September 1973 B73-10325

# NASA TECH BRIEF

*Marshall Space Flight Center*



## Acoustic-Emission Signal-Processing Analog Unit for Locating Flaws in Large Tanks

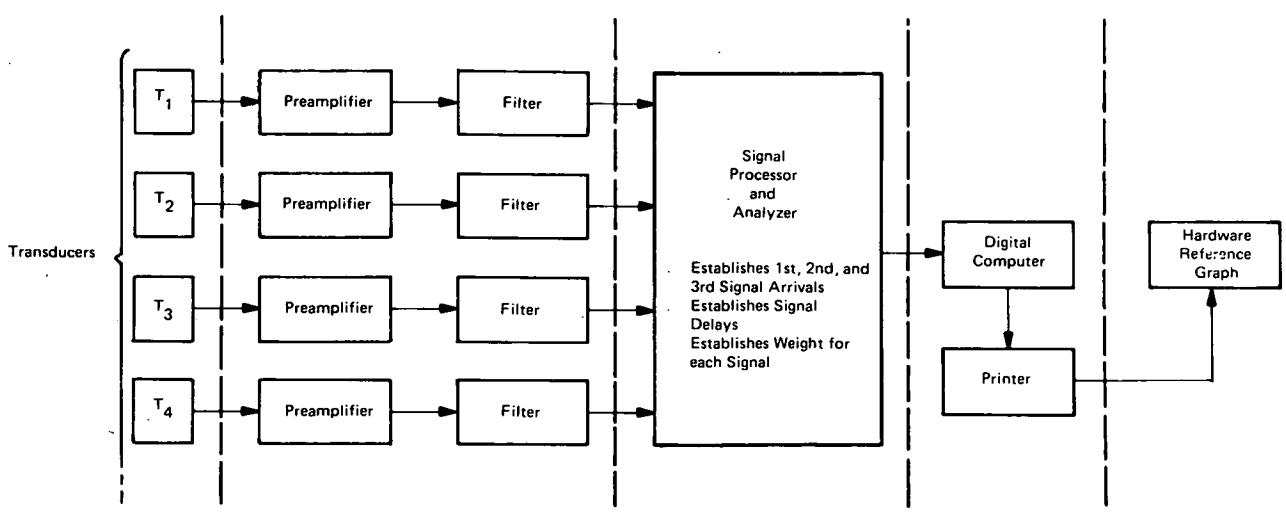
Large physical structures such as atomic reactors and power generation vessels, marine and aircraft frames, building structures and bridges, etc., must be free from serious structural flaws. Inspection of these structures can be done by the analysis of acoustic-emission signals generated within the material.

Recently, an effective technique was developed for monitoring structural flaws in 105-in. (263-cm) diameter tanks. It requires that the tank surface be divided into many areas. Each area is sectioned into 20 equilateral triangles that form an icosahedron. Twelve transducers are equally positioned on tank surface at the vertex of each of these triangles. The transducers are to monitor the area for flaws by detecting any increase in the acoustical activity.

When this technique was developed, no prototype system had been built. Now the prototype system is ready and will be explained in some detail.

The major part of this system is an analog processing unit developed to process signals from an array of acoustic-emission sensors. The unit consists of twelve analog band amplifiers and a signal processor and analyzer (see figure). Each amplifier, connected to one transducer, contains transducer impedance matching networks and signal clipping diodes to allow maximum signal transfer and prevent saturation by high excursion transients. Also, each amplifier contains filter networks which can be matched to individual transducers.

Filtered signals from the amplifier are transmitted by coaxial cables to the chassis line receiver located in the signal processor and analyzer. The twelve channels are crosslinked in several ways to reduce noise in the system. The first of the twelve multiplexers samples only the first signal arrival. The progressive lockout circuitry limits receiving to five surrounding channels after initial vertex arrival. A second arrival then limits




Acoustic Emission System

(continued overleaf)

receiving capability to two channels. A third arrival clamps the remaining channels until the system is reset.

Each signal arrival is encoded. Simultaneously, arrivals are detected and rejected to eliminate false code loading. By tagging each transducer serially, any triangle may be identified by a discrete tag sum. Thus, the code for the active triangle is determined by binary summation of transducer tags in the triangle.

Both binary and decimal representations of the data word are displayed for each acoustic-event triangulation. When the digital computer has acquired the data, the analog unit resets all channels and awaits a new acoustic event. The computer performs all data management, storage, and analysis. It contains eight thousand, 16-bit storage locations operating with a 1-microsecond memory read-store time. Eight interrupt levels are provided for input priority data handling. A 32-bit input and TTY input/output allows complete communication.

A standard teletypewriter is used for communication between the operator and computer. It is used to process all programming, service requests, and output printing. The teletypewriter is provided with an eight-hole paper tape read and punch.

**Note:**

Requests for further information may be directed to:

Technology Utilization Officer
Marshall Space Flight Center
Code A&PS-TU
Marshall Space Flight Center, Alabama 35812
Reference: B73-10325

**Patent status:**

NASA has decided not to apply for a patent.

Source: F. J. Moskal and J. D. Fageol of
Rockwell International Corp.
under contract to
Marshall Space Flight Center
(MFS-24424)