# Abstract

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## Development of Preceramic Polymer (polysiloxane) Precursor Materials That, When Pyrolyzed, Produce a Fire-Safe Ceramic Surface

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Flexible Ceramics, Inc. has developed an advanced fire-resistant material that relates to the use of "preceramic" (Ref. 1) polymer precursor materials (polysiloxane resins) whose pyrolysis from high temperature heat sources produces a ceramic fire-safe surface.

The precursor resin blend has been formulated and processed to extend the elastic "compression/rebound" properties of polysiloxane silicone rubber from typically -40 to 300ºC (Ref. 2) performance range to retain rebound elastic capability up to 700ºC with no out-gassing from 700 to 1000ºC.

Consequently, this preceramic resin blend first produces an elastic composite precursor which can be molded into composite structures that when pyrolyzed by fire or other high temperature heat sources will produce fire safe protective ceramic on all surfaces exposed to the heat.

The precursor material is "essentially noncombustible" as evidenced by overwhelmingly passing the ASTM E-136 – 09 furnace testing (Ref. 3). The test requires that specimens remain within a Vertical Tube Furnace at 750ºC (1382ºF) for at least 30 minutes, without flaming or contributing to the furnace heat. Two Flexible Ceramics, Inc. materials were tested. one an elastomeric preceramic, the other a non-elastomeric preceramic. Both materials exceeded the testing requirements and had a 98 weight percent yield.

Fire and flammability tests that have been passed by the Flexible Ceramics, Inc. materials are summarized as follows:

ASTM E 136-09 750ºC Vertical Tube Furnace Testing
Govmark Organization Inc., Farmingdale, New York.

Aircraft Advanced Fire Resistant Materials Testing
FAA fire tests (as specified by FAR 25.853); to FAA fire penetration requirements certified by National Technical Systems.
Fire blanket burn through requirements conducted by Mexmil Company in Irvine, CA.
Smoke density and heat release requirements as specified by FAR 25.853 and Boeing BSS 7239 toxicity, testing by Test Corp, Mission Viejo, CA.

Engine Combustion Durability Testing

Advanced Fire-Safe Composite Products Being Developed
Flexible Cables

Liquid Gaskets
Honeycomb Materials
Wire Insulation Coatings
High Temperature Circuit Boards

References:
1. a. Wynne, K.J., Rice, R.W., Ann. Rev. Mater. Sci. (1984) 14, 297. b. Rice, R.W. Am Ceram. Soc. Bull. (1983) 62, 889, c. Rice, R.W. Chem. Tech. (1983) 230.

2. Sorenson, W.R. and Campbell, W. T., *Preparative Methods of Polymer Chemistry*, John Wiley & Sons (1968) p. 387.

3. ASTM International, Designation E 136-09, Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750$^{o}$C.