August 2013

NIC Components Corp.

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FLAMMABILITY CHARACTERISTICS

Products: Aluminum Electrolytic Capacitors
Type: Liquid Electrolyte Construction
Series: Radial, Snap-In, Screw Terminal and Surface Mount (V-Chip)

SUMMARY: The following guideline covers flammable characteristics of materials used in liquid electrolyte construction aluminum electrolytic capacitors. Examples of needle flame testing (on samples of surface mount V-chip version components) and component self ignition is also provided.

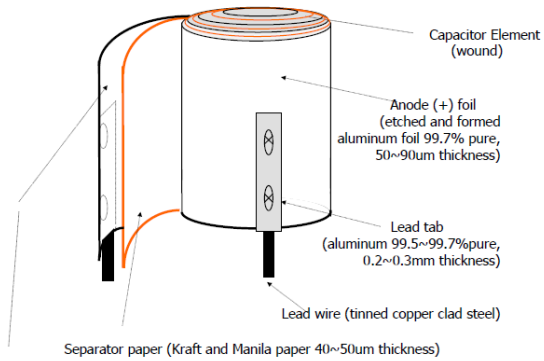
FLAMMABILITY OF COMPONENT:

Liquid electrolyte construction aluminum electrolytic capacitors are an assembly of several flammable materials:

- Organic electrolyte liquid system
- End seal rubber
- Separator paper
- Scotch tape
- Insulation sleeve (typically PET) on radial leaded versions
- Base plate (typically PPS) on surface mount V-chip versions

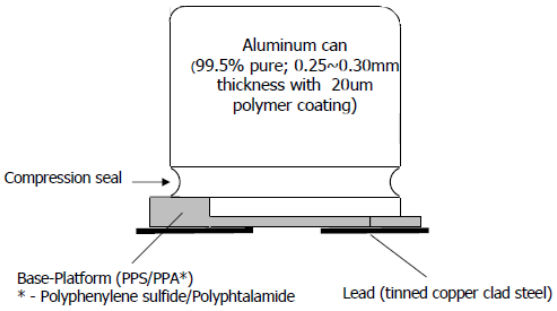
And also inflammable materials; aluminum foil, aluminum can case and lead wires

Internal Construction



Separator paper (Kraft and Manila paper 40~50um thickness)

Cathode foil (etched aluminum foil 99.7%pure, 30~50um thickness)



Not shown:

Electrolyte (Main Solvent): γ - Butyrolactone (GBL) & Ethylene Glycol (EG)

End Seal Material: Ethylene Propylene Tarpolymer (EPT)
Isobutylene Isoprene Rubber (IIR)

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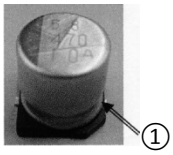
FLAME TEST (COMPONENT):

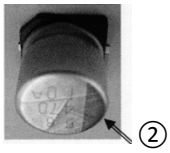
In a needle flame test* (flaming 120 second) according to IEC60695-2-2 (JIS C-60695 2-2 ,2000), capacitor may eject gas radically at the top of the capacitor and sustains flaming during contact with needle flame burner, but ceases flaming after removal of the burner. Judgment by criterion defined in chapter 10, the capacitor is compliant with IEC695-2-2 (JIS C-60695 2-2, 2000)

Needle flame ignition test and result:

- Capacitor sample: PN: NSPE-S471M10V10x10.8F
- Test method: IEC695-2-2 (JIS C-60695 2-2 ,2000)
- Flaming : 120 second with 12mm length flame
- Vertical test: Flame contact position ① & ②
- Number of tested sample: n=3 for each ① & ②

** - Needle Flame Test*
Insulation and combustible materials used inside electronic products may propagate flames when a failed component ignites. The Needle Flame Test is used to assess the fire hazard of such component materials. The test is performed to determine that the test flame does not cause ignition of parts, or that a combustible part ignited by the test flame has a limited duration of burning or a limited extent of burning, without spreading fire by flames or burning or glowing particles falling from the test specimen





(Test Result) Flame contact

Sample Part Number	Flame contact position	Compliance with IEC60695-2-2
NSPE-S471M10V 10x10.8F	①	Compliance
	②	Compliance

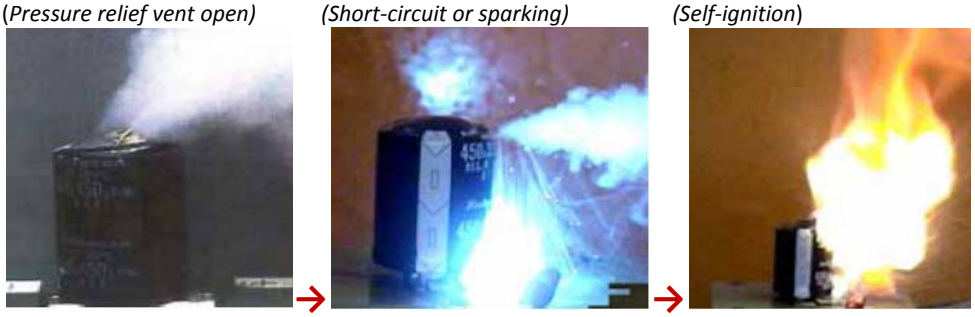
FINDINGS:

- In both flame contact positions, the capacitors ejected gas from the can top vent valve after flame contact, ~90 seconds for position ① and ~60 seconds for position ② and gas ejection continued for 10 seconds after removal of the flame. The ejected gas caught fire only when contacted with the flame. The capacitor samples did not burn by its self, and no glowing particles fell from the test specimens.

SELF IGNITION:

In rare cases, the liquid electrolyte construction aluminum electrolytic capacitor can ignite by itself, under heavy electrical over-load, due to rapid reaction & heat rise accompanied by hydrogen gas generation and electrical spark. Below photos show one typical process to self-ignition of an input filtering snap-in capacitor subjected to over-voltage caused by wrong regulation of AC line voltage.

(*Pressure relief vent open)* (*Short-circuit or sparking)* (*Self-ignition*)



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FLAMMABILITY OF LIQUID ELECTROLYTE MATERIALS:

- Organic liquid electrolytes - the most commonly used solvents are based on Gamma-butyrolactone (GBL) and Ethylene glycol (EG), and are composed of C (carbon), H (hydrogen) and O (oxygen) which are substances easy to ignite. The flammability characteristics are shown in the following table:

	γ-butyrolactone (GBL)	*Ethylene glycol (EG)*
Boiling point °C	*204°*	*197.85°*
Flash point °C	*98°*	*111.1°*
Ignition point °C	*455°*	*398°*

FLAMMABILITY OF POLYMER MATERIALS:

Aluminum electrolytic capacitors will typically contain one or more of the following polymers** that can be characterized concerning their flammability characteristics.

- Rubber end seal (bung) - used on both leaded and surface mount component styles, typically produced from ethylene-propylene terpolymer rubber (EPT) is a compound material of synthetic rubber, isobutylene-isoprene rubber loading more than 10% of carbon black as a reinforcing filler and some percentage of zinc oxide and may include inorganic fillers such as talc, calcium carbonate, silica. The end seal mass is 0.5 ~115 grams (dependent on component package size), its polymer content is 100% and its oxygen index is 19%. Basically the end seal rubber does not contain flame retardant additives, is easy to ignite, and has not been tested to UL-94

- Polyethylene terephthalate (PET) insulation sleeve is commonly used on radial leaded construction components. Standard heat shrink PET tubing is not fire resistant, but is a relatively fire retarding material, with flame retardancy of 25% oxygen index. PET sleeve is not qualified by UL flammability test standard.

- PVC sleeve & top plate used on Snap-in or Screw Terminal version aluminum electrolytic capacitors
  - PVC sleeve is qualified by UL testing as UL224 VW-1
  - PVC top plate is qualified as UL 94 V-0

- Surface mount V-chip style components parts have standoff base-plate meeting UL 94V-0 requirements:
  PPS (*UL yellow card supplied by Dainippon Ink ^& Chemical Inc.)*
  PPA (*UL yellow card supplied by Amoco Polymers Inc.)*

** - Flammability testing, such as the Japanese test (JIS C0061-1985 Fire Hazard Testing Part 2: Needle Flame Test) or UL94 (Tests for flammability of plastic materials), covers the flammability characteristics of components containing polymers.

If you have any questions, or need any further information, please do not hesitate to contact NIC's Technical Product Marketing Group at tpmg@niccomp.com