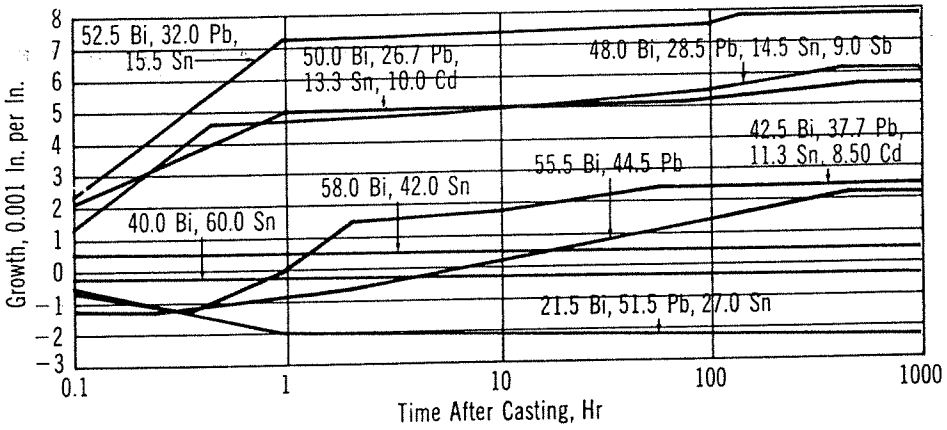

Alloys containing bismuth vary in growth characteristics, making them useful in casting materials for specialized applications.

from 0 to more than 200%. All alloys creep or flow at room temperature under relatively light, continuous loads, as do some lead alloys.

Basically, application involves only a few mechanical principles. First, bismuth alloys are used for anchoring, joining or attaching similar or dissimilar materials. When two members must be joined, a low melting alloy that expands as it solidifies can be poured in to fill the cavity between them. When solidified, the alloy holds the parts together. Tool and diemakers employ this technique, particularly for anchoring punches in piercing and stamping dies. A bismuth alloy allows ease of disassembly, making it invaluable for joining parts temporarily in testing.

Scientists of NASA's Lewis Research Center have taken advantage of the method to seal tanks for testing and manufacturing for cryogenic applications. Seals hold at pressures up to 2000 psi. (We should note, of course, that these applications are limited to about room temperature or below.) Other items which can be fastened in this manner are bearings, bushings and nonmoving parts in machinery, as well as locator members in aircraft assembly fixtures. Such alloys also anchor precision parts for testing and inspection, secure Alnico rotors to shafts, and fix magnets in magnetic chucks.

Jigs and Fixtures

Jigs or fixtures generally consist of movable jaws and stationary parts. When they are shaped to fit components being clamped, they require much machining time. With a bismuth alloy, a machinist can fill voids between a workpiece and a suitable container or adapter, producing perfectly fitting tools in only a fraction of the time normally required.

Such a technique is also used in making duplicate workholders of a variety of shapes and sizes. Easily fabricated containers with circular or other shapes will nest the part snugly. Then, liquid alloy fills the container, the part being immersed and held in place until the metal freezes to make an impression of the contour. The method is suitable for making fixtures to support, internally or externally, workpieces for machining, grinding and broaching.

Considerable quantities of Alloy 2 in Table I are used to position jet engine blades and buckets for grinding several pieces simultaneously. Melting at 158 F, the quaternary eutectic expands rapidly after solidification, securely gripping parts. Since it is easy to melt in hot water, it is re-usable.

Certain bismuth alloys that contain indium adhere to glass. Optical manufacturers rely on them to secure or block lenses during grinding and polishing, eliminating the need to remove conventional blocking materials. And they are re-usable.

Fusible Cores

Bismuth alloys may be die cast to shapes with accurate dimensions and fine surface finishes. Such parts are used in the foundry to produce cores; the alloy melts out when the core is baked, leaving the desired shape. Fusible cores allow metals, such as copper and nickel, to be plated, "electroforming" complicated shapes requiring close dimensional tolerances and smooth surfaces. Waveguides and other microwave fittings typify such components.

A rapidly growing coring application involves the fabrication of light, strong tanks of fiber glass reinforced plastic for compressed gases. For this purpose, the hardware required for attaching gas lines is placed in the mold in which bismuth alloy is cast. Plastic and its reinforcement become attached to the fitting. When the plastic is cured, the alloy melts out, leaving a hollow vessel. Obviously, this technique can be extended to the