

Next Generation Aircraft Wiring Insulation

Tiburon Associates, Inc.

4027 Colonel Glenn Highway, Suite 110
Beavercreek, OH, 45431

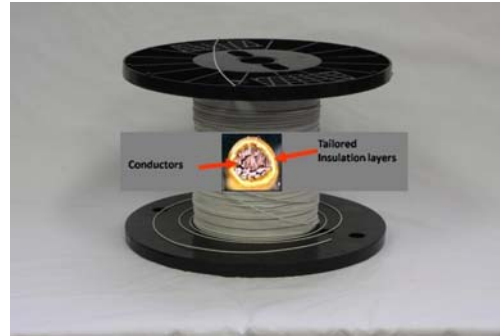
Mr. Joseph D'Angelo

Phone: (937) 458-0470

Fax: (937) 458-0399

Email: jjd@tiburonassociates.com

Website: <http://www.tiburonassociates.com/>



Command: NAVAIR

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PROBLEM STATEMENT

Aircraft wire insulation is susceptible to damage resulting from aging and prolonged exposure to extreme environmental and operating conditions. As a result, aircraft wire is more prone to physical and chemical degradation which ultimately results in wire failures. Wire failure is a significant safety concern that adds both tangible and intangible costs to Navy fleet life cycle costs including delayed/failed missions and unnecessary removal and troubleshooting of functional equipment. A stronger insulation is necessary for improved safety and reduced costs of Navy fleets. Tiburon's technology addresses the Navy's need for Next Generation Wire Insulation. Advancing the current wire insulation will lead to reduced maintenance, fewer safety hazards and an increased overall life of aircraft wiring. Tiburon's solution also presents additional benefits including weight reduction, reduced hydrolysis and significantly reduced potential for arc tracking.

WHO CAN BENEFIT?

All aircraft systems can benefit from improved wiring performance and extended lifetime. The technology applications include the Air Force and other Navy fixed wing systems and all rotary aircraft systems. Organizations such as the Joint Services Action Wiring Group [JSWAG], the Aircraft Wiring Support Equipment Commodity (AWSEC) at NAVAIR, the V-22 Integrated Product Team, and organizations responsible for aging aircraft should find this endeavor to be of value. The commercial market is also a potential area for application pending specific modifications. An additional high volume market for an extruded interconnect product is flexible cables used in the automotive industry.

BASELINE TECHNOLOGY

Current wire construction technology was first introduced in 1991 and although there have been some improvements; there has been no significant advancements in performance. The current composite insulation technology is based on a tape wrapped construction consisting of one layer of fluoropolymer-polyimide-fluoropolymer and a second layer of polytetrafluoroethylene (PTFE). This construction is commonly referred to as TKT (Teflon-Kapton-Teflon). The primary wire insulation characteristics of this construction are similar to those of aromatic polyimides. H film aromatic polyimide (Dupont™ Kapton®) has well documented issues with hydrolysis, which result in the breakdown of material leading to cracking of the insulation and arc tracking. During the lifetime of an aircraft, polyimide (i.e. Kapton®) and other types of aircraft wire insulation can become damaged by abrasion, hydrolysis, fatigue, chemical reaction and their combination. In comparison to other polymers used as insulation, polyimides are especially susceptible to damage by hydrolysis reactions.

TECHNOLOGY DESCRIPTION

Tiburon is currently working to optimize their insulation formulation to improve resistance to hydrolysis, abrasion, and chemicals. During Phase I the developed insulation candidates met or exceeded Navy requirements and current shortcomings of wire insulation in film formation. Phase II research continues to validate wire insulation formulations with on-wire testing. Tiburon's technology provides reduced arc tracking and weight, decreased toxic hazards, increase abrasion and hydrolysis resistance. Tiburon's solution is based on existing composite wire made out of Teflon and polyimide coatings. Tiburon's insulation formulation is a polyimide base with specific concentrations of additives for performance enhancement.

Feature	Advantage	Benefit
Abrasion Resistance	Less susceptible to chafing	Longer lifetime
Hydrolysis Resistance	Survive in high moisture wet environments	Reduced failure due to wire cracking
Low flammability	Reduced incidence of catastrophe	Operator Safety
Reduced toxicity	Reduced incidence of toxic inhalation	Operator Safety

CURRENT STATE OF DEVELOPMENT

To date Tiburon's technology has reached a Technology Readiness Level (TRL) of 5. We have refined our insulation formulation and are currently working on defining the coating process and insulation layers. A wire construction which fits the family of AS22759 type wire is targeted to be the first product resulting from this Small Business

Innovation Research (SBIR) project. The current status is a layered construction meeting the electrical properties with improved flame, hydrolysis and abrasion resistance. Work is continuing to finalize the construction and make prototype wire with an appropriate top coat.

MILESTONES	TRL	RISK	Measure of success	Date
Define coating process and insulation	5	Moderate	Define insulation layers and adhesion between layers	December 2009
Complete risk reduction plan and implementation	5	Moderate	Continuous updating of risk reduction plan and implementation, reduce cracking, successful adherence	January 2010
Second Prototype Wire Construction	5	Moderate	Successful run at Nexans plant, wire available for testing	Feb-March 2010
Final Phase II Option testing and Evaluation	5	Moderate	Testing of wire from prototype runs and any additional lab runs; successful pass testing of AS22759	April – May 2010

Our intent is to work with the V-22 program office and prepare samples for qualification testing that would make it a candidate for the Qualified Products List (QPL). We are interested in working closely with prime contractors that could benefit from next generation wiring with these properties.

REFERENCES

The Federal Aviation Administration (FAA) has evaluated Tiburon's self healing wire coated with the modified polyimide resulting from this SBIR (Michael.Walz@faa.gov). The preliminary test results were very positive for flammability tests. The Air Force Research Laboratory (AFRL) has tested the preprototype wire produced during this SBIR with passing results for a battery of AS74373 electrical tests. More details can be provided upon request.

ABOUT THE COMPANY

Tiburon Associates, Inc. is a small business with multiple Department of Defense (DoD) contracts and subcontracts. It provides professional services to ManTech offices, Title III and Aircraft Battle Damage Repair (ABDR) Offices. Tiburon also provides engineers, technicians and hourly personnel to Army and Marine depots and maintenance

organizations. Tiburon personnel have experience in aircraft electrical wiring systems and demonstrated expertise in synthesizing new polymer materials, as well as experience in transitioning technologies. This presents the aerospace communities with the opportunity to obtain durable, reliable, and environmentally compliant next generation aircraft wiring insulation materials. Tiburon was established in 2001 and has over 300 technical and professional staff at nine locations.