Buffet Working Group

Test Case 3

Version 3
March 25, 2026

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SHAPING THE FUTURE OF AEROSPACE

Change Log

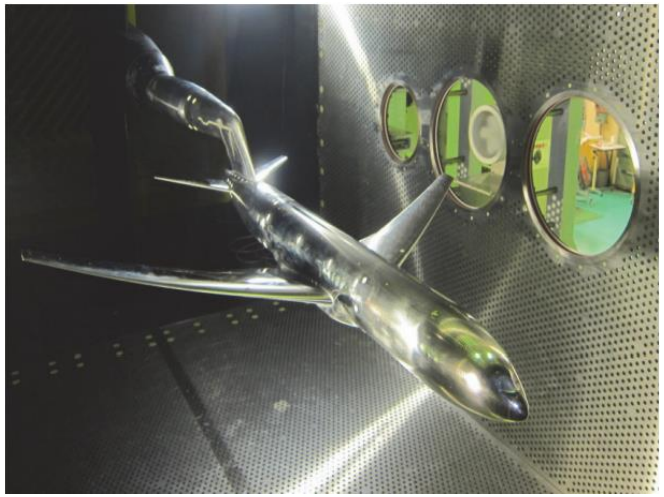
- **Version 3**
  - March 25, 2026
  - Retracted former Slide 7, “Deformation Measurements”
- **Version 2**
  - September 29, 2025
  - Updated geometry link on Slide 9 to point to the official, NASA-hosted geometry
- **Version 1**
  - September 16, 2025
  - First release

Test Case 3: Overview

- **CRM wing/body/tail0 configuration**
- **Unsteady CFD with dynamic wing**
- **Includes fluid/structure interaction**
- **Simulations executed at wind-tunnel scale**
  - Maximize consistency with dimensional FEMs and Test Case 2
  - Geometry and grids are model scale (2.16%)
- **Test Case 3**
  - Released 9/16/25
  - Data comparison to uPSP data set

Sugioka, Y., Nakakita, K., Koike, S. et al. Characteristic unsteady pressure field on a civil aircraft wing related to the onset of transonic buffet. Exp Fluids 62, 20 (2021). https://doi.org/10.1007/s00348-020-03118-y
Paper: `investigating copyright and ability to post`
Data available on: `to be determined`

Experimental Test



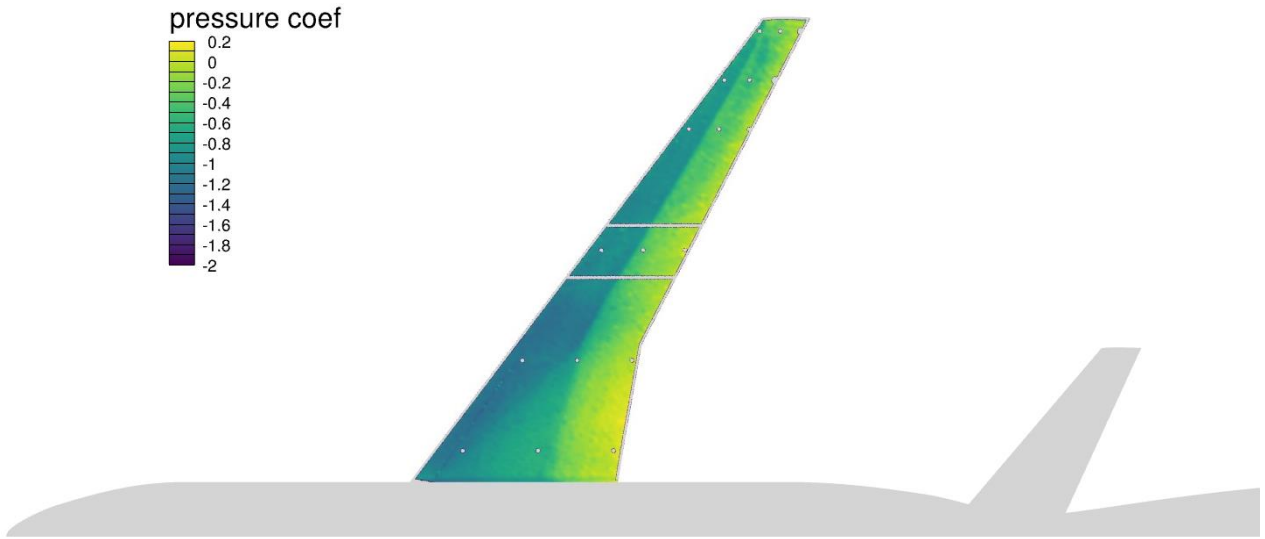
- **2.16% scale CRM (80% scale of NASA model) tested in JAXA 2m x 2m transonic wind tunnel**
  - Reynolds numbers of 2.3 million
  - Separate test, same model as Test Case 2 experiment
  - Rich set of unsteady pressure-sensitive paint (uPSP)
- **Model details**
  - 80% scale NASA CRM (2.16% full-scale vehicle)
  - Wing/body/tail
  - Wind-off wing shape is the as-defined (in 2008) 1-G shape (same as NASA CRM)
- **Corrections**
  - Data were re-reduced between paper publication and DPW-8/AePW-4
  - Updated alphas are about 0.1 deg less than the paper alphas
  - Use the workshop alphas

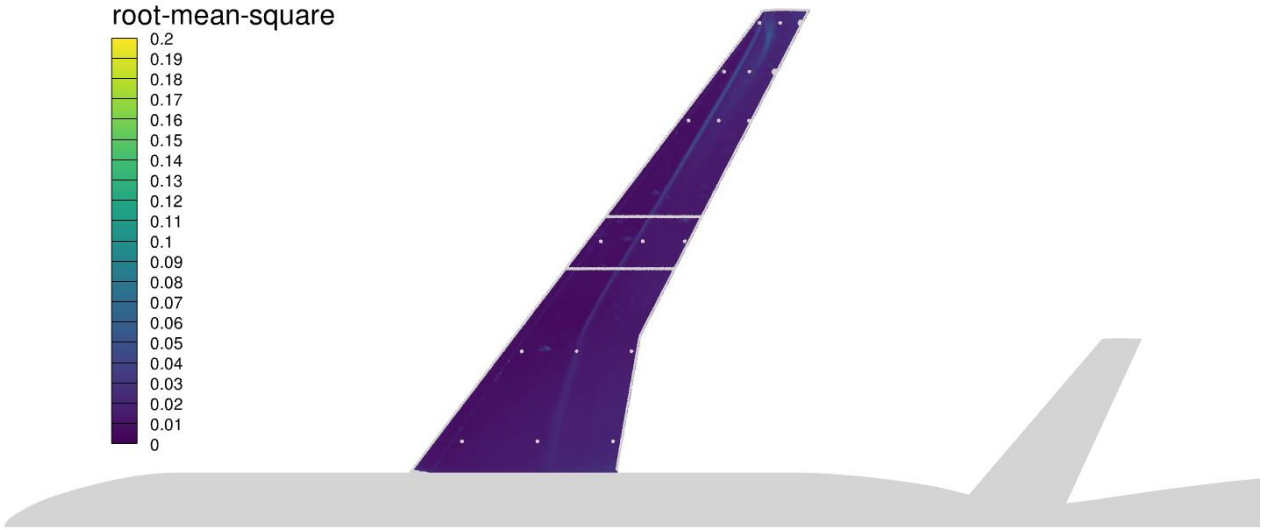
Experimental Data Available

Alpha	Geometry data			Balance	Pressure Sensors			
	Deformation data	CAD	FEM	Aerodynamic forces (CL,CD,CM)	Tap average pressure (η=0.5, 0.6)	Kulite RMS pressure (η=0.5, 0.6)	Kulite pressure histories (η=0.5, 0.6, one channel)	Kulite pressure PSD (η=0.5, 0.6, one channel)
3.05	N/A	●	●	Fig 10	Fig 6	Fig 7	N/A	Fig 8
3.61	N/A	●	●					
4.70	N/A	●	●					

Alpha	Strain	PSP						
	Wing-root strain gauge (buffet intensity coefficient)	PSP average pressure (η=0.5, 0.6)	PSP RMS pressure (η=0.5, 0.6)	PSP pressure PSD (η=0.5, 0.6, same x-location of Kulite channel)	PSP pressure PSD (η=0.5, 0.6, full x-St plane)	PSP average pressure (3D map on full wing)	PSP RMS pressure (3D map on full wing)	PSP Fluctuation snapshots (only a few* for one alpha)
3.05	Fig 11	Fig 6	Fig 7	Fig 8	Fig 17	Fig 12	Fig 15	Fig 14
3.61								
4.70								

PSP data





- **PSP data mapped on the CRM jig shape**
- **.plt files contains (x,y,z) coordinates, "PSP average pressure coefficient" and "PSP RMS pressure" data**
- **Mask has been applied to regions where data are not reliable:**
  - Unsteady pressure sensors lines
  - Markers
  - Areas near model edges

Simulation Conditions

- **Recommended to use your best practices from Test Case 2**
- **Freestream settings**
  - Mach 0.85
  - Re_c= 2.27m (based on chord length)
  - T_{total} = 326.15 K (127.4 F)
  - p_{total} = 120.0 kPa (17.4 psi)
  - q_∞ = 38.0 kPa (5.51 psi)
  - Alpha: 3.05, 3.61, 4.70 deg
- **Grids**
  - Baseline grid is Medium (L3)
  - Grid convergence study optional
- **Optional sensitivities**
  - Time step, simulation length, turbulence model, etc.

Alpha	Purpose
3.05	Pre-buffet, close to design point
3.61	Buffet onset
4.70	Post buffet

Geometry and Grid Files

- **Committee-supplied CAD for undeformed wing geometry ("jig")**
  - CRM wing/body/tail (0 deg tail deflection)
  - Jig wing geometry is available https://commonresearchmodel.larc.nasa.gov/geometry/dpw6-geometries/DPW6_CRM_wbnpt_ih+0_v09_2016-01-28_cf.*
- **Committee-supplied URANS grids**
  - Cadence, Helden, and Ames https://dpw.larc.nasa.gov/DPW8/Buffet/Test_Case_3
  - Recommended to use model-scale grids
  - Model scale maximizes postprocessing consistency and FEM compatibility
  - Scale-resolving schemes will need custom grids
  - Provide custom grids to the committee for posting to the DPW site

Time Step Settings

- **Goal**
  - Resolve wing structural dynamics
  - Capture as much of the spectra as reasonably possible
- **Recommended baseline settings**
  - 30 CTU after initial solution stabilized
  - 100 time steps per CTU
  - More CTU may be required to resolve frequency at high resolution
- **Limitations**
  - Computational resources will limit the user's selected time step and simulation time
  - Utilize your best practice for iterations per CTU and simulation length

Data Submission

- **Required**
  - Integrated Forces and Moments
  - Surface Cuts
  - Time Series of a Single Point at Kulite coordinates
  - Custom Grid Metrics (or clear reference to committee-supplied grids; this information must be submitted for inclusion in the ensemble analysis)
  - Boundary Layer Profiles
  - Geometry deformation data file (in preparation)
  - Surface contour .plt file for each condition (submit via Box)

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