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NASA TECH BRIEF

This NASA Tech Brief is issued by the Technology Utilization Division to acquaint industry with the technical content of an innovation derived from the NASA space program.

Lightweight Magnesium-Lithium Alloys Show Promise

The problem: To develop metals for applications in which weight is a primary consideration. Structural applications in the aerospace industry require lightweight, high-strength metals such as magnesium alloys, aluminum alloys, and titanium alloys. However, there are many applications for metals in which strength is less important than light weight. Examples of such applications are packaging for electronic assemblies, housings for cameras, etc.

The solution: A class of magnesium-lithium alloys.

Although magnesium alloys have been, for many years, the lightest commercially available structural metals, they can be made even lighter by additions of lithium. Magnesium-lithium alloys are more ductile than other alloys of magnesium.

How it's done: Research, started in the 1940's and continued through the intervening years, has resulted in a class of lightweight, highly formable magnesium-lithium-base alloys. These alloys have great potential for both aerospace and industrial applications.

Two alloys, LA141 and LA91, developed in the Battelle Memorial Institute research program and evaluated under NASA sponsorship for aerospace possibilities, have tensile strengths in the range of 20,000 psi. Since about 1960, the aerospace industry has been making considerable use of the LA141 alloy in prototype hardware components, and this alloy is now available commercially. The LA91 alloy is not being made commercially but is available on custom orders. A third alloy, LAZ933, has just been developed but is not ready for commercial use.

The nominal compositions and some properties of these three alloys are shown in the table below. Further research is needed on the LAZ933 alloy to permit a more detailed evaluation of its properties.

SOME PROPERTIES OF THREE MAGNESIUM-LITHIUM ALLOYS*

Alloy	*Nominal composition, weight percent (Balance Mg)*	*Density, g/cm³***	*Ultimate Tensile Strength p.s.i.*	*Yield strength p.s.i.*	*Elongation in 2 inches, percent****	*Elastic modulus, 10^6 p.s.i.*
LA141	14Li-1Al	1.35	21,000	17,000	30	6.5
LA91	9Li-1Al	1.45	22,000	16,500	30	6.5
LAZ933	9Li-3Al-3Zn	1.56	30,000	21,000	30	6.5

* At room temperature.

** Compares with 1.74 g/cm³ for pure magnesium.

*** LA141 and LA91 sheet can be formed at room temperature over a radius of about 1T. LAZ933 requires a radius of 3 to 4T at room temperature, but 1T at about 350°F.

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Notes:

1. At their present stage of development, the magnesium-lithium alloys should not be used at temperatures above 200°F, because of rapid strength deterioration.
2. In general, the corrosion resistance of these alloys is comparable to that of most commercial magnesium alloys. They can be given the same surface-protection treatments that are generally applied to commercial magnesium alloys. A satisfactory method for electroplating the new alloys has not yet been developed.
3. Although the alloys are readily weldable by resistance and inert-gas welding techniques, they cannot be brazed.
4. The alloys have been found satisfactory for the fabrication of electronic component and instrument cases, and it is expected that with further development and lower-cost quantity production their commercial and industrial applications will be considerably extended.
5. Further information concerning these alloys is contained in: *Evaluation of Magnesium-Lithium Alloys for Possible Missile and Space Applications* by T. G. Byrer, R. J. Jackson, A. M. Sabroff, and P. D. Frost, available from Battelle Memorial Institute, 505 King Avenue, Columbus 1, Ohio, and Defense Metals Information Center Memorandum 146 *Magnesium-Lithium Alloys—A Review of Current Developments* by P. D. Frost, February 6, 1962, available from the Department of Commerce, Office of Technical Services, Washington, D.C. 20230. Inquiries may also be directed to:
   Technology Utilization Officer
   Marshall Space Flight Center
   Huntsville, Alabama 35812
   Reference: B63-10389

Sources:

1. Battelle Memorial Institute under contract to Army Ballistic Missile Agency and Marshall Space Flight Center
2. Marshall Space Flight Center (M-FS-17)