



Crossflow Attenuated Natural Laminar Flow

CATNLF Flight Test

Advancing laminar flow technology through flight testing

National Aeronautics and
Space Administration



Challenge

- One path towards reducing emissions and fuel burn is by implementing drag-reduction technology
- Laminar flow is known to reduce vehicle drag by reducing skin friction and profile drag
- Natural laminar flow is desirable because it does not require additional systems to obtain benefit, but has historically been limited to either small components or vehicles that fly slowly

Expected Impacts

- Laminar flow on the upper surface of the main wing offers the largest potential for drag reduction
 - For a 777-sized aircraft, 60% laminar flow on the wing upper surface could provide between 5-10% fuel burn savings
- Next-generation configurations account for performance benefit from laminar flow to meet emissions objectives

Solution

- Crossflow Attenuated Natural Laminar Flow (CATNLF) technology provides a path toward obtaining natural laminar flow on the wing of typical transonic transports without having to reduce the speed
- CATNLF is an aerodynamic design approach that changes the shape of the airfoils to obtain pressure distributions known to control instabilities that lead to boundary layer transition

Computational Study

2014 - 2017



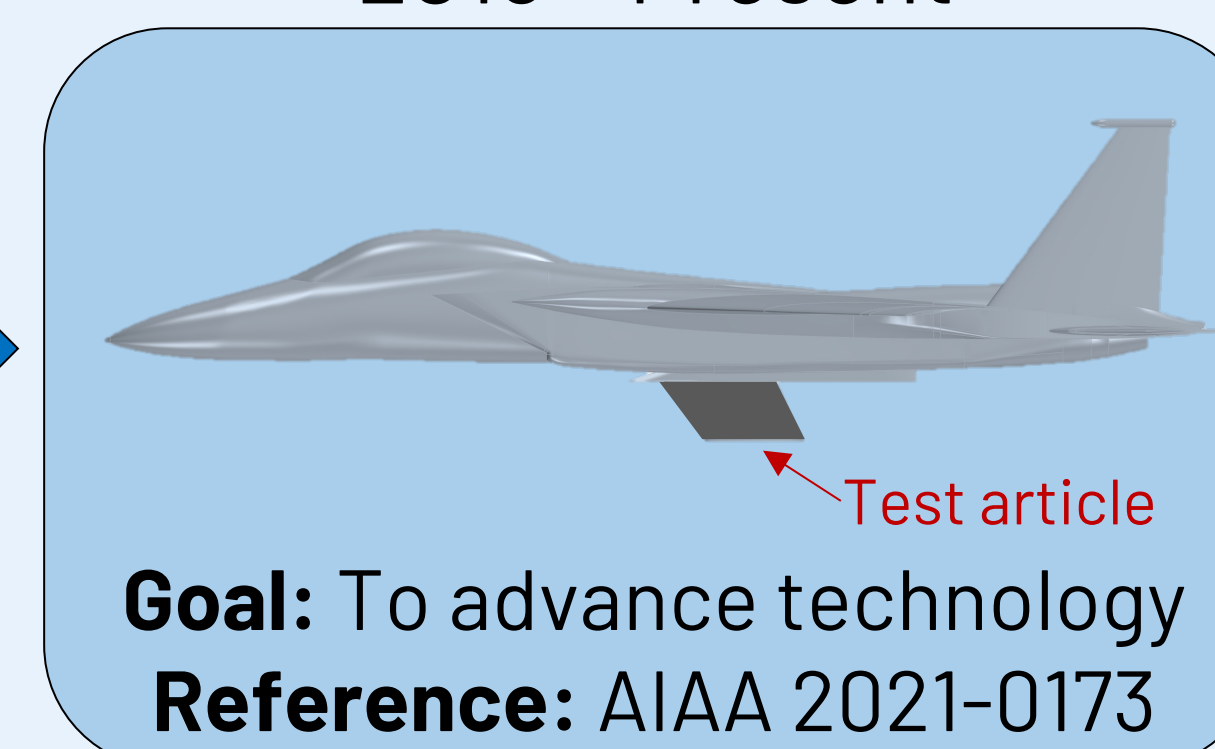
Wind Tunnel Test

2017- 2019



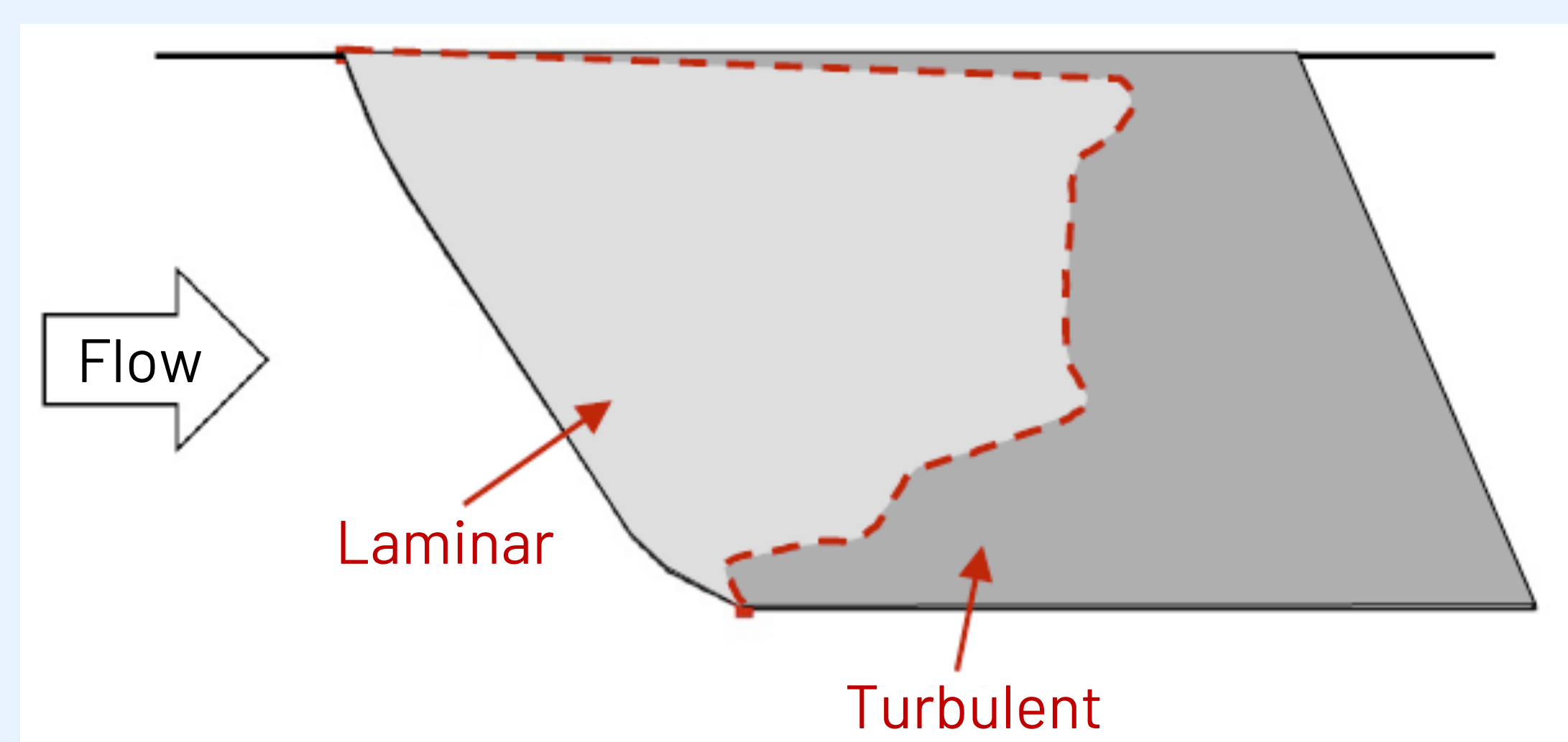
Flight Test

2019 - Present

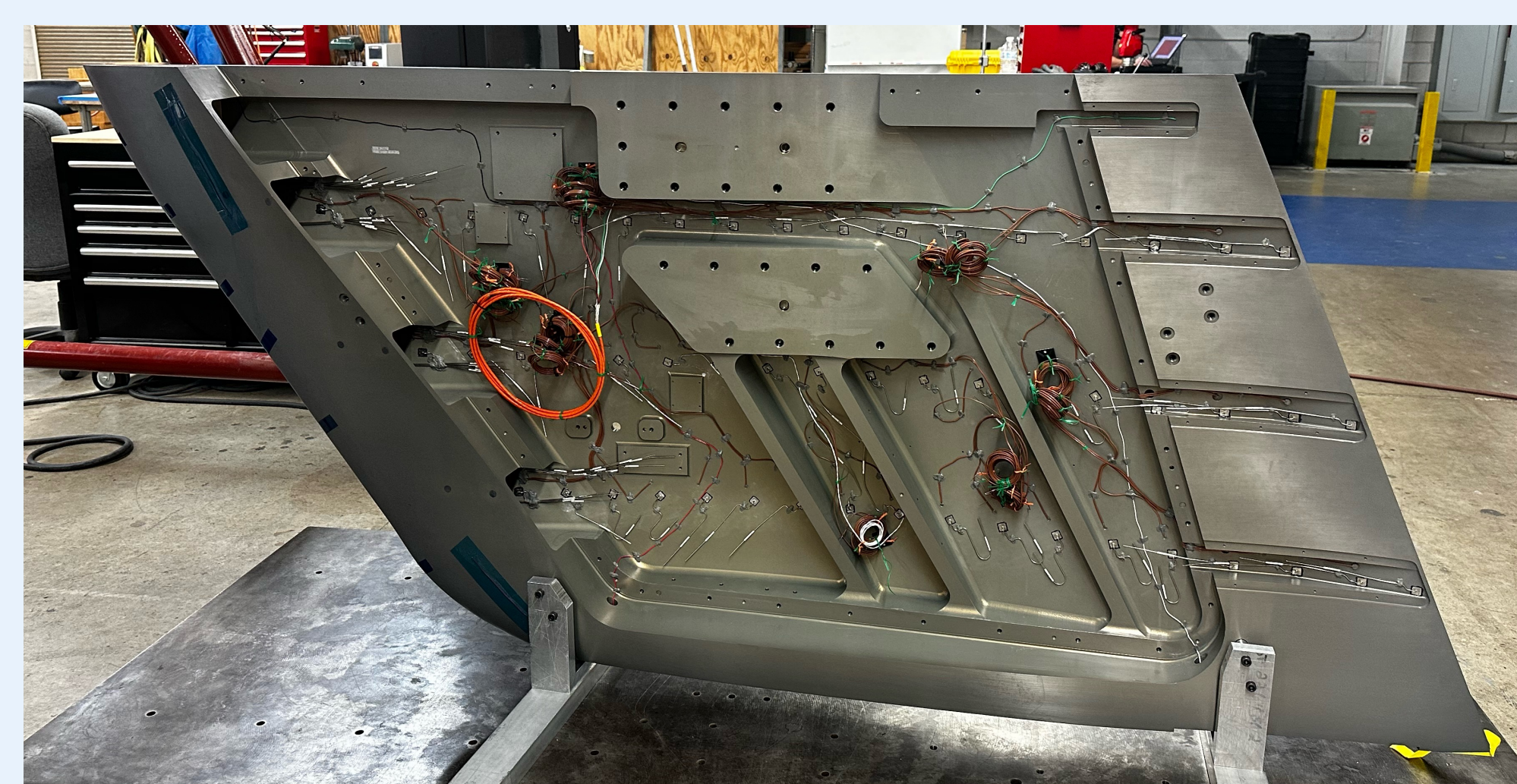


Results to Date

- Several Computational Fluid Dynamics (CFD) studies provided data needed to develop the technology
- A wind tunnel test in the National Transonic Facility was used to confirm the computational predictions
- A flight test utilizing the F-15B and Centerline Instrumented Pylon (CLIP) testbed is underway to advance the technology



Predictions of laminar flow extents on the CATNLF Flight Test article



Instrumentation cavity on the CATNLF Flight Test article

Current Flight Test Effort

- CATNLF Flight Test will provide opportunity to study laminar flow in a realistic flight environment
- A wing-like test article was designed using CATNLF technology to be flown underneath the F-15 and have large extents of laminar flow
- Test article is instrumented to gather useful experimental data to advance technology
- First flight scheduled for Summer 2024

IMAGINAVIATION

CATNLF Partners	Centers	• NASA Langley Research Center, Research Leads • NASA Armstrong Flight Research Center, Flight Test Leads
	Projects	• Advanced Air Transport Technology, Research Development • Flight Demonstrations and Capabilities, Flight Test Execution

