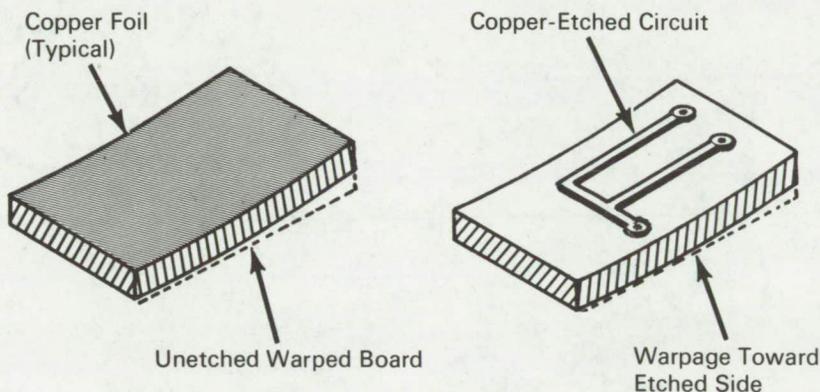


# NASA TECH BRIEF



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## Warpage Eliminated in Copper-Clad Microwave Circuit Laminates



### The problem:

To prevent stresses, inherent in copper-clad microwave circuit laminates, that cause warpage when a circuit is etched on one side of the board. This warpage causes various problems in manufacturing processes and decreases reliability of microwave components.

### The solution:

Treat the laminated circuit boards cryogenically. Prior to etching, the stresses may be eliminated to prevent warpage; after etching, they may be eliminated to reduce warpage.

### How it's done:

The temperature required to stress-relieve a board depends upon the composition of the plastic which makes up the board. A copper-clad, fiberglass/styrene

copolymer board (Rexolite 2200) employed for study, required  $-80^{\circ}\text{C}$  to prevent warpage during etching and to eliminate warpage resulting from etching. The process used for the board tested follows:

- (1) Prior to etching, the flat boards are slowly cooled to  $-80^{\circ}\text{C}$ , maintained at that temperature for one to two hours, and slowly returned to room temperature.
- (2) Boards that have not been treated, as described above, and have warped during manufacture, are first heated to  $+100^{\circ}\text{C}$ . This is to allow clamping between two sheets of aluminum with minimum stress. After the boards are clamped flat, they are cooled to  $-80^{\circ}\text{C}$ , maintained at that temperature for one to two hours, and returned to room temperature.
- (3) Etched boards, if warped, may also be treated as described in step (2) above.
- (4) The boards that were treated in this manner remained flat and were processed and assembled without difficulty.

(continued overleaf)

**Notes:**

1. Further details of the method are contained in:  
*Stress Relief of Copper-Clad Microwave Circuit Laminates to Reduce and Prevent Warpage*, IBM Report No. 67-U60-0021, 25 May 1967.
2. This report is available from:  
Technology Utilization Officer  
Marshall Space Flight Center  
Huntsville, Alabama 35812  
Reference: B67-10454

**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: W. L. Boone, Jr.  
of IBM  
under contract to  
Marshall Space Flight Center  
(MFS-13892)