A5.01 Laminar Flow Ground Testing

Lead Center: LaRC

Laminar flow enabling technologies are required to allow the Environmentally Responsible Aviation (ERA) Project to simultaneously achieve its aggressive fuel burn, noise, and emissions goals for the N+2 timeframe. To achieve these breakthrough achievements related to drag reduction, the system level requirements for viable aircraft configurations utilizing laminar flow technologies must be established. Although numerous flight tests have proven the aerodynamic possibilities, such flight tests are much too expensive to allow for extensive parametric exploration and optimization to reduce the risks. Therefore, one of the key contributions needed to further advance the technology readiness level of laminar flow technologies integrated into vehicle concepts is the ability to conduct ground-based testing at relevant chord and unit Reynolds numbers. To achieve this need, the ERA Project plans to use the National Transonic Facility (NTF). The NTF is a pressurized, cryogenic wind tunnel capable of approximately 45 million chord Reynolds numbers at transonic speeds.

To date, testing has been done on a Natural Laminar Wing Model with mixed results. The preliminary results indicate contaminants in the flow path of the wind tunnel contributed to early boundary layer transition on the model. These contaminants are suspected to be a combination of minute frost particles, oil droplets, and dust. Based on the surface quality requirements for laminar flow testing at the conditions of the NTF contaminants as small as a few microns are sufficient to disrupt the stability of the boundary layer.

This solicitation seeks proposals to develop:

Wind tunnel circuit cleaning techniques/processes to remove oil and dust contaminants from the NTF and other similar facilities. Because of the cryogenic testing requirements for dry test circuits water-based approaches are discouraged. The proposed process needs to demonstrate that particles and oil at the micron level can be sufficiently captured and removed from the test environment.

Methods to polish, clean, and protect the surface quality of a wind tunnel model leading edge to sufficient levels to enable successful laminar flow testing at the NTF.