

8. Examples of Failures

• Probable causes of failure and failure mode of film capacitors

Failure mode	Probable causes of failure	
	Foil electrode tab structure	Evaporated electrode
	F2D,P2S,H2D	Extended foil structure MMG,MMB,MTB MMBA,MMH,MMK MPS,MPH and MPE
Short-circuiting	<ul style="list-style-type: none"> Dielectric breakdown of dielectric film by application of overvoltage and/or high pulse voltage Self-heating due to overcurrent High temperature environment Moisture absorption by film <p>Dielectric breakdown of dielectric film due to the lowering of withstand voltage</p>	—
Short-circuiting with resistance value (*)(**)	—	<ul style="list-style-type: none"> Dielectric breakdown of dielectric film by application of overvoltage and/or high pulse voltage Self-heating due to overcurrent High temperature environment Moisture absorption by film <p>Dielectric breakdown of dielectric film due to the lowering of withstand voltage</p>
Open	<ul style="list-style-type: none"> Self-heating due to overcurrent High temperature environment <p>Connection instability by heat contraction of a dielectric film</p>	<ul style="list-style-type: none"> The connected portion between the evaporated electrode metal and metallic metal is heated and dispersed instantaneously by high pulse current. Self-heating due to overcurrent High temperature environment <p>Connection instability by heat contraction of a dielectric film</p> <p>Reduction in electrode area caused by oxidation of evaporated metal due to moisture absorption (Reduction in capacity Open)</p>

*) In case of the metallized film capacitors (evaporated metal electrode type), if voltage in excess of the withstand voltage (or apparently in excess of the withstand voltage due to the lowering of withstand voltage) is applied, self-healing will happen continuously. Upon such occasion, the film may be melted and carbonized by discharging energy, thus leading not to complete short-circuiting, but to short-circuiting with resistance value.

**) Upon occurrence of short-circuiting with resistance value, if some of the conditions deemed to be its probable causes are combined with each other or critical, it may sometimes lead to fuming and/or ignition. Particularly for the laminated type, it is necessary to pay due attention to overvoltage because the withstand voltage in the portion having been cut upon formation of capacitor elements is low.

• Concrete example

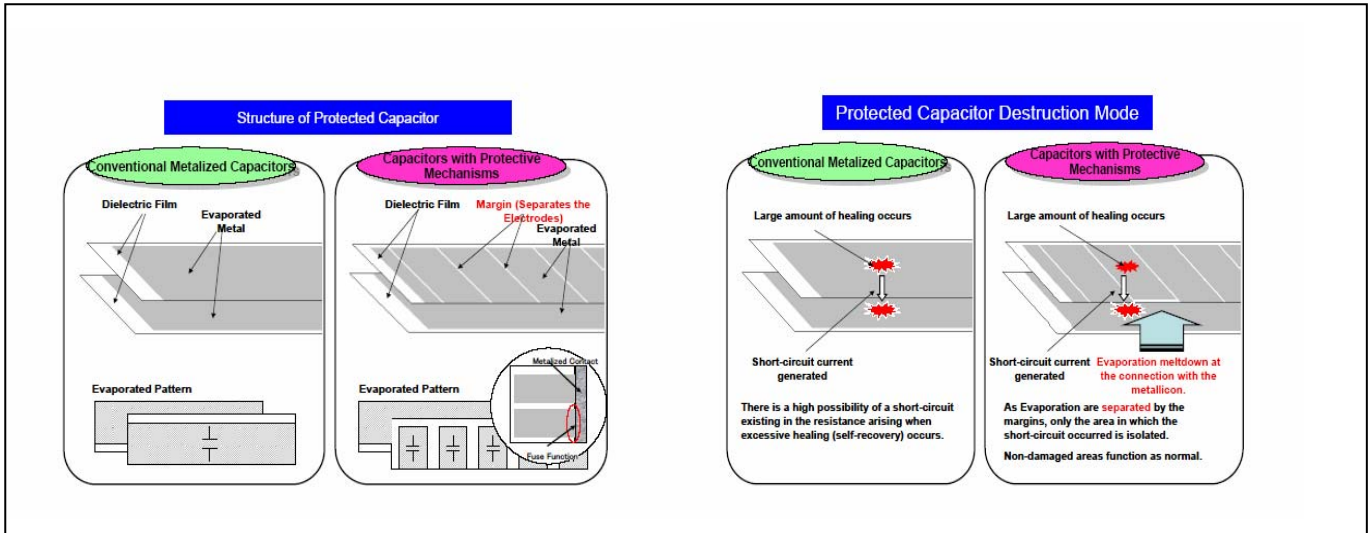
The product of evaporated electrode extended foil structure became open after 8 years operation in the field. Results of analysis: Judging from the fact that the evaporated metal has been almost lost, it is supposed to have been used in the high humidity environment.

9. Safety and Environmental Protection

- Safety

Preventive measures against fuming and ignition of evaporated electrode type

Improvement in screening accuracy by charging/discharging test and $\tan \delta$ measurement at higher frequency



- Environmental protection

Compliant with the RoHS Directive

Reduction in quantity of used materials by miniaturization

Saving of packaging materials

Environmental protection measures to be taken for incineration and decomposition are now under investigation.

10. Future Prospects

- Miniaturization by manufacturing method for unification of dielectric film formation and evaporation
- Development of higher allowable current products to enhance the superiority of low loss.
- Reduction of noise generated when AC voltage is applied