

Buffet Working Group Test Cases Overview



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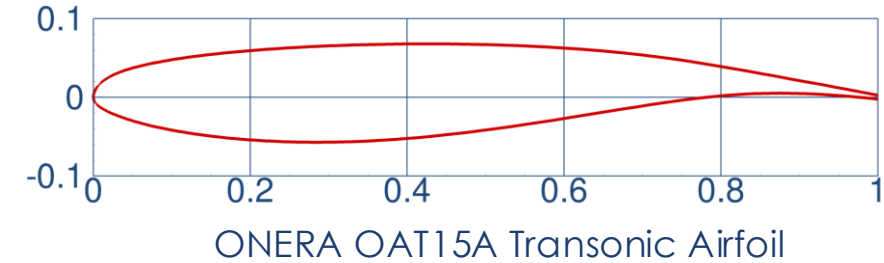


- **Three test cases**
- **Leveraged JAXA uPSP data set**
- **Test Case 1b**
 - Unsteady, high-alpha for the ONERA OAT15A transonic airfoil
 - “Ticket to entry” for the workshop
 - More difficult than anticipated
- **Test Case 2**
 - Unsteady CFD, static (committee-deformed) wing on the CRM
 - Committee-supplied geometry for all four alphas
 - Challenging and resulted in significant lessons learned
- **Test Case 3**
 - Unsteady CFD, dynamic wing on the CRM
 - Very difficult; committee-supplied jig geometry only

Test Case 1a: Workshop-Wide Validation

- **Validation of steady CFD analysis, required**
- **Users are encouraged to employ best practices**
- **Settings**
 - Steady CFD (e.g., RANS)
 - Prefer some version of SA, multiple turbulence models can be submitted
- **Grids**
 - Six-member grid family; four are required, six are desirable
 - Encourage use of committee-supplied grids; user-generated grids are acceptable
- **Conditions**
 - Mach 0.73, $Re_c=3M$
 - Alpha: 1.36, 1.50, 2.50, 3.00, 3.10 deg
 - Buffet WG supplement: 3.25, 3.40, 3.50, 3.60, 3.90 deg (all post buffet)
 - Matched experimental conditions

Jaquin, et al. "Experimental Study of Shock Oscillation over a Transonic Supercritical Profiles." AIAA Journal, Vol. 47, No. 9, 2009. Pages 1985-1994



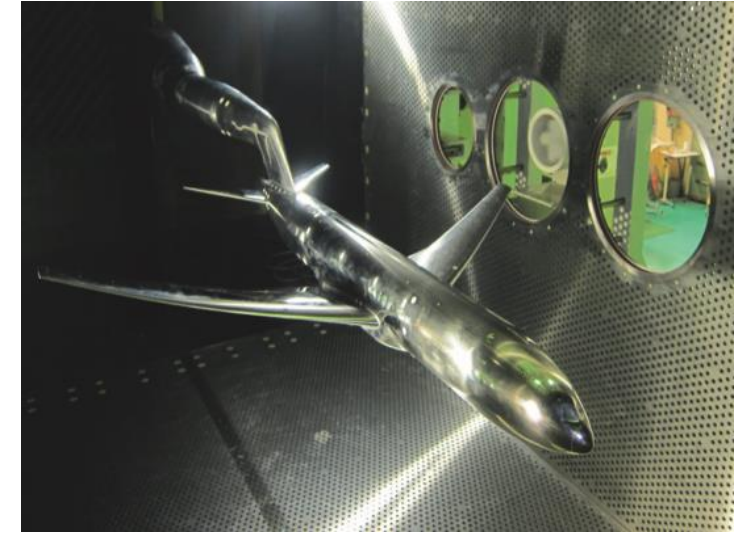
See [buffet-case1-v3.pdf](#) for more details

- **Extension of Test Case 1a**
- **Unsteady CFD (e.g., URANS, DES, WMLES, LES, etc.)**
- **Minimal standardized metrics/settings provided**
 - Users encouraged to employ best practices
 - Custom grids permitted; public release requested
- **Validate computational approach for Test Cases 2 and 3**
- **Key metrics of interest**
 - $C_{P,rms}$
 - Residual convergence

See [buffet-case1-v3.pdf](#) for more details

Test Case 2: Overview

- CRM wing/body/tail configuration
- Unsteady CFD with committee-supplied static wing geometry (no FSI)
- **Committee-supplied URANS grids**
 - Extension of DPW-established RANS best practices
 - Scale-resolving schemes require custom grids
 - Baseline grid is L3
 - Grid convergence encouraged but not required
- **Setup sensitivities encouraged but not required**
- **Conditions**
 - Mach 0.85, $Re_c \sim 1.5M$
 - Alpha: 1.22, 2.29, 4.84, 5.89 deg

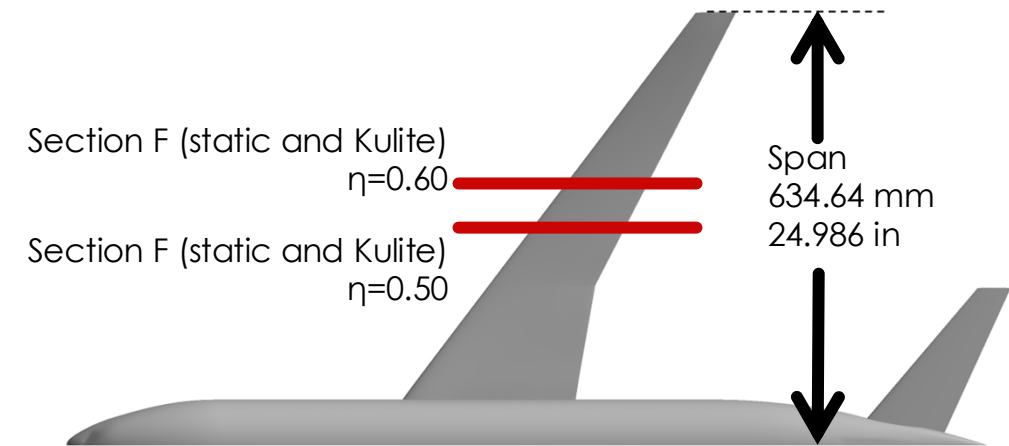


Source: Koike 2016
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See [buffet-case2-v5.pdf](#) for more details

Test Case 2: Experimental Test

- **2.16% scale CRM (80% scale of NASA model) tested in JAXA 2m x 2m transonic wind tunnel**
 - Reynolds numbers of 1.5 and 2.3 million
 - Rich data set of steady and unsteady data
 - Wind-off wing shape is the NASA CRM
- **Experimental data**
 - Static pressure taps
 - Belts of Kulites at $\eta=0.50$ and 0.60
 - Time-averaged F&M
 - Static time-averaged deformation metrics
 - PSDs
 - Data available on JAXA website



Source:
Adapted from Data 2026
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DPW-8 Test Case 2: Experimental data

The data shown in this page are measured on the 2.16% NASA-CRM model using JAXA wind tunnel test.

Reference Area, $S = 0.179014 \text{ m}^2$

Reference Chord, $c = 0.15131 \text{ m}$ (= MAC)

Reference Span, $b = 1.26927 \text{ m}$ (= span)

Moment Reference (X,Y,Z) = (0.72741, 0.0, 0.097627) m

For more details on the data, see the following reference (available from the NASA Common Research Model website <https://www.nasa.gov/research-models/main/crm/>):

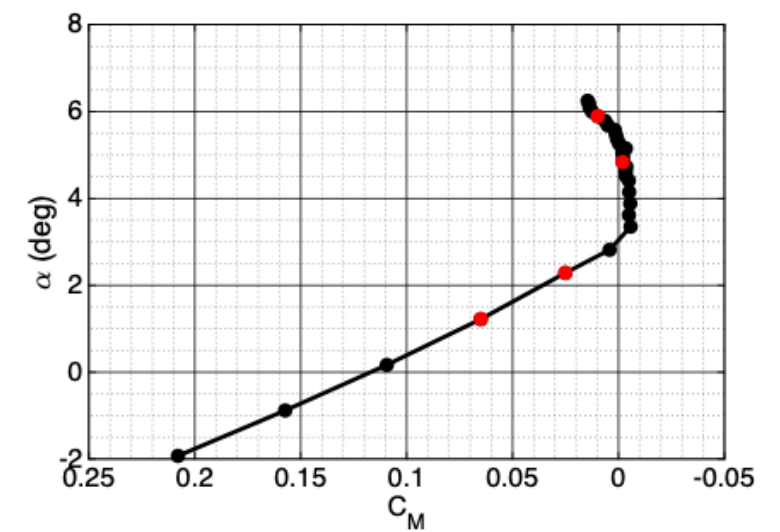
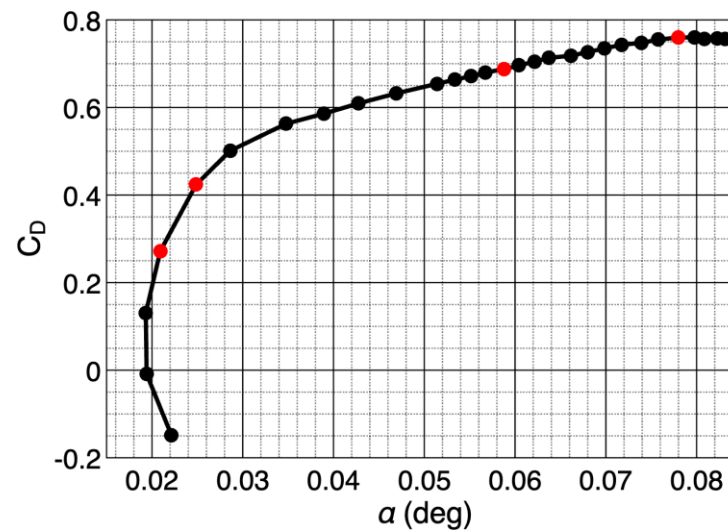
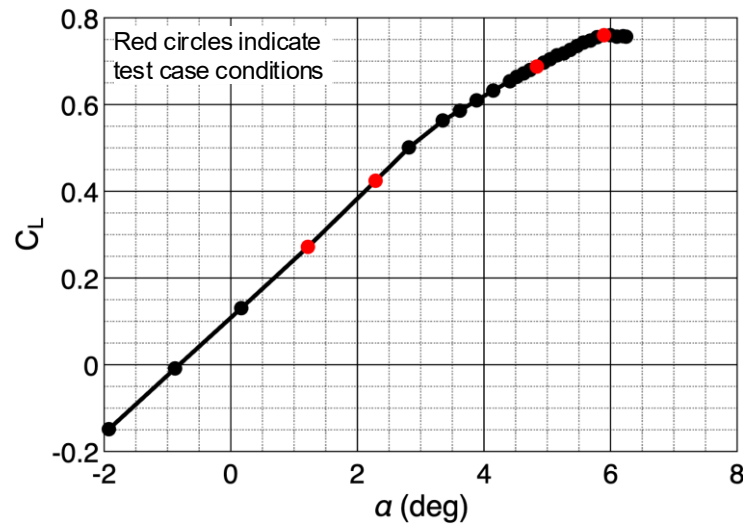
Shunsuke Koike, Makoto Ueno, Kazuyuki Nakakita and Atsushi Hashimoto, "Unsteady Pressure Measurement of Transonic Buffet on NASA Common Research Model", AIAA 2016-4044, June 2016.

Information on trip dots

Trip	Aeronautical trip dot (CAD Cut)
Diameter [mm]	1.27
Distance (between dot centers) [mm]	2.54
Height (main wing) [mm]	0.11430 (inner-wing) 0.09906 (mid-wing) 0.08890 (outer-wing)
Location (main wing)	10% chord (upper and lower sides)

Source: Data 2026

Test Case 2: Experimental F&M Results

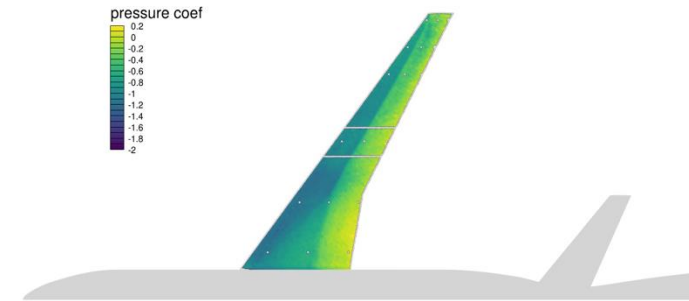
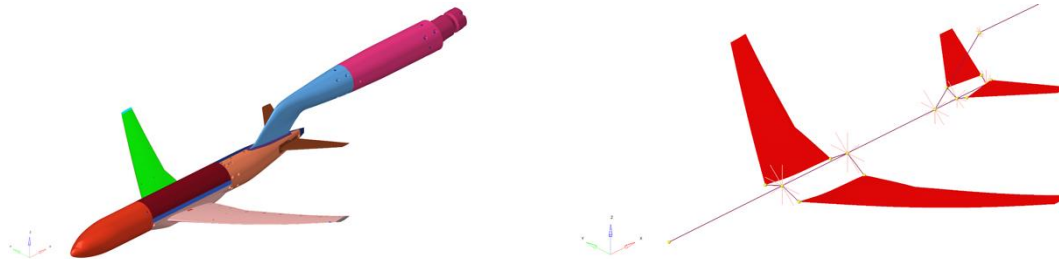


- **CRM wing/body/tail0 configuration**
- **Unsteady CFD with a dynamic wing (unsteady FSI)**
- **Committee-supplied jig URANS grids**
 - Same gridding parameters as Test Case 2
 - Only provided jig geometry (deformed not available from experiment)
- **Extremely challenging test case**
 - Designed to establish the capabilities of codes
 - Computationally expensive
 - Difficult grid movement
 - Work-in-progress submissions encouraged and accepted
- **Conditions**
 - Mach 0.85, $Re_c \sim 2.3M$
 - Alpha: 3.05 deg (pre-buffet), 3.61 deg (buffet onset), 4.70 deg (post-buffet)

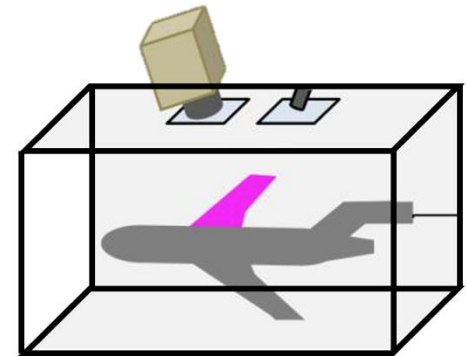
See [buffet-case3-v4.pdf](#) for more details

Test Case 3: Experimental Data & FEM

- Same test setup as Test Case 2
- Rich data set
 - F&M, Kulites, and uPSP
 - Static unloaded jig geometry (no deformation metrics)
 - uPSP data released as Tecplot-readable binaries
- New FEMs created
 - Tet-blasted full and half-span Nastran FEMS created but not cleared for export
 - Simpler stick/plate model has been released
 - Data and FEMs available on JAXA website



Source: Adapted from Data 2026
Courtesy A. Sansica
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Source: Adapted from Sugioka 2015
Used by permission

- Sugioka 2015 Sugioka, S., Numata, D., Asai, K., Shunsuka, K., Nakakita, K., and Koga, S. "Unsteady PSP Measurement of Transonic Buffet on a Wing." AIAA Paper 2015-0025. AIAA SciTech Forum. Kissimmee, FL. January, 2015.
- Koike 2016 Koike, S., Ueno, M., Nakakita, K., and Hashimoto, A. "Unsteady Pressure Measurement of Transonic Buffet on NASA Common Research Model." AIAA Paper 2016-4044. AIAA AVIATION Forum. Washington, DC. June, 2016.
- Data 2026 <https://cfdws.chofu.jaxa.jp/apc/dpw>

