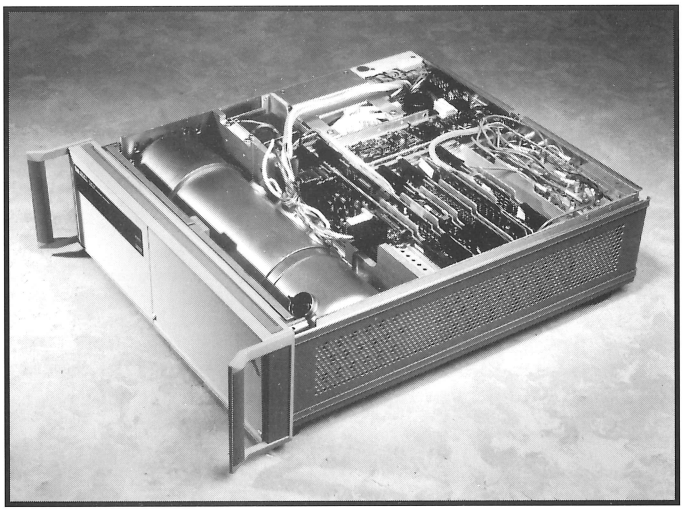
Reprinted from
"Tooling and Production / March 1996"

Atomic clock demands ultra-close tolerances

Using a new cesium beam tube design and improved electronic architecture, the HP 5071 A atomic clock represents an interesting manufacturing challenge, reports David Gottwals, a manufacturing engineer for the Santa Clara, CA, Div. of Hewlett Packard Co.



A new HP 5071 A atomic clock, considerably smaller than it's predecessor, benefits from Hudson Tool and Die's deep drawing capacity.

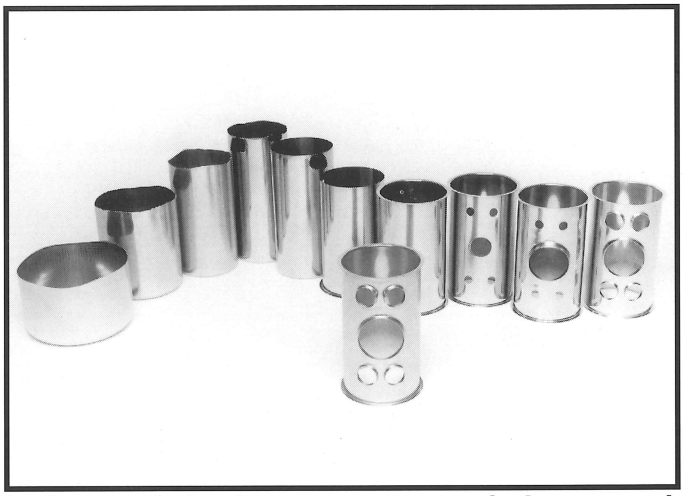
"After most of the components are mounted on a formed and machined stainless steel channel, the channel slides inside and is bolted to a stainless steel envelope center section. The need to hold required tolerances and concentricity is enough to discourage many metal-stamping vendors," he points out.

Hudson Tool and Die Co., Ormond Beach, FL, accepted the challenge and developed the progressive draw process needed to deliver the close-tolerance envelope center, plus end caps, outer-shield end caps, and several header caps. In all, Hudson produces ten components for the vacuum envelope of the cesium beam clock.

"The old HP design started out as stainless steel welded tubing," explains Joe Hynes, HTD product development manager. "By switching to deep-drawn flat blanks, we eliminated concerns over welded tube seams.

In our progressive draw process, we make a series of four draws, annealing after each draw. The entire process is based on conventional deep-draw practices: the difference is in the special tooling that we developed."

The parts that make up the envelope include the envelope center, two deep-drawn dome-shaped envelope end caps, two deep-drawn end cap internal shields, and five drawn feed-through header cups. The envelope end caps are 0.036" thick 304 stainless. The shields are 0.030" thick 4750, and the feed-through cups are 0.015" thick Kovar.



Left to right is sequence of draw and secondary operations with finished cesium clock housing front center.

As Mr. Hynes explains, the four draws require three different presses to produce the 10" long envelope center. "First, a 190-ton double-action Bliss press," he says, "and then a 50-ton redraw (toggle) press. The final draw requires a 75-ton hydraulic press."

"Next," continues Mr. Hynes, "four small pull-through holes are individually pierced. A 2" dia pull-through hole requires a separate piercing operation. The holes present access for electrical connections to the outside. All holes are then burred up to length, and the top surfaces are machined to their final dimensions."