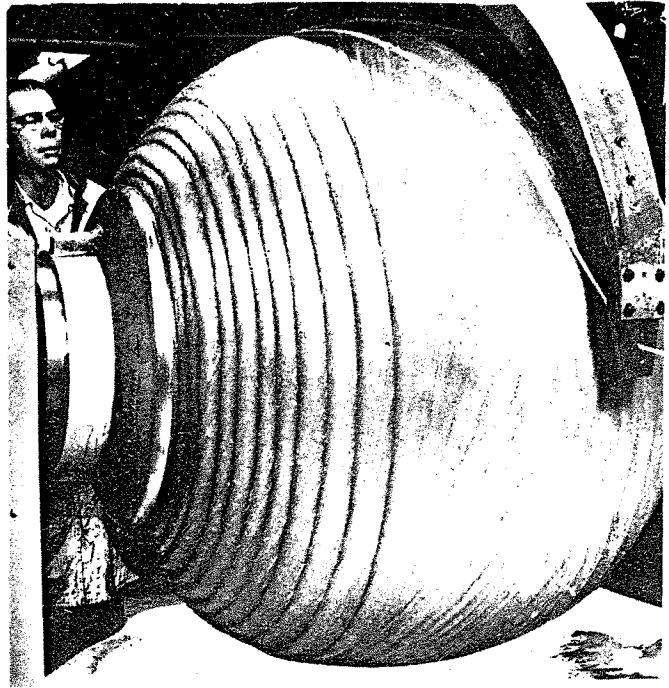


# Bismuth's Unusual Properties Meet Many Special Needs

By RICHARD D. BECKER

Low melting point and castability make the metal and its alloys useful for sprinkler plugs in fire extinguishing systems. You'll also find it in machinist's jigs, forms for winding fiber glass vessels, and many chemical compounds.



Technician at Apex Fibre-Glass Products Div., White Consolidated Industries, Inc., monitors winding of fiber glass vessel to be epoxy bonded. The core, being of fusible alloy based on bismuth, readily melts out when the epoxy is cured.

UNLIKE MOST METALS, silvery bismuth is brittle and low in strength. It expands 3.32% upon changing from liquid to solid, and melts at 520 F. Its low absorption cross section for thermal neutrons (1.35), has prompted the consideration of liquid bismuth as a coolant for nuclear reactors and as a vehicle for introducing uranium into reactors.

Other applications are more conventional: 0.1 to 0.5% Bi improves machinability of aluminum alloys, bronzes, magnesium, and steel; the metal prevents mottling in cast iron; and manufacturers of acrylonitrile fibers, paints, plastics and Lucite are a prime market. They use it as a catalyst, as do makers of methanol, ammonia, nitrous oxide and hydrocyanic acid. All of us are aware of medicinal applications

(in such compounds as Pepto-Bismol); and bismuth salts are the ingredient in cosmetics which give that frosted, iridescent look.

## Low Melting Alloys

Bismuth is used in eutectic alloys. With melting temperatures which coincide with freezing temperatures, they melt below 450 F. Definite melting points make bismuth alloys specially suited for safety devices, fuses and fire control equipment. Table I lists nine typical alloys.

In addition, bismuth alloys exhibit varying expansion and contraction characteristics. For instance, alloys containing 35 to 45% Bi plus lead shrink slightly during solidification; after freezing, they expand enough to compensate for the shrinkage. Conversely, alloys containing 50% Bi or more (but no lead) expand while solidifying and shrink only slightly while cooling to room temperature.

## Properties Dictate Uses

Bismuth alloys which melt below 300 F have specialized applications. Few, if any, of those listed in Table I have much strength or hardness, which rules them out as structural materials. Hardness ranges from about Brinell 9 to 22; tensile strengths vary from 3000 to 13,000 psi; and elongations range

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Table I—Bismuth Alloys With Low Melting Points

Alloy No.	Composition, %				Melting Temperature, F
	Bi	Pb	Sn	Other	
1	49.00	18.00	12.00	21.00 In	136
2	50.00	26.70	13.30	10.00 Cd	158
3	51.60	40.20	—	8.20 Cd	197
4	52.50	32.00	15.50	—	203
5	54.00	—	26.00	20.00 Cd	217
6	55.50	44.50	—	—	255
7	56.00	—	40.00	4.00 Zn	266
8	58.00	—	42.00	—	281
9	60.00	—	—	40.00 Cd	291