

Ice Prediction Workshop 2

Test Case Descriptions

IPW Organizing Committee

Oct 25, 2022

Revision log

- October 25, 2022
 - Initial version

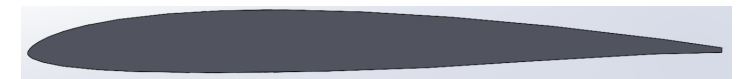
Configurations Summary



Case 1: CRM-65 Mid-span Hybrid (3D)



Case 2: CRM-65 Inboard Hybrid (3D)



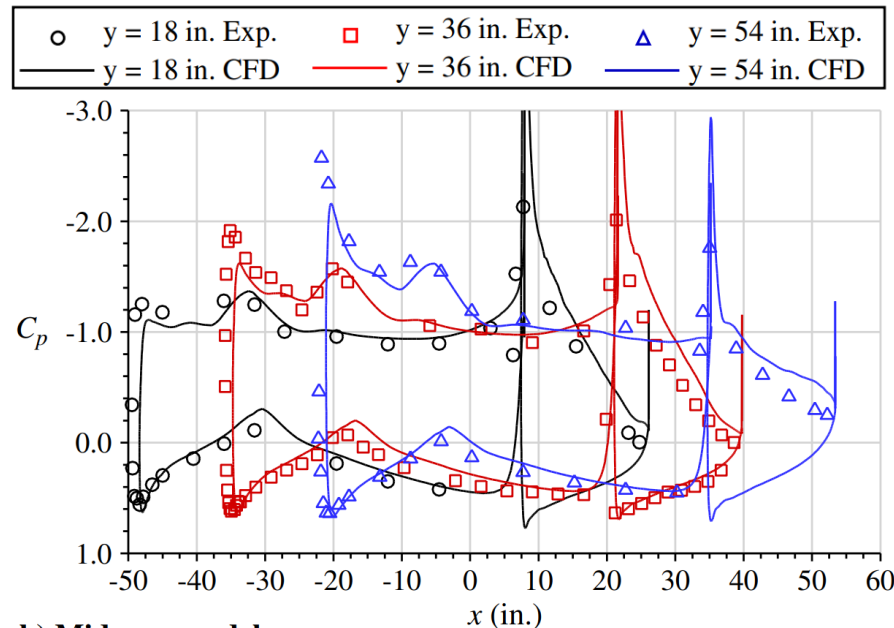
Case 3: UAV airfoil, low-Re (2D)

Case list overview

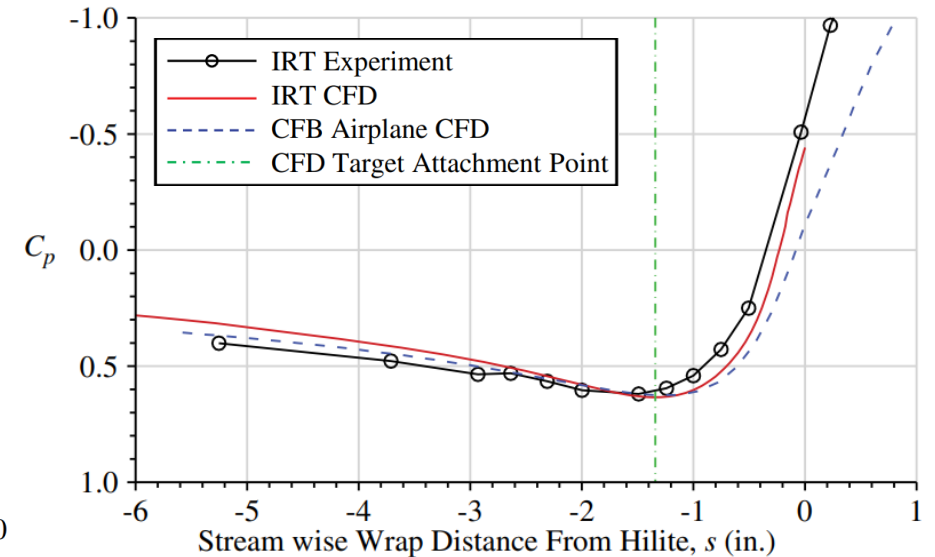
IPW-2 Case no.	Configuration	AoA	Speed	T _{total} (°C)	LWC (g/m ³)	MVD (μm)	Icing Time (minutes)
1.1	CRM65 Mid-span	3.7	130 kts	-1.4	1.0	25	29
1.2	CRM65 Mid-span	3.7	130 kts	-6.3	1.0	25	29
1.3	CRM65 Mid-span	3.7	130 kts	-23.8	1.0	25	29
2.1	CRM65 Inboard	3.7	130 kts	-1.4	1.0	25	29
2.2	CRM65 Inboard	3.7	130 kts	-6.3	1.0	25	29
2.3	CRM65 Inboard	3.7	130 kts	-23.8	1.0	25	29
3.1	Small UAV wing	0	25 m/s	-2	0.44	24	20
3.2	Small UAV wing	0	25 m/s	-4	0.44	24	20
3.3	Small UAV wing	0	25 m/s	-10	0.44	24	20

Cases 1.1-1.3: CRM65 Mid-span

IPW-2 Case no	AoA (deg.)	Flap angle (deg.)	Speed (knots)	Speed (m/s)	T_{total} (°C)	T_{static} (°C)	P_{total} (kPa)	P_{static} (kPa)	MVD (μ m)	LWC (g/m ³)	Time (min.)	Freezing fraction	2015 ice mass (kg/m)	2021 ice mass (kg/m)	2022 ice mass (kg/m)
1.1	3.7	25.0	130	66.9	-1.4	-3.6	99.3	96.5	25	1.0	29.0	0.12	4.17	3.75	3.70
1.2	3.7	25.0	130	66.9	-6.3	-8.5	97.5	94.7	25	1.0	29.0	0.35	6.42	6.64	5.93
1.3	3.7	25.0	130	66.9	-23.8	-26.0	99.3	96.3	25	1.0	29.0	1.00	6.5	5.43	5.30

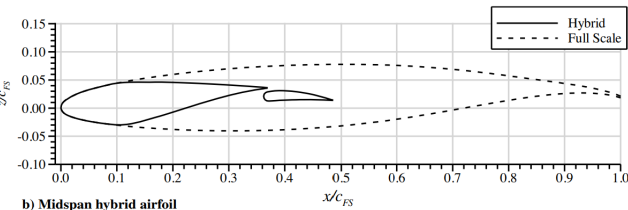


b) Midspan model



b) Midspan model

- Workshop CAD and grids are provided with AoA and flap angle built-in
- Pressure coefficients are based on inlet static pressure and density: CFD results that set back pressure at tunnel exit should use converged inlet static pressure as reference when computing C_p .

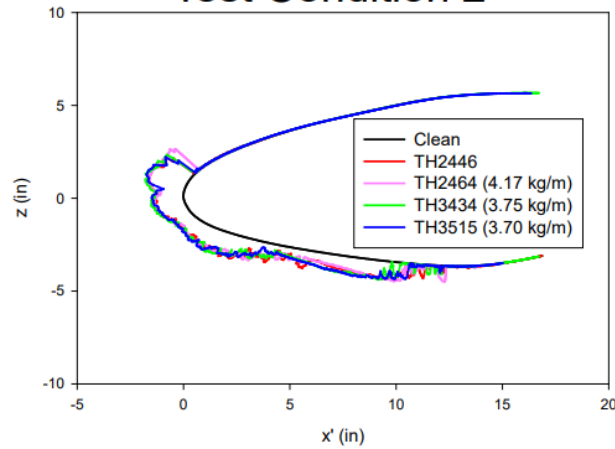


b) Midspan hybrid airfoil

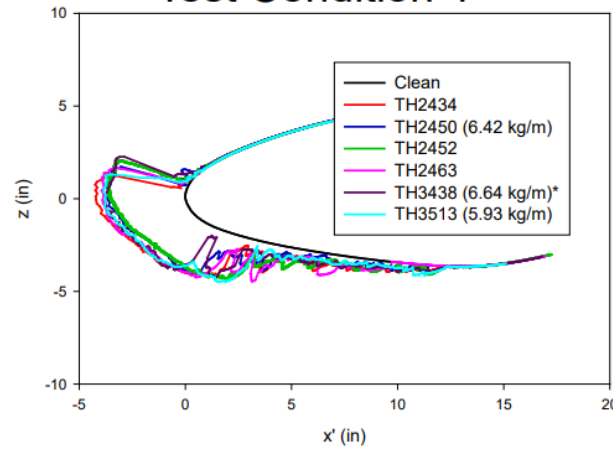
Cases 1.1-1.3: CRM65 Mid-span: Comparison of MCCS

IPW-2 Case no	AoA (deg.)	Flap angle (deg.)	Speed (knots)	Speed (m/s)	T _{total} (°C)	T _{static} (°C)	P _{total} (kPa)	P _{static} (kPa)	MVD (μm)	LWC (g/m ³)	Time (min.)	Freezing fraction	2015 ice mass (kg/m)	2021 ice mass (kg/m)	2022 ice mass (kg/m)
1.1	3.7	25.0	130	66.9	-1.4	-3.6	99.3	96.5	25	1.0	29.0	0.12	4.17	3.75	3.70
1.2	3.7	25.0	130	66.9	-6.3	-8.5	97.5	94.7	25	1.0	29.0	0.35	6.42	6.64	5.93
1.3	3.7	25.0	130	66.9	-23.8	-26.0	99.3	96.3	25	1.0	29.0	1.00	6.5	5.43	5.30

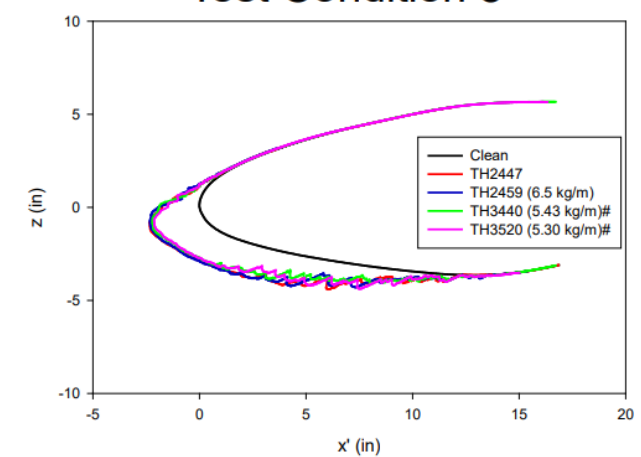
Test Condition 2



Test Condition 4



Test Condition 8



Case 1.1



Case 1.2

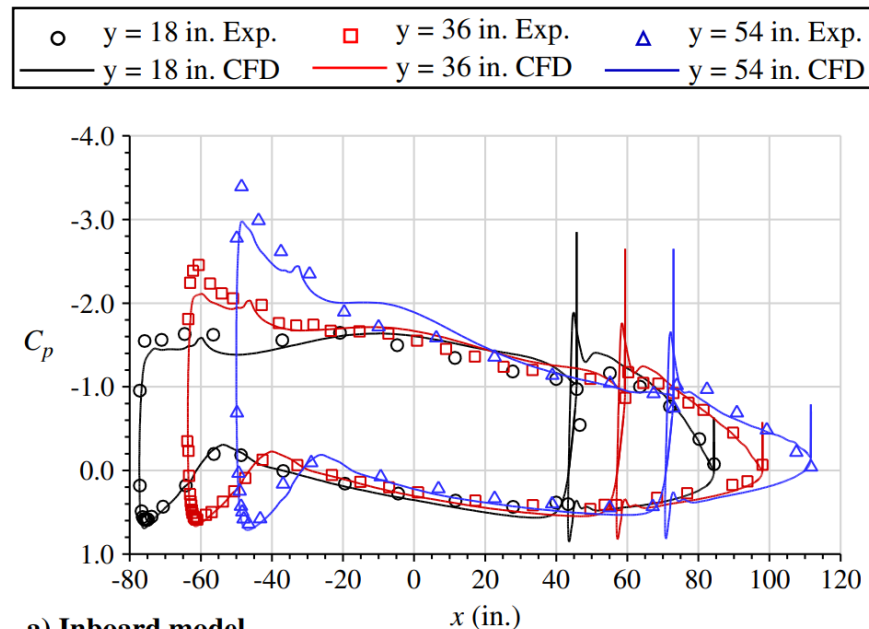


Case 1.3

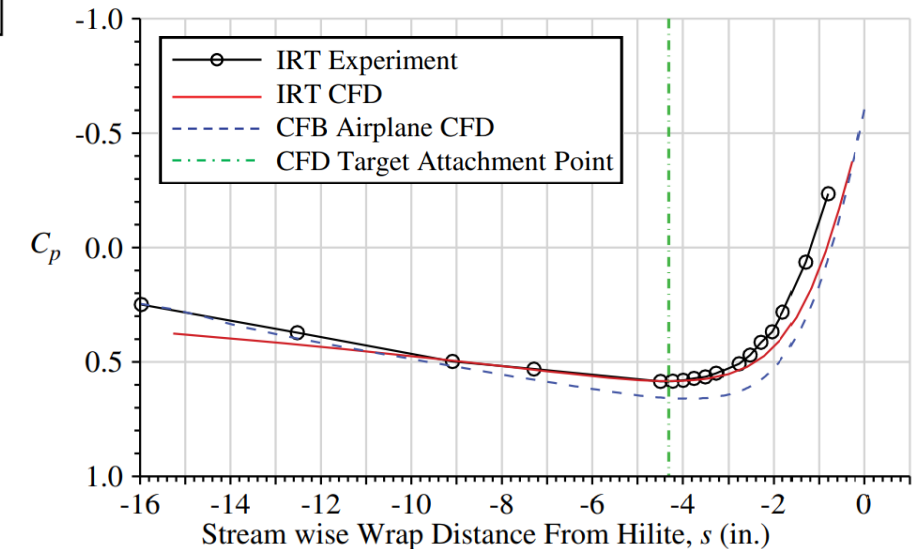


Cases 2.1-2.3: CRM65 Inboard

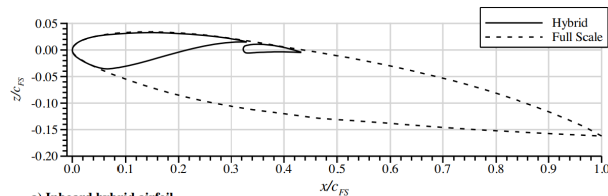
IPW-2 Case no	AoA (deg.)	Flap angle (deg.)	Speed (knots)	Speed (m/s)	T_{total} (°C)	T_{static} (°C)	P_{total} (kPa)	P_{static} (kPa)	MVD (μm)	LWC (g/m ³)	Time (min.)	Freezing fraction	2015 ice mass (kg/m)
2.1	3.7	13.8	130	66.9	-1.4	-3.6	99.3	96.5	25	1.0	29.0	0.12	4.92
2.2	3.7	13.8	130	66.9	-6.3	-8.5	100.7	97.8	25	1.0	29.0	0.35	8.22
2.3	3.7	13.8	130	66.9	-23.8	-26.0	99.3	96.3	25	1.0	29.0	1.00	7.90



a) Inboard model



a) Inboard model



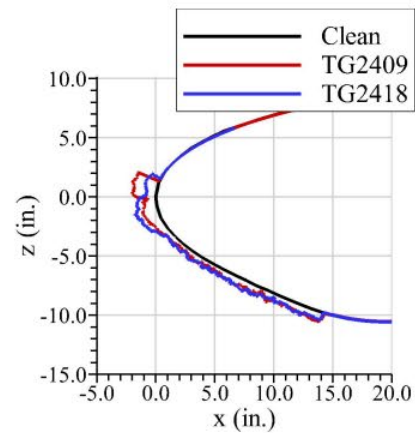
a) Inboard hybrid airfoil

- Workshop CAD and grids are provided with AoA and flap angle built-in
- Pressure coefficients are based on inlet static pressure and density: CFD results that set back pressure at tunnel exit should use converged inlet static pressure as reference when computing C_p .

Cases 2.1-2.3: CRM65 Inboard: Comparison of MCCS

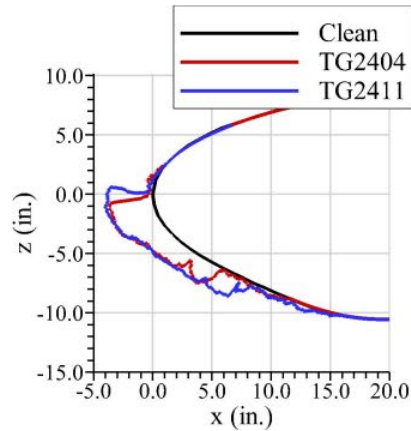
IPW-2 Case no	AoA (deg.)	Flap angle (deg.)	Speed (knots)	Speed (m/s)	T_{total} (°C)	T_{static} (°C)	P_{total} (kPa)	P_{static} (kPa)	MVD (μm)	LWC (g/m ³)	Time (min.)	Freezing fraction	2015 ice mass (kg/m)
2.1	3.7	13.8	130	66.9	-1.4	-3.6	99.3	96.5	25	1.0	29.0	0.12	4.92
2.2	3.7	13.8	130	66.9	-6.3	-8.5	100.7	97.8	25	1.0	29.0	0.35	8.22
2.3	3.7	13.8	130	66.9	-23.8	-26.0	99.3	96.3	25	1.0	29.0	1.00	7.90

Test Condition 2



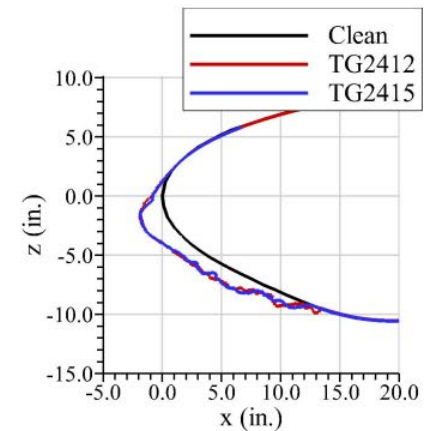
Case 2.1

Test Condition 4



Case 2.2

Test Condition 8



Case 2.3

Cases 3.1-3.3: Small UAV airfoil

IPW-2 Case no.	AoA (deg.)	Speed (m/s)	T _{total} (°C)	T _{static} (°C)	P _{static} (kPa)	MVD (μm)	LWC (g/m ³)	Time (min.)
3.1	0	25	-2	-2.3	101.3	24	0.44	20
3.2	0	25	-4	-4.3	101.3	24	0.44	20
3.3	0	25	-10	-10.3	101.3	24	0.44	20

