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Calculation Procedure for Transient Heat Transfer to a Cooled Plate in a Heated Stream Whose Temperature Varies Arbitrarily with Time

The surface temperature and surface heat flux for a cooled flat plate when the fluid passing over it has a temperature at the plate leading edge that varies arbitrarily with time can now be found by using newly developed heat transfer equations.

The equations have many practical applications. The flat plate can be a rocket motor during startup, a nuclear reactor component, a recuperative heat exchanger during startup and shutdown, or gas turbine blades and vanes during startup, shutdown, or changes in the steady-state power level of an already operating engine.

The equations were developed by starting with the specific solutions for the case when the fluid temperature at the plate leading edge varies linearly with time between two specified temperatures. The solution to the linear case was then generalized and served as the basis for the case when the fluid temperature varied arbitrarily with time. For this latter case, the actual fluid temperature variation at the plate leading edge was approximated by a sequence of ramps or steps.

Notes:

1. These equations are described and their use demonstrated by examples in the following report:
NASA TM-X-3238 (N75-25095), Calculation Procedure for Transient Heat Transfer to a Cooled Plate in a Heated Stream Whose Temperature Varies Arbitrarily with Time

Copies may be obtained at cost from:

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Category 03