

ENGINEERING PRACTICE STUDY

TITLE: THE USE OF PURE TIN FINISHES IN MIL-PRF-39019
AND MIL-PRF-55629 CIRCUIT BREAKERS.

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FINAL REPORT

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I. OBJECTIVE

To determine if allowing the continued use of pure tin finishes in the manufacture of MIL-PRF-39019 and MIL-PRF-55629 circuit breakers poses a significant risk to component failure.

II. BACKGROUND

In recent years there has been a renewed interest in and concern about electronic component failures due to tin whisker growth caused by pure tin finishes. Because of this renewed interest, there is concern that our sole Qualified Parts List (QPL) manufacturer, Airpax Power Protection Products, uses pure tin finishes and intends to continue using pure tin finishes in the construction of these breakers. For the MIL-PRF-39019 breakers, the coil frame is tin plated, the braid is tin plated, and the headers are electro tinned. The MIL-PRF-55629 product has tin plated terminals and frames. Also, most have tin plated nuts and washers.

The QPL supplier is a leading manufacturer of magnetic-hydraulic circuit breakers who has provided circuit breakers for over 30 years. This manufacturer is aware of the potential risks associated with the use of pure tin finishes on electronic components and assemblies, and they take steps to mitigate these risks. They use a variety of tin finishes such as hot oil flowed Sn and matte acid Sn. These tin finishes are less likely to cause the formation of whiskers than are small organic bright tin baths which they do not use. The manufacturer also maintains that their circuit breakers are used in higher voltage and higher current circuits where any possible whisker growth would be quickly burnt out and not pose as serious a threat as in low power circuits. Also, they say the conductor spacing inherent in circuit breakers physically mitigates the impact of whiskers. Finally, they state that no incidents of whisker growth have occurred on magnetic-hydraulic circuit breakers.

An EP study was initiated by DSCC-VAT on November 15, 2007. We began a government and industry fact finding effort by distributing an electronic (email) request for definitive information on any past or present use of these circuit breakers. We wanted to determine if anyone had experience in using these breakers, what specific applications were involved, and if they had recorded evidence of known breaker failures due to tin whisker growth. We asked that all respondents be definitive in discussing their involvement with these QPL breakers and that they include any supporting data available.

Our request for information was distributed electronically to individuals on the DSCC military and industrial document distribution lists and to members of both the NEPAG and Government Electronics and Information Association (GEIA) user groups.

III. RESULTS

Industry feedback:

Only one company (Goodrich Power Systems), of the dozens solicited for comment, stated they had an application of an Airpax circuit breaker (MIL-PRF-39019). This breaker is used in a civil, fixed-wing aircraft and there have been no reported failures to date.

Military feedback:

1. US Army Communications - Electronics Life Cycle Management Command (Army-CR) stated they see no reason to prohibit the use of pure tin since pure tin has been used on these circuit breakers for many years.

2. US Air Force Aeronautical Systems Center (AF-11) said their experience with these circuit breakers has been in working deficiency reports, item reduction studies, DLA requests for engineering assistance, and specification revision reviews. The applications for these devices are in ground equipment or test equipment. In a few cases these circuit breakers are used directly on an aircraft. Their research in the current deficiency report (DR) data base, dating back to 2004, found no reports. Their research in the historical deficiency report data base found seven reports dating back to 1989. None of the seven reported failures were attributed to tin whiskers. The failures were mechanical failures, incorrect construction, or receipt of incorrect item. AF-11 stated it is their opinion that tin whiskers, although an acknowledged issue, is not a problem with these Mil-Spec circuit breakers or their commercial derivatives.

IV. CONCLUSIONS

There was nothing found to indicate that the use of pure tin finishes in the manufacture of MIL-PRF-39019 and MIL-PRF-55629 circuit breakers have resulted in any failures in military or civil applications that can be attributed to tin whiskers. It would seem that Airpax Power Protection Products are correct in their assertions.

V. RECOMMENDATIONS

It is recommended that no pure tin prohibitions be included in military specifications MIL-PRF-39019 and MIL-PRF-55629. However, notes should be added to indicate that the use of pure tin finishes has the potential to promote the formation and growth of tin whiskers.