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Aerodynamic stability of blunted-cone heat shields for atmospheric entry vehicles JOHN SADER, ELEANOR BUTTON, DANIEL LADIGES, CHARLES LILLEY, NICHOLAS MACKENZIE, EDWARD ROSS, The University of Melbourne — Spacecraft entry into the atmosphere of a planet requires protection against the extreme temperatures that result from aerodynamic heating. This is normally achieved through use of a heat shield, which also provides the necessary aerodynamic braking and stability. The shape of the heat shield used varies considerably between spacecraft, and spherical and blunted-cone geometries are often employed. The "blunted-cone" heat shield has been developed through experimental design and computational simulation. Here, we demonstrate that this generic shape can be derived mathematically and yields the *maximum stabilizing aerodynamic torque* of all possible shapes. The derived single shape is universal, depending only on the center-of-mass, and provides invariance in static stability due to minor heat shield damage. Importantly, the design of practical heat shields involves numerous competing factors, which include the expected heat load and the craft volumetric efficiency, in addition to aerodynamic stability. We thus emphasize that the presented results focus on only one component of this multi-objective problem. Nonetheless, the derived shape shows good agreement with the heat shields of previous entry vehicles, a comparison of which shall be given.

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