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**SPECIAL AIRCRAFT SEALANTS MAY OFFER
IMPROVED PROTECTION AGAINST CORROSION,
FIRE, AND ELECTROMAGNETIC INTERFERENCE**

For Immediate Release

January 5, 1990

Color & B/W Available

Georgia Tech researchers and the U.S. Air Force are now field testing two conductive aircraft sealants designed to fight metal corrosion, electromagnetic interference, and fire hazard.

Whenever two aircraft parts are joined together, water can be trapped within the seal, and this causes corrosion that weakens the structure. At the same time, an improper seal may permit stray electromagnetic signals to enter the plane, interfering with communications and compromising security. Metal joints can also pose a fire hazard by interrupting electrical conductivity across the plane's surface.

In an effort to remedy these problems, researchers at the Georgia Institute of Technology have established guidelines for producing conductive sealants that are galvanically adjusted to fight corrosion on aluminum substrates. They have also identified two materials that demonstrated superior protection during laboratory tests.

These promising materials -- silver-coated aluminum and aluminum/nickel fillers in a two-part, "powder in plastic" urethane matrix -- are now being subjected to field performance tests coordinated by the U.S. Air Force. Researchers also expect to evaluate the sealants using Navy aircraft.

"The typical aircraft needs to be conductive because of the danger of lightning striking," said Dr. Jan W. Gooch, senior research scientist at Georgia Tech. "The aircraft must conduct along its entire surface in order to dissipate the charge. Otherwise, heat would build up and cause a fire."

Gooch believes the galvanic, or oxidation-reduction potential of conductive sealants is the key to producing high-performance materials. Silver-coated aluminum and aluminum/nickel fillers may have performed well in the laboratory because they offer a galvanic potential similar to the aluminum substrates used, he said.

"We are advocating the use of a two-part material with no volatiles," Gooch said. "In other words, 100 percent solids -- two materials that you mix together using a conductive component that produces the same galvanic potential."

Gooch and Project Co-Director John Daher recently described their research during the Corrosion '89 conference sponsored by the National Association of Corrosion Engineers.

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Any gap in the metal structure can allow electricity to penetrate aircraft joints, which jeopardizes electronic systems inside the plane. If arcing occurs, Daher explained, this can pose a fire hazard. Maintaining electrical continuity across metal joints also helps protect internal avionics systems from the damaging effects of electromagnetic waves produced by nuclear explosions. Similarly, conductive sealants shield the plane from stray electromagnetic signals issued by sources such as broadcast towers or enemy aircraft.

Sponsored by the U.S. Air Force, the research project addressed two related issues. First, Daher and Gooch researched the validity of a military specification requiring aircraft sealants to be highly conductive, with less than 2.5 milliohms of electrical resistance. They also sought to identify optimum materials for low-resistance sealants.

The researchers found that the 2.5 milliohms requirement was originally established for practical reasons, because military contractors can easily test for low bond resistance, whereas more valid performance indicators -- like electromagnetic shielding effectiveness -- may be difficult to evaluate. The low-resistance specification forces aircraft manufacturers to take great care in bonding joints properly, Daher said, and this helps in achieving high-performance bonds, including protect from electromagnetic pulse/electromagnetic interference (EMP/EMI).

Unfortunately, the only approved method for producing low-resistance materials (chromate conversion coating) can allow moisture to be trapped between metal surfaces, Gooch said. So the Georgia Tech team set out to determine the validity of the 2.5 milliohms requirement, and they also wanted to identify high-performance materials. To achieve this, they established a correlation between electrical resistance, corrosion protection, and electromagnetic shielding.

Various specially-selected sealant materials were applied to four metal test joints. As a control, no sealant was applied to a fifth joint. A Kelvin bridge milliohmmeter was used to measure dc resistance, and the joints were subjected to electromagnetic signals to determine shielding effectiveness. Corrosion tests were performed in a salt fog chamber. Silver-coated aluminum and aluminum/nickel fillers showed little or no signs of corrosion after 1,000 hours in the salt fog, and they demonstrated protection from EMP/EMI. Since aluminum fillers corroded rapidly, this material is not recommended.

Research demonstrated no direct correlation between dc resistance and shielding effectiveness of metal bonds. However, findings supported the validity of the 2.5 milliohms resistance requirement in that well-constructed bonds having resistances less than or equal to 2.5 milliohms tended to provide a high degree of protection from electromagnetic fields.

Field tests were arranged through Tinker Air Force Base in Oklahoma City. In November, joints on an E-3 AWACS aircraft were coated with the sealants, and baseline data was recorded. Following a one-year test period at Kadena AFB in Okinawa, the plane will be re-evaluated.

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