life

Items and names of parts		Durable period and service life	Remarks
Mechanical parts	Cooling fan	2 to 3 years	Life of bearings
	Connector	15 years	Whisker and silver movement
Electric and electronic parts	Aluminum electrolytic condenser	7 to 10 years	Dried up electrolyte
	Volume resistor	7 to 10 years	Evaporation of grease
	Semiconductors	15 years	Decrease in air-tightness and increase in leakage current

Examples of deterioration of parts

Short circuit due to whisker phenomenon and silver movement of the connector

Decrease of capacity due to dried up condenser electrolyte

Exhaustion of grease in the volume resistor

Short circuit due to the run-off of IC pin coating material

Disconnected pattern due to IC electro-migration

Peeled solder on the diode lead

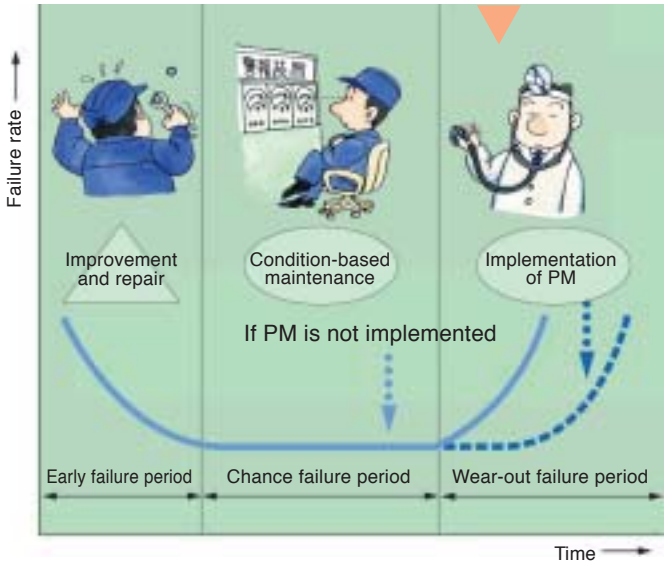
Proposal for preventive maintenance and upgrades

What is preventive maintenance?

Preventive maintenance (PM) makes significant contributions when the equipment enters into the deterioration failure period of the bath-tub curve.

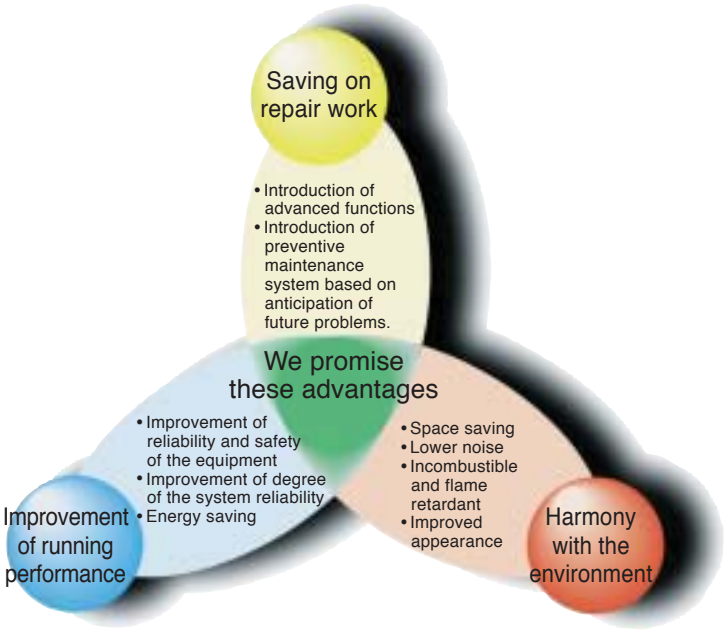
Implementing PM will result in:

- Prevention of failure
- Prevention of deterioration
- Life extension.



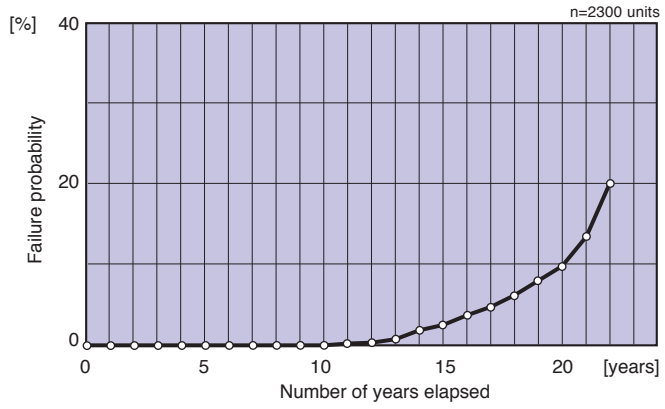
What are the advantages of upgrading?

The upgrading of deteriorated electric equipment and/or facilities will not only help lower the failure rate of the equipment/facilities, but also allow rebuilding of optimal facilities with up-to-date technology. The expected effects of upgrading are shown below.



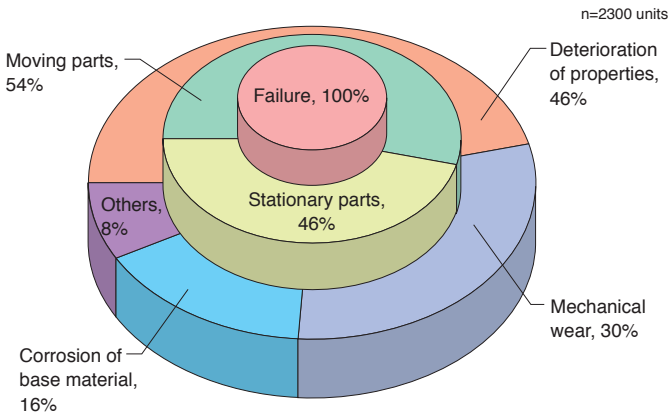
Failure probability

The failure probability tends to increase when approx. 15 years have passed after equipment installation.



Classification of parts failures

According to failure mode analysis, parts tend to break down due to wear and/or deterioration.

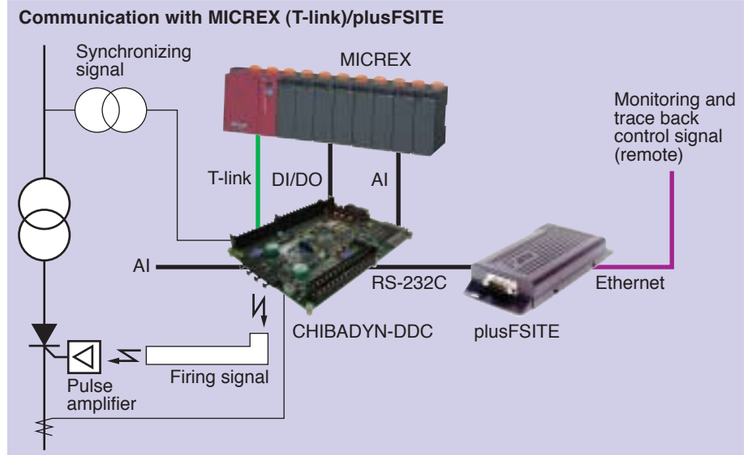


Note: An example of our Transidyn C is shown above.

Changes in S-Former control equipment

Era		1960s	1970s	1980s	1990s	2000s
Control equipment		Transidyn A / Transidyn B / Transidyn C				
				Transidyn D		
					ACC unit	
					Chibadyn	
						CHIBADYN-DDC
Instal-lation	Diode S-Former		Transidyn B / Transidyn C		ACC unit	
	Thyristor S-Former		Transidyn B / Transidyn C	Transidyn D	Chibadyn/CHIBADYN-DDC	

System configuration of S-Former



Old model

Control equipment of old model in which Transidyn C was used.

Transidyn C

Transidyn D

Updating

New model

ACC unit for diode rectifier

CHIBADYN-DDC for thyristor rectifier (digital control unit)

Chibadyn for thyristor rectifier

Up-to-date thyristor rectifier control panel

Each facility has a service life

We recommend that you implement periodic inspections and systematic upgrades.

S-Former uses a lot of parts that are subject to deterioration.
Those parts that are now operating may have deteriorated.
The major parts and their replacement periods are shown in the table below.
We recommend that the parts be replaced periodically.
Please note that the replacement periods shown here do not represent the guaranteed service life of these parts.

Recommended replacement periods of major parts

Names of parts	Recommended replacement period	Possible causes of deterioration and criteria for replacement		Example of failures
Aluminum electrolytic condenser (condenser)	7 to 10 years	The service life may vary depending on ripple current and ambient temperature. The condenser must be replaced when electrolyte leakage is detected. Deterioration of the sealing rubber of the explosion-proof valve may cause electrolyte leakage.		Decrease of capacity ↓ Larger voltage ripple ↓ Unstable control action
Other condensers (film/oil, etc.)	12 years	The condenser must be replaced as soon as possible, when the deformed or discolored oil condenser and/or leakage of the insulation oil is detected.		
Cooling fan (bearing)	2 to 3 years	The service life is determined by the condition of the bearings. The average life of the grease in the ambient temperature of 40˚C is 22,000 hours. Therefore, the cooling fan should be replaced after 20,000 hours in the case of continuous operation, or after 3 years in the case of intermittent operation. When the cooling fan is installed in a dusty location, rotating failure may occur due to the attachment of dust.		Deterioration of grease ↓ Fan stops ↓ Overheating of equipment
Thyristor, diode, transistor, printed circuit board	15 years	The service life of electronic parts using general semiconductor devices may vary widely depending on the use conditions and environment. Those located at dusty places with high temperatures should be replaced earlier because problems due to insulation failure may occur. In the case of photo couplers, deterioration of the transfer characteristics may occur due to secular degradation.		Damaged case → Deterioration of insulation ↓ Short circuit between G and K ↓ Damaged thyristor, fuse
Wirewound resistor	7 to 10 years	The service life of the wirewound resistor may vary widely depending on the ambient conditions. This resistor must be replaced as soon as possible when the wire and ceramic portion are deformed due to generated heat.		Large sliding noise ↓ Unstable control due to the large voltage noise
Electro magnetic contactor, auxiliary relay	7 years	The service life of the coil (contact) in case of continuous excitation expires when the number of contacts reaches 1 million times for the electric type and 10 million times for the mechanical type.		
Reactor, transformer	20 years	The reactor and transformer must be replaced when the insulation materials deteriorate due to the heated winding.		
Fuse for protection of semiconductor	15 years	It is recommended that you replace the fuse when approx. 15 years have passed, in order to maintain the reliability of the rapid fuse.		
Connector	15 years	The connector must be replaced when contact failure occurs due to the drop of the engagement force.		
MCCB (FAB)	15 years	It is recommended that you replace the MCCB/indicator light at the recommended time in order to maintain reliability.		
Indicator light	1 to 2 years			

Photographs of parts (Examples)

Condenser

Fan

Printed circuit board

Electro magnetic contactor

Fuse for protection of semiconductor

Printed on recycled paper

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