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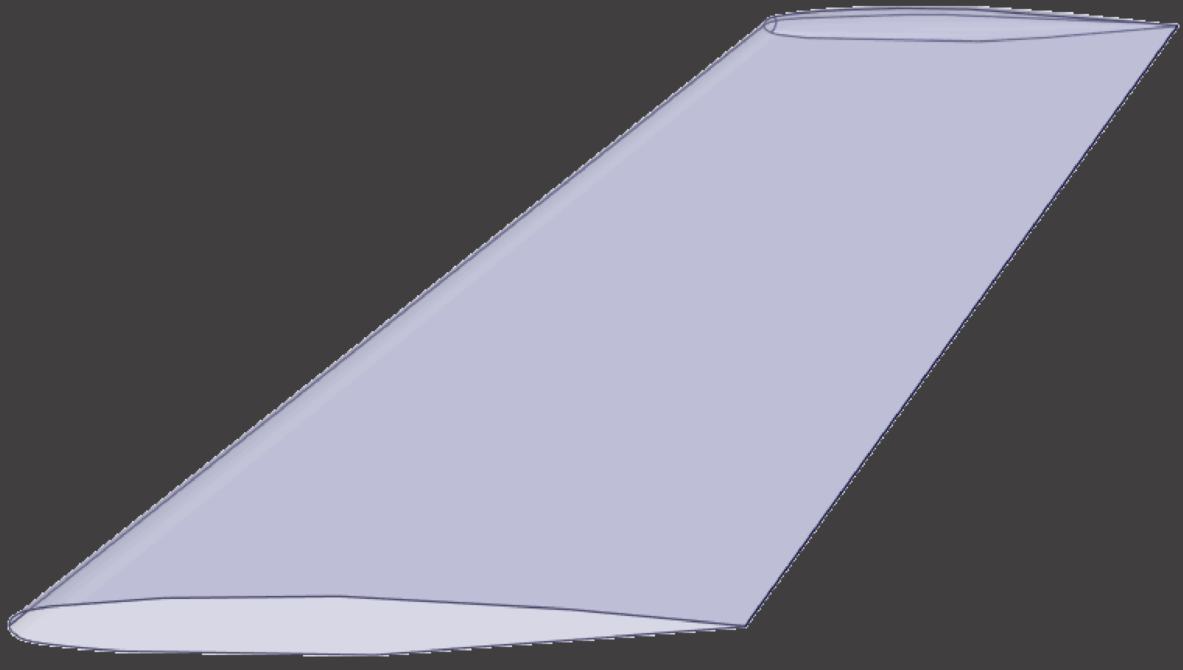
CASE STUDY · AEROSPACE

TRANSONIC WING STALL AT 10° AoA

COMPRESSIBLE CFD WITH NEXUS & ANSYS FLUENT

Tools Nexus · ANSYS Fluent 2026 R1 · CAD import
Outcome 50% engineering time saved · stall at 10° AoA diagnosed



WHAT'S INSIDE

A walk-through of how Nexus took a Transonic Wing Stall CFD study from ~12 hours of manual work down to ~6, collapsing the meshing-and-setup time. What the agent set up, where it made the non-obvious calls, and where the engineer simply confirmed.

SUMMARY

A full transonic stall study, simplified with Nexus. Setup, solved, and explained in half the time.

Nexus ran a complete transonic CFD study of an aircraft wing at a punishing 10° angle of attack (AoA), set up and solved end-to-end. Engineering time dropped from **12 hours to 6 hours**, and with the wing driven into stall to force the failure, Nexus identified the **shock-induced separation** that drives the drag up, pinpointing where and why the flow breaks down.

50%
ENGINEERING TIME SAVED

Mach 1.85
SUPERSONIC POCKET RESOLVED

0
CONTOURS BUILT BY HAND

PROBLEM

Transonic flow sits at the hard edge of external aerodynamics: the air over the wing turns supersonic and snaps back through a shock. It leaves an engineer caught between a setup too delicate to rush and an analysis too slow to repeat.

01 The setup is expert-gated

Turbulence model, wall treatment, compressible air: a transonic case needs the right calls, and they are not in a manual. Get one wrong and the stall moves.

02 The boundary layer is mesh-sensitive

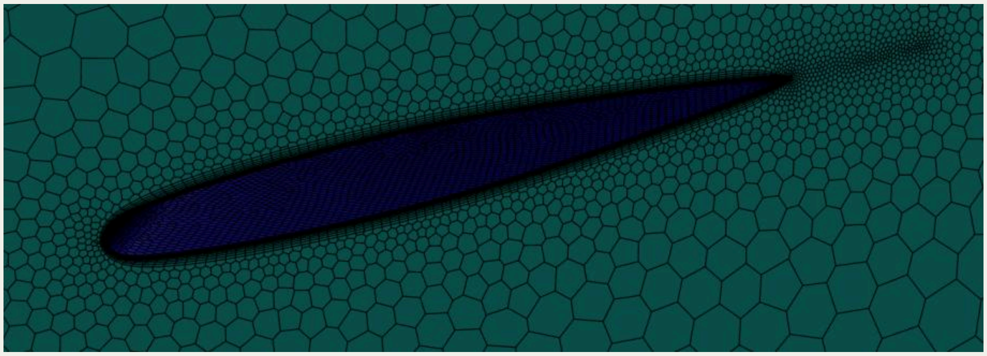
Eleven prism layers, sized by hand to catch the flow right at the wall, the part that decides whether the separation is real or an artifact.

+ Benefit to engineer

The agent does the setup and the math. The engineer verifies and signs off. The inputs and contours generated on request, and the result read back to the engineer: why the wing stalls, in plain language.

METHODOLOGY

A half-span wing was modeled on a symmetry plane and meshed with a poly-hexcore grid, resolving the near-wall flow with an 11-layer boundary layer, fine enough to catch where it separates behind the shock. With the flow at Mach 0.8395, the case was run compressible: ideal-gas air, temperature-dependent viscosity. Nexus proposed the turbulence and solver settings, worked out the 10° flow-direction components and reference areas, and ran the steady solve until the lift and drag coefficients settled.



POLY-HEXCORE MESH · SYMMETRY SECTION · 11-LAYER BOUNDARY LAYER · WAKE BODY-OF-INFLUENCE · 981,758 CELLS · AVG ORTHOGONAL QUALITY 0.93

SETTING	VALUE	
Solver	Pressure-based, steady	
Turbulence model	k-ω SST, automatic wall treatment	NEXUS
Material	Air: ideal-gas density, Sutherland-law viscosity	NEXUS
Pressure farfield	Mach 0.8395 · 0 Pa gauge · 255.56 K	
Flow direction (10° AoA)	(0.9848, 0, 0.1736)	NEXUS
Coupling & schemes	Coupled (Rhie-Chow) · 2nd-order · hybrid initialization	
Convergence	Lift & drag coefficients monitored to steady state	

+ Nexus proposed the transonic setup

k-ω SST with automatic wall treatment, ideal-gas air with Sutherland-law viscosity, and the farfield pressure condition, the standard recipe for compressible external aero.

+ The engineer stayed in the loop

Nexus made the setup calls and derived the inputs (chord, the 10° flow-direction components, planform and frontal area) while the engineer checked each call and signed off before solve.

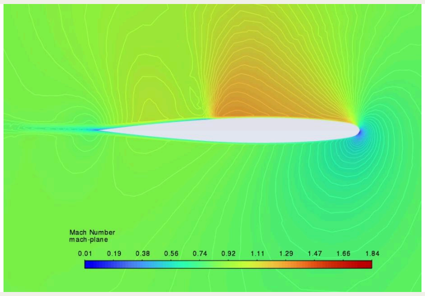
RESULTS

PHASE	MANUAL	WITH NEXUS	SAVINGS
Geometry prep & mesh generation	~4 h	~2 h	**–50%**
Case setup & running the solve	~4 h	~2 h	**–50%**
Post-processing & report prep	~4 h	~2 h	**–50%**
Total	**~12 h**	**~6 h**	**–50%**

Manual times are experience-based estimates; actual time varies with geometry, physics, and hardware.

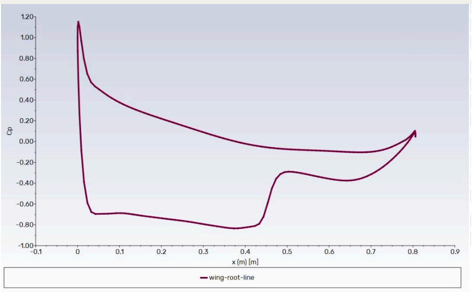
`RESULT · Cd 0.1104 · Cl 0.5029 · L/D 4.6`

Every figure below was produced in ANSYS Fluent during the session as Nexus ran the post-processing, resolving detail down to the shear layer at separation onset. The series of contours explains how the supersonic pocket ends in a shock, allowing the boundary layer to separate. The low-energy wake that follows drives Cd to 0.11 and L/D to 4.6.



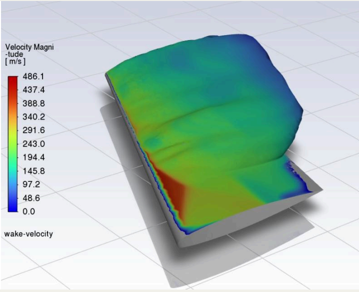
1 · Mach field: the supersonic pocket

Air over the wing accelerates past the speed of sound, peaking at Mach 1.85, then snaps back through a shock. This is where the trouble begins.



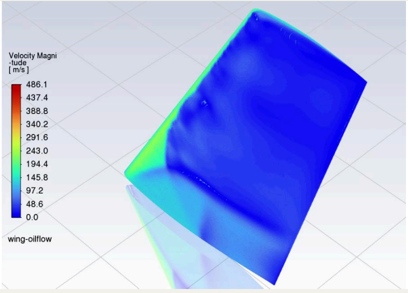
2 · Surface pressure: the shock's signature

The Cp curve holds a smooth suction plateau, then jumps sharply near mid-chord, the pressure rise across the shock, read straight off the wing.



3 · Separated wake: velocity in the deficit

Behind the shock the boundary layer lets go. A stagnant dead-air core (~0–50 m/s) sits beneath a fast shear layer (~240–390 m/s), and total pressure collapses from ~+39,700 Pa to near zero, the energy-dead wake that drives Cd to 0.11.



4 · Surface flow: the stall footprint

On the wing itself, the separation is pinned to the root leading edge, directly under the shock. This is where the stall lives.

AGENT DESIGN INPUT

After the run, the engineer asked Nexus to interpret the results. The agent explained why the wing stalls at 10° AoA, and pointed out which numbers are reliable and which are only approximate. It described the mechanism in plain terms, from the shock to the separated wake.

Takeaway

Nexus read the contours and found one cause. A pocket of supersonic flow forms over the wing, peaks at Mach 1.85, and terminates in a shock. The boundary layer cannot survive the pressure jump, so it separates, and the low-total-pressure wake behind it drives Cd to 0.11 and L/D to 4.6. Nexus placed the separation core at the root and leading-edge region of the upper surface, exactly where the shock terminates the supersonic pocket.

! Fidelity caveat, flagged by the agent first

The result comes from a single mesh with wall-function near-wall treatment (y+ ~171) and a steady solve, while shock-induced separation at this condition is genuinely unsteady. Skin friction and the exact separation extent are therefore approximate, and the coefficients should be read as directional. The mechanism (shock, separation, low-energy wake) holds regardless.

A Where the drag comes from

The high drag traces directly to the separated wake. With the boundary layer detached behind the shock and its total pressure collapsed, the wake is what pushes Cd to 0.11 and holds L/D at 4.6, steep penalties for a wing at only 10° AoA.

B How Nexus read the flow

Nexus did not plot everything at once. It chose the views that would expose the mechanism: the wake iso-surface, the surface pressure, and the shear layer at separation. The right contours are why the cause was visible at all.

→ Next steps and Nexus

The next step is to sweep the AoA downward and find where the separation clears. The setup already exists, so Nexus can re-run each new angle in minutes rather than rebuilding the case. That turns a single result into the wing's full usable envelope.

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Think through > click through. Let Nexus handle the rest.

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