

Buffet Working Group

Test Case 3



Version 2
September 16, 2025

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- **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

Characteristic unsteady pressure field on a civil aircraft wing related to the onset of transonic buffet

Research Article | Published: 08 January 2021

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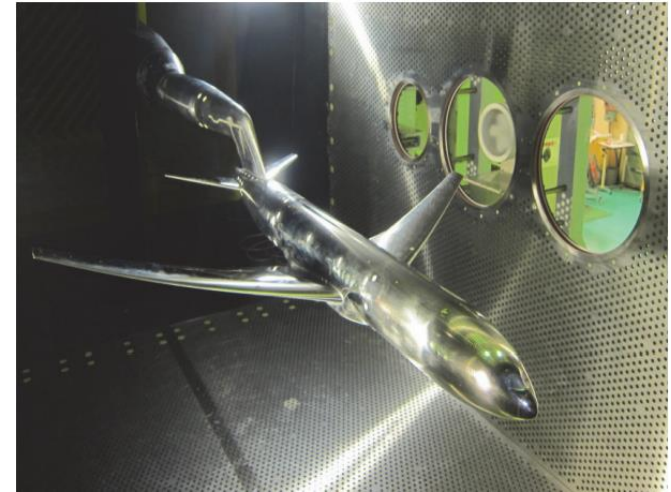
[Yosuke Sugioka](#) , [Kazuyuki Nakakita](#), [Shunsuke Koike](#), [Tsutomu Nakajima](#), [Taku Nonomura](#) & [Keisuke Asai](#)

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

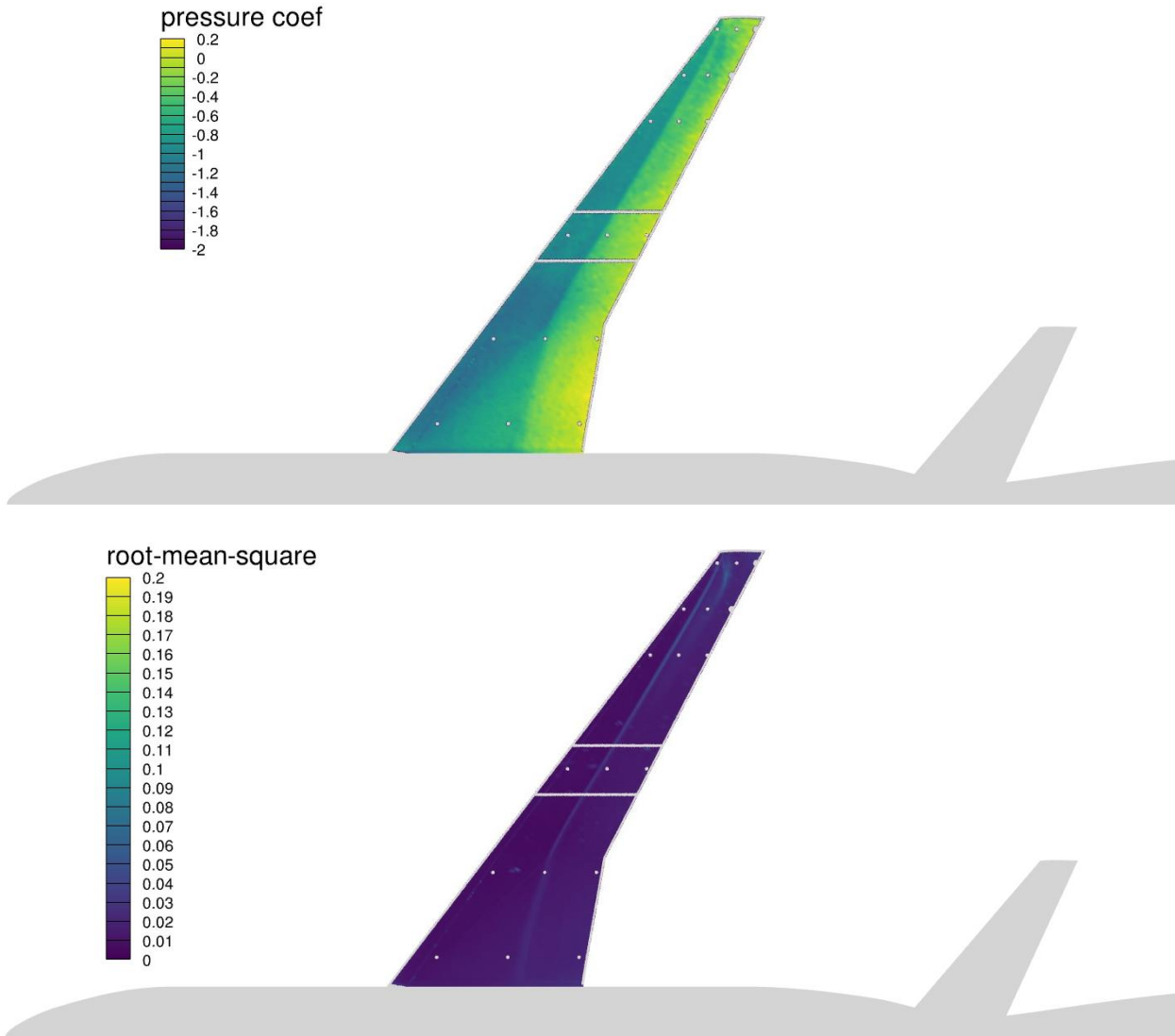
- **2.16% scale CRM (80% scale of NASA model) tested in JAXA 2m x 2m transonic wind tunnel**
 - Reynolds numbers of 2.3 million
 - Separate test, same model as Test Case 2 experiment
 - Rich set of unsteady pressure-sensitive paint (uPSP)
- **Model details**
 - 80% scale NASA CRM (2.16% full-scale vehicle)
 - 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

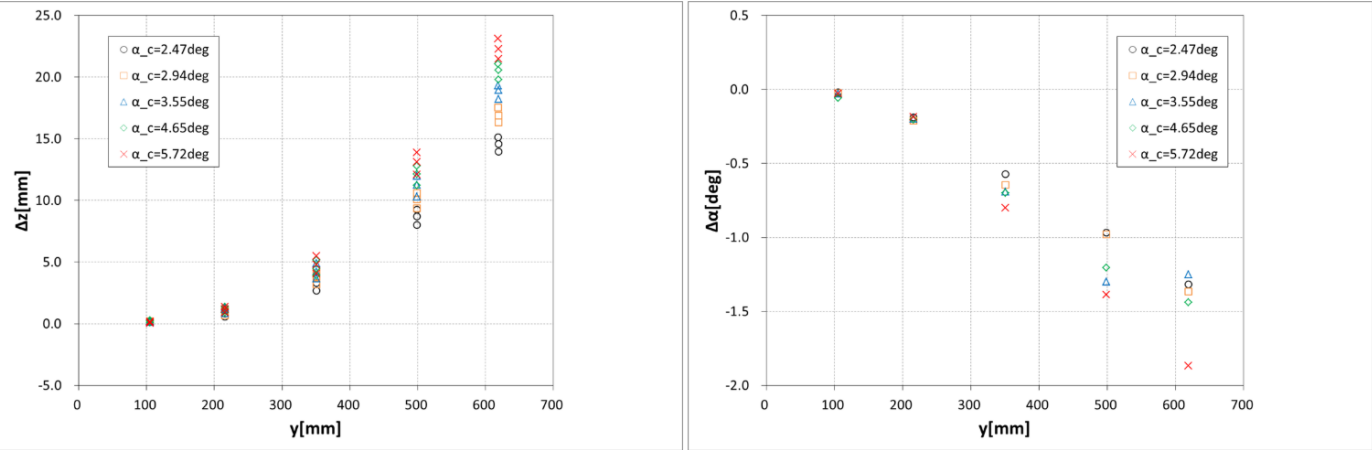
Alpha	Geometry data			Balance	Pressure Sensors			
	Deformation data	CAD	FEM	Aerodynamic forces (CL,CD,CM)	Tap average pressure ($\eta=0.5, 0.6$)	Kulite RMS pressure ($\eta=0.5, 0.6$)	Kulite pressure histories ($\eta=0.5, 0.6$, one channel)	Kulite pressure PSD ($\eta=0.5, 0.6$, one channel)
3.05	N/A	●	●	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 ($\eta=0.5, 0.6$)	PSP RMS pressure ($\eta=0.5, 0.6$)	PSP pressure PSD ($\eta=0.5, 0.6$, same x-location of Kulite channel)	PSP pressure PSD ($\eta=0.5, 0.6$, 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 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

Deformation Measurements



- Deformation measurements for this campaign are NOT available
- However, deformations for similar flow conditions, angles of attack and geometry exist
 - These will be made available for qualitative comparisons with the FSI results

変形前の計測座標位置				$\alpha_c = 2.47$		$\alpha_c = 2.94$		$\alpha_c = 3.55$		$\alpha_c = 4.65$		$\alpha_c = 5.72$	
マーカID	x[mm]	y[mm]	z[mm]	Δz [mm]	$\Delta \alpha$ [deg]	Δz [mm]	$\Delta \alpha$ [deg]	Δz [mm]	$\Delta \alpha$ [deg]	Δz [mm]	$\Delta \alpha$ [deg]	Δz [mm]	$\Delta \alpha$ [deg]
101	558.358	105.170	-15.720	0.115		0.134		0.122		0.107		0.041	
102	651.408	105.210	-22.210	0.111	-0.021	0.144	-0.025	0.217	-0.028	0.252	-0.057	0.149	-0.028
103	744.008	105.190	-35.750	0.175		0.210		0.201		0.268		0.116	
104	632.318	215.670	-16.200	0.551		0.673		0.853		0.897		0.919	
105	699.538	215.650	-16.140	0.813	-0.191	0.996	-0.211	1.191	-0.198	1.151	-0.206	1.195	-0.187
106	766.558	215.700	-23.570	0.992		1.162		1.313		1.376		1.355	
107	728.958	350.750	-9.920	2.669		3.189		3.662		3.908		4.051	
108	780.298	350.680	-7.290	3.295	-0.572	3.822	-0.645	4.213	-0.690	4.483	-0.701	4.802	-0.800
109	831.768	350.710	-11.600	3.695		4.346		4.900		5.167		5.487	
110	836.318	498.890	5.170	7.991		9.351		10.299		11.227		12.091	
111	873.118	498.930	7.680	8.685	-0.966	10.102	-0.979	11.267	-1.301	12.148	-1.204	13.110	-1.386
112	910.188	498.920	5.400	9.237		10.613		11.976		12.778		13.878	
113	923.188	618.870	23.300	13.968		16.344		18.230		19.805		21.475	
114	948.268	618.880	25.620	14.580	-1.318	16.885	-1.366	18.959	-1.250	20.549	-1.440	22.259	-1.869
115	973.498	618.830	24.840	15.128		17.545		19.325		21.073		23.117	

- Recommended to use your best practices from Test Case 2
- **Freestream settings**
 - Mach 0.85
 - $Re_c = 2.27m$ (based on chord length)
 - $T_{total} = 326.15\text{ K}$ (127.4 F)
 - $p_{total} = 120.0\text{ kPa}$ (17.4 psi)
 - $q_{\infty} = 38.0\text{ kPa}$ (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

- **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/Buffer/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

- **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

- **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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