



Safety and Reliability

Safety

The specialty polymer aluminum electrolytic capacitor (SP-Cap) is more difficult to "smoke" and ignite than a tantalum capacitor. The capacitor will not "red-heat" or ignite even if a 10A current is applied; even in the case of a short circuit.

Safety test

A constant current was passed through a short-circuited capacitor, and the capacitor was observed to check for smoking and ignition.

- Test conditions

To short-circuit, an overvoltage of 30 V DC was applied to a capacitor at room temperature, and then a constant current was applied to the capacitor for two minutes.

- Test results

The presence or absence of smoke and the number of capacitors that red-heated and ignited are shown below (unit: piece)

Specialty polymer aluminum electrolytic capacitor 6.3V 33 μ F (7.3 x 4.3 x 1.8)

Current (A)	Test times	Not smoked	Smoked	Red-heated and ignited
1	50	50	0	0
3	50	50	0	0
5	50	35	15	0
7	50	8	42	0
10	50	2	48	0

In the conditions shown above, red-heating and ignition were not induced.

The smoke emitted in the tests above was analyzed and harmful substances were not detected. (Detail: carbon dioxide <0.34mg, carbon monoxide <0.53mg, methane gas < 0.19mg/piece)

Tantalum electrolytic capacitor 6.3V150 μ F (7.3 x 4.3 x 2.8)

Current (A)	Test times	Not smoked	Smoked	Red-heated and ignited
1	50	50	0	0
2	50	25	25	0
3	50	8	8	34
4	50	0	0	50
5	50	0	0	50

*These test data are simply the results obtained from the reference tests and actual data may vary in actual applications.

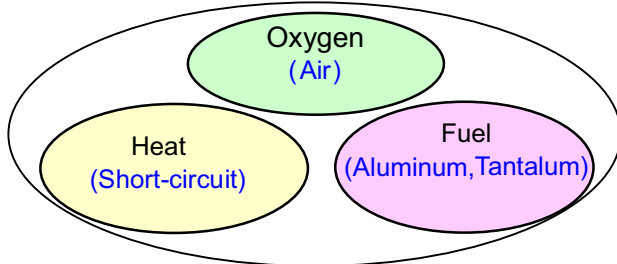


The Specialty Polymer Capacitor is difficult to "smoke" and ignite

It is because:

- Aluminum is more difficult to burn than tantalum.
- Specialty polymer emits less oxygen than manganese dioxide.

Three elements of combustion



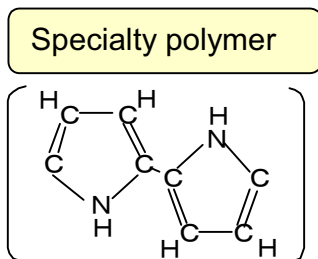
*For substances to burn, the three elements of combustion - heat, fuel, oxygen - are mandatory. If one of them is not present, burning will not occur.

Aluminum is more difficult to burn than tantalum.

	SP-Cap	Tantalum capacitor
Burning reaction	Al + O ₂	Ta + O ₂
Reaction start temperature	400°C ~ 600°C	250°C ~ 450°C
Activation energy	170kJ/mol	115kJ/mol

*Reaction becomes easier when the activation energy is lower.

→ Tantalum is more readily bound to oxygen (O₂), and burns at lower temperatures than aluminum.



Manganese dioxide

MnO₂
 Example of the oxygen release reaction of manganese dioxide



→ Manganese dioxide releases oxygen to cause combustion.

Aluminum is more difficult to bind with oxygen than tantalum, and the specialty polymer will release less oxygen than manganese dioxide.
 As a result, the SP-Cap is more difficult to "smoke" and ignite than a tantalum capacitor.



Reliability

The Specialty Polymer Aluminum Electrolytic Capacitor (SP-Cap) is more difficult to short-circuit than a tantalum capacitor.

Reliability test

Capacitors were tested for possible short-circuiting or burnout when voltage is applied in a high temperature environment.

- Test conditions

Test temperature : 85 to 145°C

Applied voltage : Rated voltage (W.V.) x (0.8 to 1.25)

Test time : 1,000 hours (without protective resistance)

Quantity of specimens: n = 20 for each condition

- Test results

The number of capacitors short-circuited or burned out are shown below.

Specialty polymer aluminum electrolytic capacitor 6.3V 47μF(7.3 x 4.3 x 1.8)

	0.8 x W.V.	W.V.	1.1 x W.V.	1.25 x W.V.
85°C	0	0	0	0
105°C	0	0	0	0
125°C	0	0	0	0
145°C	0	0	0	0

During the test, short-circuits did not occur under any of the conditions.

Tantalum capacitor 6.3V 220μF(7.3 x 4.3 x 2.8)

	0.8 x W.V.	W.V.	1.1 x W.V.	1.25 x W.V.
85°C	0	0	0	0
105°C	0	0	0	1
125°C	0	0	0	3
145°C	1	0	0	0

The short-circuited products were all burned out.

Normally, when the atmospheric temperature and voltage become higher, a product tends to short-circuit.

Predicted failure rate of SP-Cap*

- As a result of our reliability test, the following data were obtained.

Failure rate resulting from the temperature accelerated test: **46 FIT or less** (Predicted failure rate when the temperature is 105°C and the rated voltage is applied)

- Predicted market failure rate: **0.13 FIT or less** (c = 0, predicted failure rate when reliability level is 60%)

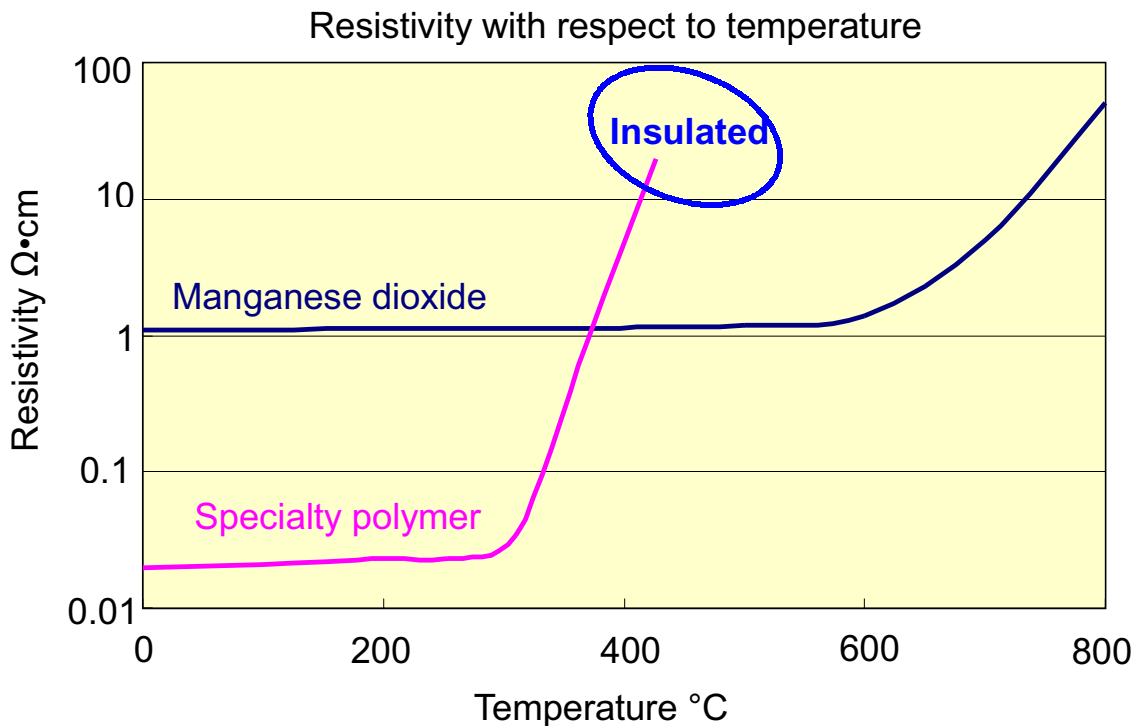
*This failure rate is for reference only. Actual failure rates may vary in actual applications.



The SP Cap is difficult to short-circuit

The specialty polymer is a substance (electrolyte) whose resistance rises with temperature.

When a defect occurs in the dielectric, the joule heat of the current flowing through the defect raises the resistance of the polymer to the point that it becomes self-insulating and shuts off the current flow.



The specialty polymer insulates itself at a lower temperature compared with manganese dioxide. As a result, SP-AI is more difficult to short-circuit than a tantalum capacitor.