Comment on "Nonequilibrium Nozzle Flow of a Nitrogen-Hydrogen Mixture"

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THE enthalpy dependency suggested by Edwards and Stalker[1] should be re-evaluated based upon the entropy correlation already established both analytically[2-5] and experimentally[6] for expanding, chemically reacting flows. Since the enthalpy dependency as presented[1] was for only one given pressure value it readily may be re-expressed as an entropy correlation. In fact, it would be desirable for the author[1] to substantiate this by making calculations and obtaining data over a matrix of enthalpy-entropy values. These results then would more clearly show whether freezing occurs for both high and low enthalpy values at high entropy values for nitrogen-hydrogen mixtures as is experienced with other gases.[3,5,7]

References

[1]Edwards, B.P., and Stalker, R.J., "Nonequilibrium Nozzle Flow of a Nitrogen-Hydrogen Mixture," *AIAA Journal*, Vol. 13, Nov. 1975, pp. 1536-1538.

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[4]Harris, C.J., "Correlation of Inviscid Air Nonequilibrium Shock Layer Properties," *AIAA Journal*, Vol. 9, Feb. 1971, pp. 334-336.

Received May 5, 1976.
Index categories: Nozzle and Channel Flow; Reactive Flows; Thermochemistry and Chemical Kinetics.

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[5]Ebrahim, N.A. and Hornung, H.G., "Nonequilibrium Nozzle Expansion of Carbon Dioxide from a High Enthalpy Reservior," *AIAA Journal*, Vol. 11, Oct. 1973, pp. 1369-1370.

[6]MacDermott, W.N. and Dix, R.E., "Mass Spectrometric Analysis of Nonequilibrium Airflows," *AIAA Journal*, Vol. 10, April 1972, pp. 494-499.

[7]Young, W.S., "Correlation of Chemical Freezing in a Freejet Expansion," *AIAA Journal*, Vol. 13, Nov. 1975, pp. 1478-1482.

Reply by Authors to C. J. Harris

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AT this stage, it would be premature to attempt to generalize the result presented in Fig. 1 of our Note.[1] The analytical results presented in that figure demonstrate the importance of the exchange reactions, 8 and 10 in Table 1 of the Note, in determining both the composition, and the frozen enthalpy, of the expanded freestream. However, the experimental results on shock stand-off, presented in Fig. 2b of the note, indicate that the rates presented for reactions 8 and 10 cannot be used with confidence. While there is no doubt that the entropy correlation is a useful generalization, it seems unwise to attempt to develop such a correlation before the rates for these important reactions have been validated by other experiments.

References

[1]Edwards, B. P. and Stalker, R. J., "Nonequilibrium Flow of a Nitrogen-Hydrogen Mixture," *AIAA Journal*, Vol. 13, Nov. 1975, pp. 1536-1538.

Received Oct. 25, 1976.
Index categories: Nozzle and Channel Flow; Reactive Flows, Thermochemistry and Chemical Kinetics.

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