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Brief 66-10544

NASA TECH BRIEF

Ultrasonic Quality Inspection of Bonded Honeycomb Assemblies Is Automated

The problem:

To design an inspection system for bonded honeycomb assemblies that is accurate, fast, and automated. The size and complexity of the panel sections to be inspected ranged from 12 to 33 feet in diameter, and consisted of cylindrical, truncated, hemispherical, and flat sections of varying lengths and nonsymmetric internal and external protrusions. The inspection record would have to indicate clear, interpretable, and precisely situated test results capable of displaying the unbond conditions as to the size and extent of the unbond.

The solution:

An ultrasonic inspection system that consisted of inner and outer transducer positioning assemblies with suitable motor controls, a centerless turntable assembly to rotate the test parts, water squirter assemblies to assure the watertightness of joined areas, and an inspection program that was completely encoded on tape suitable for use on a high speed computer.

How it's done:

Each assembly required careful preparation prior to its inspection to assure that water from the squirter assemblies could not enter through joined areas. The prepared assembly was then located in place on the turntable with the applicable tooling. The position and relative clearance of the assembly surface, and the instrumentation, recording model, and all program controls were readied for an automatic inspection as required by the specific test. All suspect recorded void areas were further evaluated by complementary ultrasonic techniques such as contact, resonant, frequency shift, sonic, and dimensional checks to locate voids to their respective sides and interfaces to facilitate their repair.

Eight-channel tape readers were utilized as the program control. Since the position and gimbal motions of both the inside and outside transducer assemblies required an independent program, six channels were designated for their control. One channel was used to control the transducer positioning logic during an automatic inspection cycle and the eighth remaining channel was used to control the turntable angular velocity necessary to maintain a uniform surface inspection speed and recorder writing density.

The program information was generated with the aid of a high speed computer coded with the necessary mold line equations for both the inner and outer surfaces of the specific panel assembly. A complete series of calculations was performed and the data was stored on magnetic tape and transferred, by a punched tape computer, to mylar tape in a usable coded form.

The programmed tape is indexed past the tape reader photocell head to initiate the operation of each controlled function. Since the tape reader is only required to initiate automatic programmed transducer indexing each turntable revolution, the function is provided with a control to permit the transducer index increment to be adjusted by the operator.

Notes:

1. More than 500 Apollo and Saturn S-II adhesive bonded assemblies have been successfully inspected since the installation of the ultrasonic inspection systems.
2. The adaptation of punched tape-reader programming to ultrasonic inspection systems contributed to the feasibility of systems capable of automatically inspecting geometric shapes previously considered impractical.

(continued overleaf)

3. This programmed method of positioning should readily adapt itself to many other complex positioning and synchronizing needs frequently encountered by inspection departments.
4. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Manned Spacecraft Center
   Houston, Texas 77058
   Reference: B66-10544

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

Source: C. C. Kammerer
of North American Aviation, Inc.,
under contract to
Manned Spacecraft Center
(MSC-859)