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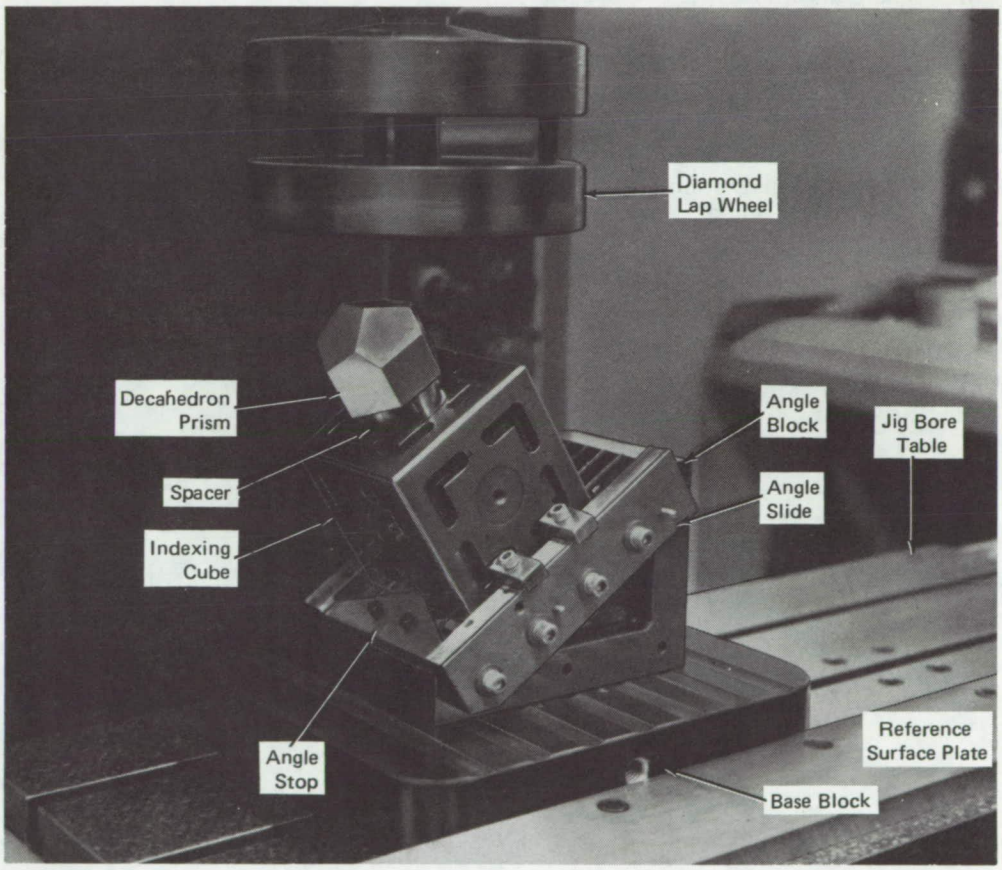
NASA TECH BRIEF

Marshall Space Flight Center

Precision Machining of Steel Decahedrons



The problem:

A decahedron prism used in checking angular alignment of the mounting pads of all the components of a strapdown guidance unit requires a high degree of accuracy. To provide this accuracy, the prism must be fabricated with great precision. However, the required prism tolerances of 0.5 second of arc could not be produced with existing equipment.

The solution:

The required tolerance is obtained with positive-reference precision machining. This method uses a precision flat surface plate for reference.

How it's done:

The equipment that provides this precision is shown in the figure. It consists of a surface plate, a base block,

(continued overleaf)

an angle block, angle sides, angle stop, cube, and spacer. The decahedron prism is also shown in the figure. It is made from hardened stainless steel and has 10 facets polished to a high degree of accuracy and reflectivity.

In positive-reference precision machining, each facet of the prism is lapped so that it is parallel to the surface plate to a tolerance of 50 nm ($2x10^{-6}$ inch). The surface plate constructed from granite has an overall flatness of 635 nm ($25x10^{-6}$ inch).

The prism is lapped with a diamond lap wheel which is adjusted to 508 nm ($20x10^{-6}$ inch) accuracy with the three adjusting screws. At the beginning of the lapping procedure, the cube with the attached prism is removed from the angle block assembly and base block and placed directly onto the jig bore table. The first two opposite facets are lapped parallel with the cube which is resting directly on the jig bore table. The remaining facets are lapped with the prism and cube mounted again on the angle block. To prevent dust particles from adhering to the tooling and prism surfaces, the entire process is conducted in a dust-free atmosphere. Each facet angle is lapped at $31^{\circ}43'2.8'' \pm 0.5''$.

The finished prism is measured for flatness with an air gauge which compares each facet with the reference surface plate. Finally, the prism angles are checked with an autocollimator and a mechanical polygon which have respective angle accuracies of 0.1" and 0.25", respectively.

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
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Patent status:

NASA has decided not to apply for a patent.

Source: W. J. Abernathy and J. R. Sealy
Marshall Space Flight Center
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