

To: NEPAG

Date: May 23, 2001

From: Jay Brusse/QSS Group, Inc.

Subject: **Survey of MIL Ceramic Chip Capacitor Manufacturers Regarding Termination Finishes**

I conducted an informal survey to clarify the termination finishes commonly supplied by the various manufacturers of multilayer ceramic chip capacitors. The MIL specs for these capacitors (MIL-PRF-55681 and MIL-PRF-123) specify several different termination finish options intended for different user applications. **In fact, these two specifications are among the few MIL specs I know that still allow for an optional PURE TIN plated termination.** Some of the termination finishes are intended for solder mounting others are for conductive epoxy or wire bonding applications. This **survey focused solely on the solderable type terminations** because the existing termination finish definitions are very loosely defined and can be the source of great confusion amongst the user community. It must be noted that this survey was limited to the primary suppliers of MIL ceramic chip capacitors. In the interest of time, the commercial supplier base for ceramic chip capacitors was NOT surveyed.

As can be seen from the survey results, the "non-specific" MIL specification requirements can lead to a large variation in the termination finishes provided by various suppliers for a given designation. In fact, one manufacturer (AVX) even supplies dramatically different termination finishes for Type W depending on which capacitor style you order.

The survey was actually initiated because of photos recently provided to NASA Goddard by a European user who observed **tin whiskers growing on ceramic chip capacitor terminations plated with pure tin.** Photos are provided on the following pages for reference. **Because of the general acceptance that a tin/lead finish is highly resistant to tin whiskers, it becomes important for users to fully understand what they are ordering/receiving from their suppliers.** To help clarify this confusion, a telephone survey was performed of the following 5 QPL manufacturers for MIL-PRF-55681 style chip capacitors.

AVX (Myrtle Beach, SC)	Bob Schmitt / Quality Manager
Kemet (Simpsonville, SC)	Sandy Campbell / Assoc. Product Assurance Manager Ceramics Dick Thompson / Product Assurance Manager Ceramics
Vitramon (Bridgeport, CT)	Stu Gillespie / Quality Manager
Presidio (San Diego, CA)	Christine Pollock / Quality Manager
ATC (Huntington Station, NY)	Harrison Tarver / Quality Manager

### Comparison of Solderable Termination Finishes for Hi-Rel Multilayer Ceramic Chip Capacitors

Termination Finish (Designation Per M55681)	AVX	Kemet	Vitramon	Presidio	ATC
<b>Z</b> Base metallization barrier metal tinned (tin/lead alloy with min. 4% lead)	60/40 Sn/Pb	N/A	N/A	90/10 Sn/Pb	N/A
<b>Y</b> Base metallization barrier metal-tin (100% tin)	100% Sn	100% Sn	100% Sn	N/A	N/A
<b>W</b> Base metallization barrier metal tinned (tin OR tin/lead alloy)	60/40 Sn/Pb for CDR11 - CDR14  100% Sn for CDR01 - CDR06 CDR31 - CDR35	100% Sn	100% Sn	90/10 Sn/Pb	Sn62
<b>S</b> Solder coated final	60/40 Sn/Pb	60/40 Sn/Pb	N/A	60/40 Sn/Pb	Sn62
<b>U</b> Base metallization barrier metal solder coated	60/40 Sn/Pb	60/40 Sn/Pb	N/A	60/40 Sn/Pb	Sn62
<b>Commercial</b> (General Offerings/ Some Customer Specific Finishes May Be Available but are not included Herein)	100% Sn	100% Sn	100% Sn	Typically 90/10	Typically Sn62 or 90/10 Sn/Pb 100% Sn Series 600 100% Sn Series 650

**Notes:**

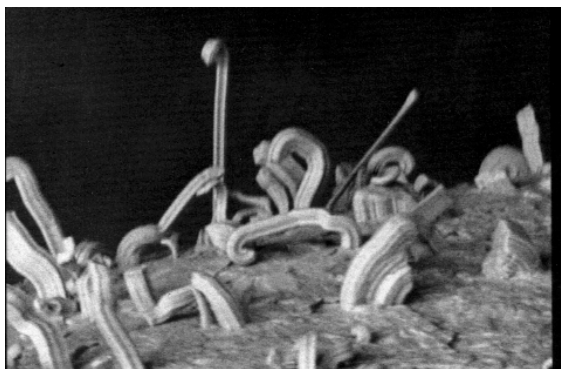
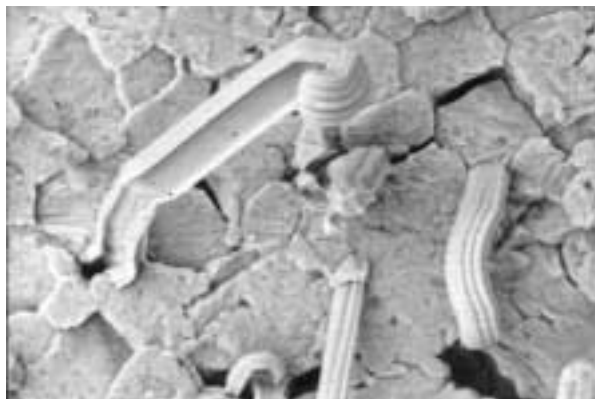
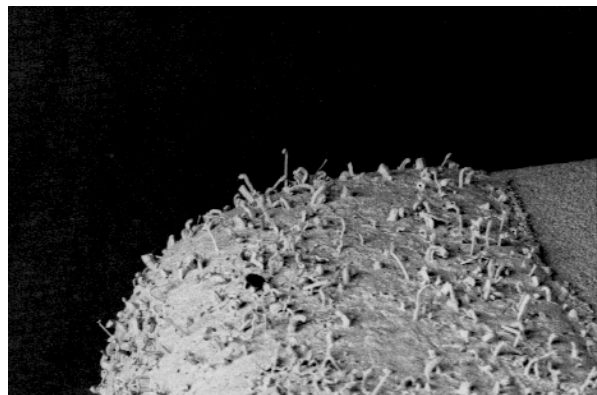
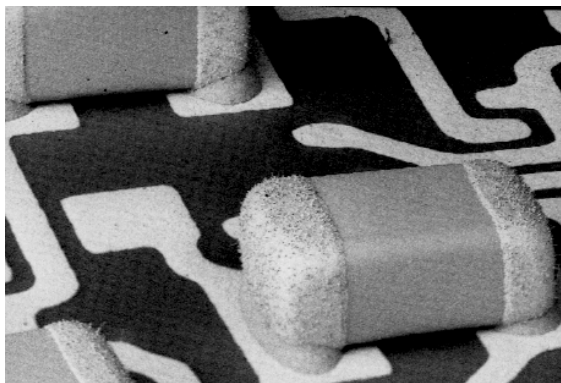
1. The above table was compiled through telephone survey of the listed manufacturers from May 18 - May 22, 2001.
2. The purpose of this table is to highlight the differences in "solderable" (Sn and or Sn/Pb style) termination finishes offered by the competing Military (Hi-Rel) ceramic chip capacitor manufacturers.
3. Other termination finishes such as Pd/Ag, Au, Ag may be offered by these suppliers but are not listed herein because these finishes are not considered to be relevant to concerns with tin whisker formation.

*(Compiled by Jay Brusse/QSS Group, Inc. May 2001)*

## Photos of Ceramic Chip Capacitors w/ Pure Tin Plated Terminations showing Formation of Tin Whiskers

Extensive details of this application were not available at the time this memo was drafted. What is known is as follows:

- Capacitors use pure tin plated terminations
- Parts are installed in hybrids using a conductive epoxy
- User is aware that epoxy mounting of solderable contacts is not a preferred practice, but opted to use this technique based on data provided to them that suggested it could be done reliably.
- *User actually ordered parts with Pd/Ag terminations but mistakenly received parts with pure tin terminations. Root cause of this logistical mistake not yet known*
- User is non-NASA affiliated
- No data yet available regarding part number, date code, manufacturer name, conditions/time that grew these whiskers, observed failures, etc. However, there is extensive research available that generally speaking shows tin whiskers can grow to be several millimeters long and can induce short circuits. NASA Advisory (NA-044 and NA-044A) provide basic info about tin whiskers



Photos provided by European user circa May 2001

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