NASA TECH BRIEF

Goddard Space Flight Center

NASA Tech Briefs announce new technology derived from the U.S. space program. They are issued to encourage commercial application. Tech Briefs are available on a subscription basis from the National Technical Information Service, Springfield, Virginia 22151. Requests for individual copies or questions relating to the Tech Brief program may be directed to the Technology Utilization Office, NASA, Code KT, Washington, D.C. 20546.

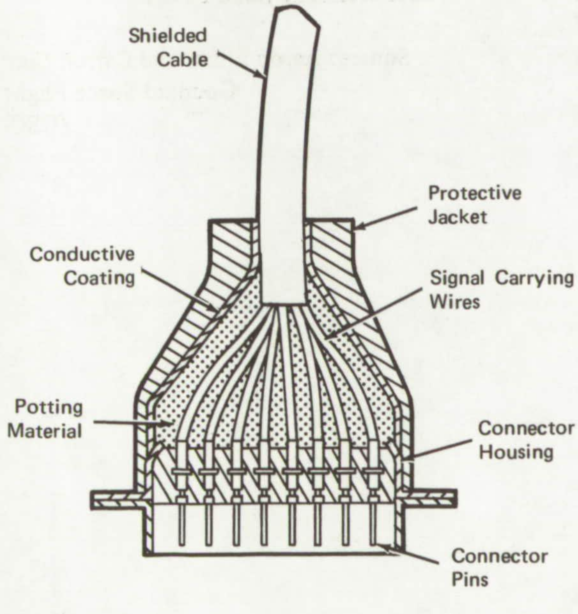
RF Shielded Connectors

The problem:

Electronic systems that operate in RF environments usually require shielded cables to protect the signal-carrying internal wires from electromagnetic RF signal interferences. Typically, these internal wires are shielded by a metal-braided conductive member along their entire length. However, in the region where this cable joins the connector housing, the shielding is terminated, creating a gap which leaves no RF protection. Various attempts to protect this gap usually result in expensive and bulky connectors.

The solution:

The gap is shielded effectively by a composite RF shielding made from a suitable potting resin material, a conductive coating, and a protective jacket (see figure).



RF Shielded Connector

How it's done:

The potting material used is a fumed silica, thixotropic prepolymer composition which is highly viscous and greaselike in consistency. Its ingredients include the following commercially available materials:

Polyester diisocyanate prepolymer	30.0 g
Polyol curing agent	21.9 g
Thixotropic agent	3.4 g
Dibutyl tin dilaurate	0.05 g
Fluorescent dye	0.05 g

The thixotropic agent for increasing resin viscosity is formed of finely-subdivided fumed silica, having a minimum purity of 99.8 percent and a particle size of 0.012 micrometers. The dibutyl tin dilaurate is a cure accelerator for the prepolymer. Finally, the fluorescent dye is an aromatic heterocyclic that requires an optical excitation source of a 365.0-nm wavelength. All of these ingredients are formulated and cured, forming a tough, flexible polyurethane material capable of fluorescing.

In application, potting material is outgassed in vacuum at 10^{-2} torr and then is inserted into a pressure gun (20-cm^3 capacity) for dispensing through a thin nozzle among the signal-carrying wires (see figure) in the gap between the shield and the connector structure. After the potting material is applied, it is inspected with an ultraviolet lamp which causes the resin to fluoresce, exposing any voids or air bubbles. These defects must be filled in before the potting material cures.

After curing, a conductive coating is applied to enclose the potted area entirely. This coating is silver-filled, flexible, polyurethane resin material that exhibits a low resistance (0.1 ohm or lower) between the cable shield and the metallic connector housing. The resin used in this coating includes the following commercial materials:

(continued overleaf)

Polyester diisocyananate prepolymer	30.0 g
Polyol curing agent	21.9 g
Dibutyl tin dilaurate	0.05 g

The final coating is composed of the following:

The above resin	3.0 g
A hydrocarbon solvent	1.5 g
Silver flakes	14-16 g

The silver flakes are at least 98 percent pure and are sized so that 90 percent will pass through a 325 mesh.

After the conductive coating is cured to a slight tackiness, the last step in the process involves the formation of the protective jacket. The flexible mold for the portective jacket is formed in a wax coated housing around another wax form having a rectangular base and contours shaped to match the desired connector configuration. A silicone room-temperature-curing elastomer is cast in the volume between the external wax coated container and the desired wax configuration, leaving the rectangular base of the connector configuration exposed. A cavity is formed when the inner wax configuration (pattern) is removed from the cured silicone elastomer. The internal silicone cavity surface is then coated by spraying it with a thin solution of acrylic-polymer barrier material which is allowed to dry. The silicone mold with approximately 0.250-inch (0.635-cm) thick walls is removed from the external supporting wax form.

The formed mold is then sliced longitudinally on one of its sides and is mounted on the metallic connector housing, the conductive coating, and part of the cable. The elastomeric mold is fitted tightly at its base to the connector housing; then the slice is made leakproof with Teflon tape; and the cable end of the mold is adjusted to be spaced uniformly around the cable. Next, a liquid resin, which later cures and becomes the protective jacket material, is injected into the mold cavity and allowed to cure. The resin composition is as follows:

Polyester diisocyanate prepolymer	30.0 g
Polyol curing agent	21.9 g
Rutile (at least 89 percent pure containing a maximum of 3 percent Al_2O_3 and a maximum of 8 percent SiO_2)	0.25 g
Dibutyl tin dilaurate	0.025 g

After the liquid resin has cured, the silicone mold is removed. The result is a tough, encapsulated permanent RF shielded structure, which can be handled, flexed, and will withstand vibration. In addition, it is radiation resistant, very low in outgassing, and can be fabricated *in situ* for emergency applications.

Note:

Requests for further information may be directed to:

Technology Utilization Officer
Goddard Space Flight Center
Code 207.1
Greenbelt, Maryland 20771
Reference: TSP73-10509

Patent status:

This invention has been patented by NASA (U.S. Patent No. 3,744,128). Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to:

Patent Counsel
Goddard Space Flight Center
Code 204
Greenbelt, Maryland 20771

Source: Aaron Fisher and Carroll Clatterbuck
Goddard Space Flight Center
(GSC-11215)