August 1974

B74-10095

NASA TECH BRIEF

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Detection of Cracks in Surface Insulation

The problem:

Surface coatings used for the protection of thermal insulators on spacecraft and other critical structures must be free from defects and irregularities. For this reason, a number of tests have been developed in which different liquids are applied to the tested surfaces. The liquids include dyes or pigments which are easily noticed when they seep through surface cracks. The problem with these liquids, however, is that they have relatively low vapor pressures at room temperature and therefore remain in cracks for a long time, drawing various contaminants below the surface coatings.

The solution:

Volatile organic liquid surface penetrants used with an appropriate detector paper leave the tested surfaces uncontaminated.

How it's done:

Surface cracks are detected with the aid of organic liquids that have room-temperature vapor pressures exceeding 1.3×10^4 N/m^2 (2 psi). One specific example of a suitable test liquid is acetaldehyde. Generally this penetrant will vaporize entirely in from 2 to 3 hours when applied to the tested surface.

The test involves either brushing, spraying, or any other method of local application of a suitable volatile liquid to the test surface. If there are any cracks in the surface, they will be penetrated. Next, a filter paper impregnated with a material that reacts with the liquid is placed over the treated surface. The reaction produces permanent or semipermanent imprints on the paper, indicating any cracks or irregularities on the test surface. For example, if acetaldehyde is used as the liquid penetrant, the filter paper must be impregnated with a freshly-prepared aqueous solution of sodium nitroprusside, 2.5 percent by weight, and morpholine, 10 percent by weight.

Notes:

1. The method can be used to detect minute cracks in materials other than spacecraft insulation, i.e., metal, glass, plastics, ceramics, and other materials.
2. Requests for further information may be directed to:
   Technology Utilization Officer
   Johnson Space Center
   Code AT3
   Houston, Texas 77058
   Reference: TSP74-10095

Patent status:

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning non-exclusive or exclusive license for its commercial development should be addressed to:

Patent Counsel
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