December 1971

Brief 71-10507

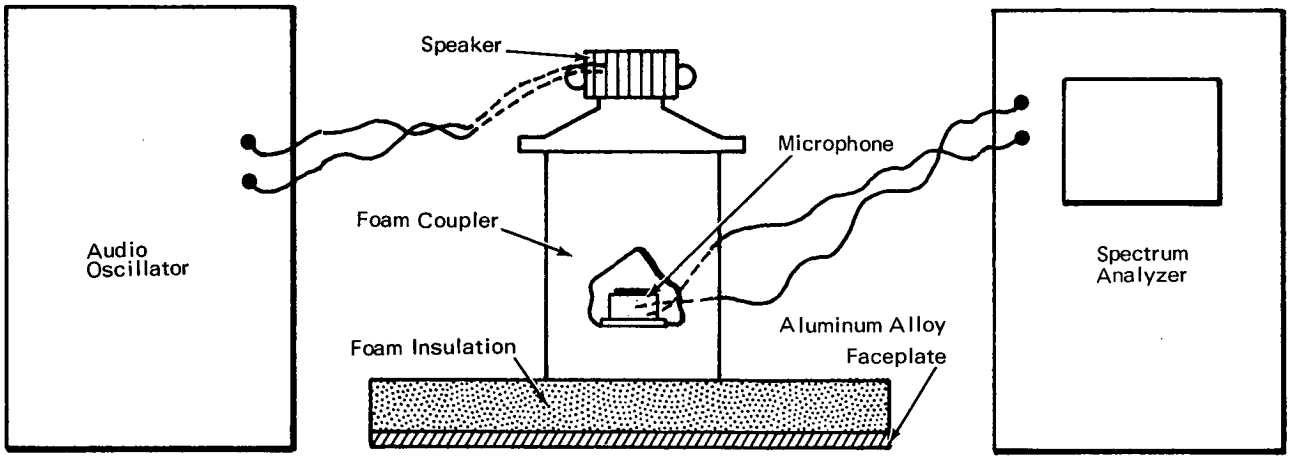
NASA TECH BRIEF

Marshall Space Flight Center

Nondestructive Testing of Bond Integrity in Foam Insulation/Aluminum Composites

New nondestructive test methods can be used for evaluating the bond integrity of a low-density polyurethane spray-on foam used as cryogenic insulation on aluminum alloy surfaces. One promising method employs a pulse-echo audio frequency system to overcome the major drawback with pulse-echo ultrasonic detection systems; i.e., that the low-density foam and the air do not have sufficiently different acoustic impedances at ultrasonic frequences. As a consequence, there is too small a difference between the magnitude of the acoustic energy reflected from the aluminum alloy/foam interface when a bond exists and that reflected from the aluminum alloy/air interface regions which exist in the absence of a bond.

The novel feature of the new audio frequency system is the use of a foam coupler which has the same acoustic impedance as the foam insulation on the aluminum alloy faceplate. In the first experimental design of the system (see figure), a commercial loudspeaker is adhesively bonded to the foam coupler. This speaker, which is driven with an ordinary audio-oscillator, is an effective means of introducing audio-vibrations into the test specimen through the foam coupler. A contact microphone within the lower portion of the coupler detects changes in vibrational patterns caused by unbonded areas in the specimen panel. The signal generated by the microphone is amplified, processed, and displayed on the oscilloscope of a spectrum analyzer. The frequencies above and below the center frequency to which the spectrum analyzer has been set are used as indicators of bond integrity. Debonded foam has greater freedom of motion than well bonded material, and the operating frequency is selected to emphasize the associated increase in vibrational energy.



Pulse Echo Audiofrequency System

Since a single method would not be adequate for evaluating composite bond conditions covering a wide range of foam-metal thickness combinations, other

(continued overleaf)

complementary methods were investigated. It was found that debonds can be detected with audiofrequency through-transmission eddy current techniques. Voids in the foam can be found with radiographic and audiofrequency transmission methods. Radiography is very sensitive to small defects in composites with very thin metal faceplates. It is also useful for evaluating questionable debond areas that are first located by other means. The through-transmission eddy current technique appears to offer greater potential for the evaluation of composites having relatively thick metal plates.

Note:

The following documentation may be obtained from:

National Technical Information Service
Springfield, Virginia 22151
Single document price $3.00
(or microfiche $0.95)

Reference:
NASA TM-53940 (N70-17360), The Nondestructive Evaluation of Low Density Foam-Aluminum Composite Materials

Patent status:

No patent action is contemplated by NASA.

Source: W.M. Clotfelter,
B.F. Bankston, and
P.C. Duren
Marshall Space Flight Center
(MFS-20786)