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Flammability Evaluations Of Reinforced, Conductive Airframe Seals

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1 INTRODUCTION

The recent trend toward increased use of electronic control systems (`fly-by-wire"), and composite structures in aircraft designs, and the proliferation of high intensity radio frequency energy sources, has created a need for more effective RF shielding systems for commercial aircraft.

The U.S. Federal Aviation Administration (FAA) and European Joint Aviation Authority (JAA) are in the process of developing regulations concerning High Intensity Radiated Fields (HIRF) protection. Interim certification requirements reflect the growing concern of HIRF hazards to fly-by-wire aircraft.

One approach to reducing the susceptibility of on-board electronics is the creation of shielded zones through conductive termination of the existing metal airframe structure. This can be accomplished by replacing conventional nonconductive reinforced silicone and fluorosilicone airframe seals with conductive equivalents. Some applications demand a fireproof or fire resistant, reinforced, conductive seal. In other cases, the seal must survive the effects of a lightning strike.

This document reports the results of flammability tests performed using the guidelines of FAA Advisory Circular (AC) 20-135, on several different airframe seal configurations of reinforced conductive elastomers. The tests were conducted in an effort to develop and characterize reinforced conductive seal designs which will meet industry needs.

The tests were performed on February and 12, 1992 at The Govmark Organization, In Bellmore, New York. Each test was observed FAA witness John Varga, DER #ANE-393.

<u>Test Requirements</u>

The aircraft industry's definition of fireproof is: 'The capability of a material or component to withstand, as well as or better t; steel, a 2001p F flame ± 150' F (1093° C, ±66° C) 15 minutes minimum, while still fulfilling its des purposes." The term "fireproof , when applied materials and parts used to confine fires within designated fire zones, means that the material part will perform this function under condition: likely to occur in such zones and will withstand, 2000° F flame (1093° C) for 15 minutes minimum.

The pass criteria for these conductive seals, when tested under normal static load conditions, requires that the seal shall not allOW flame passage, and shall not exhibit any bum through of the flame nor any back-side burning

The pass criteria does not require that gasket maintain its pretest mechanical or elec performance following completion of the bum

2 SEAL CONSTRUCTIONS

Flammability evaluations were perform on six variations of an "omega" shaped cross section and five variations of a "P' shaped configuration. One of the omega shaped seals a non-conductive control sample. All conduc seals were provided by Chomerics, Inc. Each slightly different in construction.

Seal Materials

Figures 1 and 2 detail the sample cross sections and their multi-layered designs. The following materials were used in their construction:

CHO-SEAL® 1215 conductive elastomer, with a silicone binder and silver-plated-copper filler particles.

CHO-SEAL® * 1285 conductive elastomer, with a silicone binder and silver-plated- aluminum filler particles.

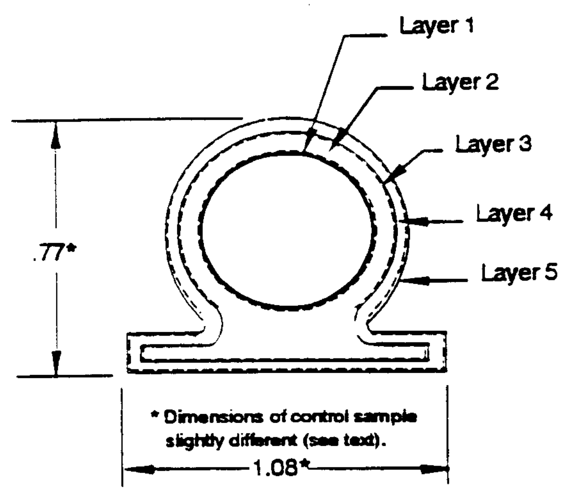
CHO-SEAL® 1298 conductive elastomer, with a fluorosilicone binder and specially processed silver-plated-aluminum filler particles for maximum corrosion resistance.

Ferrex® * wire a tin-plated, copper-clad steel wire (4.5 mil dia.). Knitted wire density is 10-18 OPI.

HTR is a high temperature resistant rubber (silicone and fluorosilicone).

MO is a metal oxide ceramic filler.
AF is an aramid fiber which provides excellent heat resistance and dimensional stability.
N.C. is non-conductive silicone or fluorosilicone.

The control specimen was a conventional nonconductive firewall seal, produced by Rohr. Its silicone rubber binder is chemically treated for improved high temperature resistance. Close to the



Sample	Layer 1	Layer 2	Layer 3	Layer 4	Layer :
A	MO	HTR	MO	1215	Ferrex
B	MO	HTR	MO	1285	Ferrex
C	MO	HTR	MO	1298	Ferrex
D	MO	HTR	MO	1215	AF
E	MO	HTR	MO	1285	AF
F	MO	HTR	MO	1298	AF
G	(non-conductive control sample)				

Figure 1
Omega Cross Section Samples

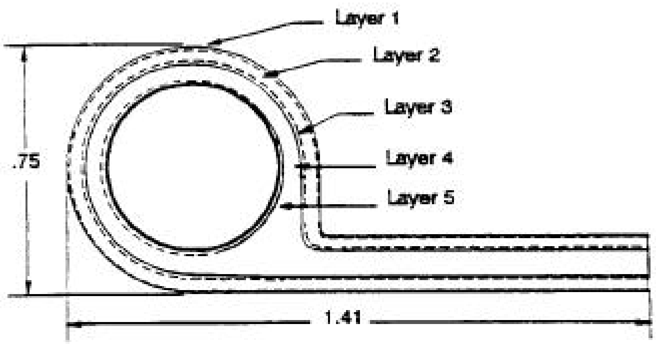
external surface of the seal are two layers of an open weave aramid fiber material. Just beneath the aramid fiber layers is a single layer of a met oxide ceramic filer. There is no inner core wrap this filler. The seal is omega-shaped, with a .62 dia bulb, foot mounted with an overall height of .750'. (Note: Back pressure in the test future
much less than the conductive seal designs.)

3 TEST SETUP AND PROCEDURE

Test Setup

The tests were performed at The Govn Organization, Inc. in Bellmore, New York using guidelines of FAA document AC 20-135.

CHO-SEAL® and Ferrex® are registered tradenames of Chomerics, div. of Parker Hannifn Corp.



Version	Layer 1	Layer 2	Layer 3	Layer 4	Layer 5
A	Ferrex +	1215	MO	N.C.	None
A1*	Ferrex +	1215	MO	N.C.	None
B	Ferrex +	1215	MO	N.C.	MO
D	Ferrex +	1215	MO	1215	None
E	Ferrex +	1215	MO	N.C.	AF
G	Ferrex +	N.C.	MO	N.C.	None

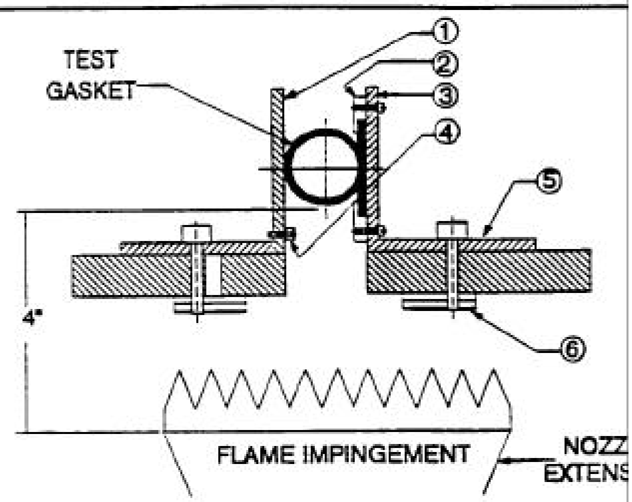
+ 10 OPI Wire Mesh
N.C. - Non-Conductive silicone or fluorosilicone
* Spliced with inner wrap of Nextel

Figure 2
"P" Cross Section Samples

Figure 3 is a cross-sectional view of the test setup, with the seal in an undeflected state. For consistency, each specimen was placed in the fixture under the normal static load condition of 33% deflection. The flame baffle shown in Figure 3 was in place during the tests of omega samples A, B, and C, but was removed for the remaining tests.

<u>Test Procedure</u>

Prior to the start of each test, the flame temperature and heat flux density were measured to ensure proper flame characteristics. Each specimen was exposed to a flame temperature of approximately 2000P F (1093° C) and a minimum heat flux density of 9.3 BTU/ft2-sec. Actual heat flux densities measurements are reported in Tables 1 and 2. A set of thermocouples (thermocouple rake) was positioned at the exact distance (4') the mouth of the burner extension cone as the mounted test specimen.



① Angle Left - Stainless Steel
2" x 2" x 1/8" x 12" long

② Clamp - Stainless Steel
1/2" x 1/8" x 12" long

③ Angle Right - Stainless Steel
2" x 2" x 1/8" x 12" long

④ Baffle (Thick) - Stainless Steel
1/4" x 3/16" x 12" long
Baffle (Thin) - Stainless Steel
1/4" x 1/8" x 12" long

⑤ Plate (Baffle) - Bansboard
25.5" x 14.5" x 1/2" thick

⑥ Plate (Doubler) - Stainless Steel
3/16" x 1" x 12" long

Figure 3
Test Setup

The burner was lit and allowed to warm for a five minute period. The oil burner mouth then rotated directly to the front of the test fixture maintaining the same distance as the thermocouple rake (used in the initial calibration During each test, a thermocouple was fed down

As noted in section 3, three samples were tested with a flame baffle in place. It did not appear that the baffle had any effect on the ability of the test seals to meet the flame test requirement.