# 3rd AIAA CFD High Lift Prediction Workshop
## *Official Test Cases*

## Test Cases and Grids

The test cases outlined in this document have been constructed to help achieve the goals of the High Lift Prediction Workshop (HiLiftPW). Participants are asked to provide flow solution data for these scenarios on a **common set of baseline grids** created by the workshop committee.

Unstructured, structured, and overset workshop-provided meshes will be available from the High Lift Prediction Workshop website: http://hiliftpw.larc.nasa.gov/Workshop3/grids.html.

Independently generated grids can be used, but participants are encouraged ***to run the requested cases on workshop-provided grids***. For more information on the parameters required to generate your own grids, see the Gridding Guidelines.

## Case 1: Grid Convergence Study

Flow solutions on a series of consistently refined fixed grids are requested to assess grid convergence. At a minimum, flow solutions should be provided for ***at least one family of coarse, medium, and fine workshop-provided meshes***. Providing the flow solution for the extra-fine mesh is optional.

### Geometry

The **NASA High Lift Common Research Model (HL-CRM)** is a wing-body high lift system that will be studied in a nominal landing configuration (slat and flaps deployed at 30° and 37°, respectively) without nacelle, pylon, tail, or support brackets.

### Case Parameters and Requirements

**Case 1a: Full Chord Flap Gap (REQUESTED)**

| | |
|---|---|
| Mach Number | 0.2 |
| Alphas | 8 and 16° |
| Reynolds Number based on MAC | 3.26 million |
| Reference Static Temperature | 518.67°R (=15.00°C=59.00°F) |
| Reference Static Pressure | 760.21 mmHg (=14.700 PSI) |
| Mean Aerodynamic Chord (MAC) | 275.8 inches full scale |
| Important Details: | • The intent here is to analyze the full-scale geometry at wind tunnel conditions. Instead of scaling the geometry down to 10% scale, we are analyzing the full-scale grid in a more viscous fluid. In other words, viscosity in this case is not sea level standard, but is scaled up appropriately, to achieve the desired Re of 3.26 million based on 275.8 inches for the full-scale model.<br>• Run simulations FULLY TURBULENT.<br>• This configuration is gapped approximately 1” full-scale between the inboard/outboard flaps and between inboard flap and side of body.<br>• All simulations are “free air”; no wind tunnel walls or model support systems. |

**Case 1b: Full Chord Flap Gap with Adaptation (OPTIONAL)**
Use grid refinement based on automatic solution adaptation and/or solution-guided grid regeneration to perform the required grid convergence study using the parameters from Case 1a.

**Case 1c: Partially-sealed Chord Flap Gap (OPTIONAL)**
Using the flow conditions from Case 1a, provide flow solutions for the medium grid only with a partial chord seal between the inboard and outboard flaps, and between the inboard flap and side of body.

**Case 1d: Partially-sealed Chord Flap Gap with Adaptation (OPTIONAL)**
Use grid refinement based on automatic solution adaptation and/or solution-guided grid regeneration to perform the required grid convergence study using the parameters from Case 1c.

# Case 2: Nacelle Installation Study

Flow solutions are required to assess the effects of adding a nacelle and pylon to the high lift system. At a minimum, flow solutions should be provided for ***at least one workshop-supplied medium grid.***

## Geometry

The **JAXA Standard Model (JSM)** is a wing-body high lift system that will be studied in a nominal landing configuration (single segment baseline slat and single segment 30° flap) with support brackets on, and nacelle/pylon on/off. The experiment used a semi-span model with a 60 mm peniche standoff, but requested computations are "free air."

## Case Parameters and Requirements

**Case 2a: Nacelle/Pylon OFF (REQUESTED)**

| | |
|---|---|
| Mach Number | 0.172 |
| Alphas | 4.36, 10.47, 14.54, 18.58, 20.59, and 21.57° |
| Reynolds Number based on MAC | 1.93 million |
| Reference Static Temperature | 551.79°R (=33.40°C=92.12°F) |
| Reference Static Pressure | 747.70 mmHg (=14.458 PSI) |
| Mean Aerodynamic Chord (MAC) | 529.2 mm model scale |
| Important Details: | • Run simulations FULLY TURBULENT and/or WITH SPECIFIED TRANSITION and/or WITH TRANSITION PREDICTION METHODS.<br>• All simulations are "free air"; no wind tunnel walls or model support systems. |

**Case 2b: Nacelle/Pylon OFF with Adaptation (OPTIONAL)**
Use grid refinement based on automatic solution adaptation and/or solution-guided grid regeneration to provide the required flow solutions using the parameters from Case 2a.

**Case 2c: Nacelle/Pylon ON (REQUESTED)**
Using the parameters from Case 2a, provide flow solutions for high lift configuration with the nacelle/pylon assembly ON.

**Case 2d: Nacelle/Pylon ON with Adaptation (OPTIONAL)**
Using the parameters from Case 2a, provide flow solutions for high lift configuration with the nacelle/pylon assembly ON using grid refinement based on automatic solution adaptation and/or solution-guided grid regeneration.

# Case 3: Turbulence Model Verification Study (REQUESTED)

The purpose of this case is to investigate the consistency in the implementation of turbulence models in a controlled grid-refinement study. The geometry is a 2-D DSMA661 (MODEL A) airfoil (see TMR website http://turbmodels.larc.nasa.gov/airfoilwakeverif.html). Case parameters are Mach=0.088, Re=1.2 million based on chord, reference freestream temperature=540°R, angle of attack=0°. This study looks at grid convergence of airfoil forces, as well as behavior of the velocity and turbulent shear stresses in the near wake. The behavior of wakes is relevant to high-lift configurations, because the wakes from upstream elements pass over and often interact with the boundary layers of downstream elements.

Grids from the TMR website (http://turbmodels.larc.nasa.gov/airfoilwake_grids.html) should be employed, if possible. Participants must run on at least the finest three grid levels provided (2241x385, 1121x193, and 561x97). I.e., at least three solutions (on three different successively-refined grids of the same family) are required in order to tell where the solution is headed as the grid is refined. Grid adaption may also be used to demonstrate grid convergence, if possible. However, the airfoil shape is not analytically defined. For this verification study you are asked to run the same turbulence model(s) being run for the other HiLiftPW-3 cases. RUN FULLY TURBULENT. For the SA and SST turbulence models, results are currently provided on the TMR website for comparison. If you are using a turbulence model other than SA or SST, your results will form the basis for future comparisons against other codes with the same model.

# Additional Information

Please check the website (http://hiliftpw.larc.nasa.gov) periodically for updates, and/or register with hiliftpw@gmail.com to be notified directly.