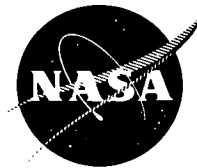


# NASA TECH BRIEF

## Lewis Research Center



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### Binary Alloys for Refractory-Metal Brazing

Data on binary-metal eutectics and melting-point minima have been assembled for use in selecting brazing filler compositions for refractory metals. The metals included are those with vapor pressures below  $10^{-10}$  torr at 1500 K (2240°F) and  $10^{-5}$  torr at 2000 K (3140°F).

In thermionics work, refractory metal parts must be bonded together at temperatures well below their melting points. Brazing is a suitable bonding method, but brazing fillers are needed which have vapor pressures comparable to those of the refractory metals but with relatively low fusion points and high remelt temperatures. Binary metal eutectics with low melting points have these characteristics. Therefore, data on binary metal compositions and their constituents, suitable for this purpose, have been compiled.

The data are presented in four tables for ready reference.

Table I lists melting and boiling points, and vapor pressures at 1500 and 2000 K (2240 and 3140°F) for twelve selected metals: zirconium, niobium, molybdenum, technetium, ruthenium, hafnium, tantalum, tungsten, rhenium, osmium, iridium, and thorium. Table II lists eutectics and melting-point minima for binary combinations of these twelve metals and their fusion point temperatures. The data in Table II indicate that thorium is a very effective constituent in formulating binary metal eutectics with low melting points and low vapor pressures. Therefore, Table III lists seven combinations of metals containing thorium which have melting points below 1774 K (2668°F), and fusion points below those of their constituents. Table IV lists other combinations of metals (exclusive of thorium) which have fusion temperatures well below those of their constituents.

The successful use of two brazing fillers selected from these data is discussed.

Since some of the eutectics listed are chemical compounds comprising metals only (metallides), a brief discussion of the problems and potentials of metallides is included in the appendix.

#### Notes:

1. This compilation has been published as the following report:

NASA TM-X-68190 (N73-19537), Some Possible Filler Alloys with Low Vapor Pressures for Refractory-Metal Brazing

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