Technical Comments

Comment on "Effects of Simulated Mars Dust Erosion Environment on Thermal Control Coatings"

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In a recent Note,[1] Adlon et al., presented erosion data for several coatings in a hypothetical Martian dust environment. Two of the coatings tested were reported as NiAl (Metco 404) and as 40% NiAl + 60% ZrO_2 (Metco 413). The published manufacturer's specifications for these two powders differ from the compositions listed by Adlon et al. Table 1 shows the reported description for these two powders.[2–5]

Table 1 Manufacturer's description for Ni/Al powders[2–5]

Material	Name	Composition	Coating description
Metco 404	"nickel aluminide"	20% Al (core), 80% Ni (cladding)	Approximately equal proportions of NiAl and Ni_3Al with some miscellaneous oxides
Metco 413	zirconia-"nickel aluminide" cermet	...	35%-zirconia plus 65%-"nickel aluminide"

There seems to be some confusion resulting from the name Metco uses to describe its 404 powder—"nickel aluminide." (Metco uses quotes around the term "nickel aluminide.") We are submitting this comment in the hope of cautioning other workers about assuming a chemical formula from a trade name. In addition, since the raw powder is unreacted, there should be further compositional changes during thermal spraying. The coating will probably be more nickel rich than the starting powders because of the increased vapor pressure of aluminum. This comment should not be taken as a criticism of the work of Adlon et al., since their work was concerned with the types of coatings available for thermal control, and not with the chemical formulas.

References

[1] Adlon, G. L., Rusert, E. L., and Slemp, W. S., "Effects of Simulated Mars Dust Erosion Environment on Thermal Control Coatings," *Journal of Spacecraft and Rockets*, Vol. 7, No. 4, April 1970, pp. 507–510.

[2] *Product Data Bulletin, Metco 404 "Nickel Aluminide" Power*, Metco, Inc., Westbury, N. Y., 1968, pp. 1–6.

[3] "Flame Sprayed Metco 404 'Nickel Aluminide,'" Bulletin 148 5M 18–63, 1963, Metco, Inc., Westbury, N. Y.

[4] "Metco Spraying Data: Metco 404 404NS, 'Nickel Aluminide,'" Instructions Q-6786, Issue C, Metco, Inc., Westbury, N. Y.

[5] *Metco Product Data Bulletin, Cermets*, Metco, Inc., Westbury, N. Y., 1968, pp. 1–3.

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Comment on "Angle of Attack and Lateral Rate for Nearly Circular Re-Entry Motion"

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Lotkin, in Ref. 1, attempts to solve for the angle-of-attack convergence and lateral rate behavior of a re-entry vehicle using relations he derived in an earlier paper[2] starting from the equations of translational motion. The solution he devises bears little semblance to previously obtained solutions to this same problem, as would be expected, since the problem he addresses is correctly described by the moment equations of rotational motion. The angle-of-attack convergence behavior of a rolling re-entry vehicle has been treated extensively[3–10] and results published in the literature reduce to the simple case considered by Lotkin when one ignores aerodynamic and normal force damping, roll-rate variations, and Magnus effects, and makes the further simplifying assumptions of small angles of attack and nearly circular motion. The case treated by Lotkin is rederived here for completeness.

Euler's moment equation for rotation of a rigid body about its mass center is[11]

$$\mathbf{M} = \dot{\mathbf{h}} + \boldsymbol{\omega} \times \mathbf{h} \tag{1}$$

where **M**, **h** and **ω** are the resultant moment, angular momentum and angular velocity vectors, respectively. Components of **ω** and **h** in Euler angle coordinates, as described in Ref. 3 and Fig. 1, are

$$\begin{aligned} \omega_\xi &= \dot{\psi}\cos\delta & h_\xi &= I_x p \\ \omega_\eta &= \dot{\delta} & h_\eta &= I_y \dot{\delta} \\ \omega_\eta &= \dot{\psi}\sin\delta & h_\zeta &= I_y \dot{\psi}\sin\delta \end{aligned} \tag{2}$$

which yield from Eq. (1) the roll, pitch, and yaw moment

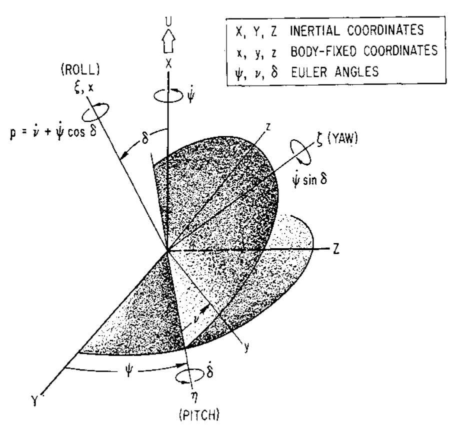

Fig. 1 Euler angles for three-degree-of-freedom rotational motion.

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