Ice Prediction Workshop
Test Case Descriptions

IPW Organizing Committee

April 28, 2021

Revision log

- April 28, 2021
  - Updated links in document.
- March 18, 2021
  - Updated temperature and pressure for horizontal tail and three-element-airfoil impingement cases (111, 112, 121, 122)
- February 25, 2021
  - Links provided to the 27-bin distribution files provided on the website for the impingement cases
- February 5, 2021
  - Corrected the typo in case 112 description of MVD from 92 to 21
  - Added figures describing how collection efficiency is calculated
- January 7, 2021
  - Updated conditions for the icing runs, highlighted in yellow, which are different than the published values
  - Added case numbers
- September 17, 2020
  - Initial version

Configurations Summary

Baseline Configurations

- Ice accretion on 3D Geometry
  - 36-inch chord NACA 0012, 30 deg. sweep, AoA = 0 deg.
  - 36-inch chord NACA 0012, 45 deg. sweep, AoA = 0 deg.
- Ice accretion on 2D Geometry
  - 18-inch chord NACA 23012, AoA = 2 deg.
- Collection efficiency on 3D Geometry
  - NACA 64A008 finite swept tail, AoA = 6 deg.
  - Three element airfoil, 36-inch nested chord, AoA = 4 deg.

Optional Configurations

- Ice accretion on 3D Geometry
  - 36-inch chord NACA 0012, 30 deg. sweep
- Ice accretion on 2D Geometry
  - 72-inch chord NACA 23012
- Collection efficiency on 3D Geometry
  - Three element airfoil, 36-inch nested chord, AoA = 4 deg.
  - Axisymmetric inlet at AoA = 15 deg.

Test Case Summary

Category	Configuration	Baseline	Optional
Ice Accretion on 3D Geometry	NACA 0012, 30 deg sweep	2	2
	NACA 0012, 45 deg sweep	2	0
Ice Accretion on 2D Geometry	18-inch chord NACA 23012	2	0
	72-inch chord NACA 23012	0	2
Droplet Impingement	NACA 64A008 finite swept tail	1	1
	Multi-element airfoil	1	1
	Axisymmetric inlet at $\alpha = 15°$	0	2

Case list

Case no	Category	Configuration	Baseline/optional	Basic info
case-111	Droplet impingement	NACA 64A008 finite swept tail	Baseline	MVD 21
case-112	Droplet impingement	NACA 64A008 finite swept tail	Optional	MVD 92
case-121	Droplet impingement	Three-element-airfoil	Baseline	MVD 21
case-122	Droplet impingement	Three-element-airfoil	Optional	MVD 92
case-131	Droplet impingement	Axisymmetric inlet at α = 15°	Optional	Low mass flow
case-132	Droplet impingement	Axisymmetric inlet at α = 15°	Optional	High mass flow
case-241	Ice Accretion on 2D Geometry	18-inch chord NACA 23012	Baseline	Rime ice
case-242	Ice Accretion on 2D Geometry	18-inch chord NACA 23012	Baseline	Glaze ice
case-251	Ice Accretion on 2D Geometry	72-inch chord NACA 23012	Optional	Monomodal SLD
case-252	Ice Accretion on 2D Geometry	72-inch chord NACA 23012	Optional	Bimodal SLD
case-361	Ice Accretion on 3D Geometry	NACA 0012, 30 deg sweep	Baseline	Rime ice
case-362	Ice Accretion on 3D Geometry	NACA 0012, 30 deg sweep	Baseline	Glaze ice
case-363	Ice Accretion on 3D Geometry	NACA 0012, 30 deg sweep	Optional	3D scan, Ts = -10C
case-364	Ice Accretion on 3D Geometry	NACA 0012, 30 deg sweep	Optional	3D scan, Ts = -13.4C
case-371	Ice Accretion on 3D Geometry	NACA 0012, 45 deg sweep	Baseline	Rime ice
case-372	Ice Accretion on 3D Geometry	NACA 0012, 45 deg sweep	Baseline	Glaze ice

Case-111: Droplet Impingement: NACA 64A008 H-Tail, α = 6, MVD 21

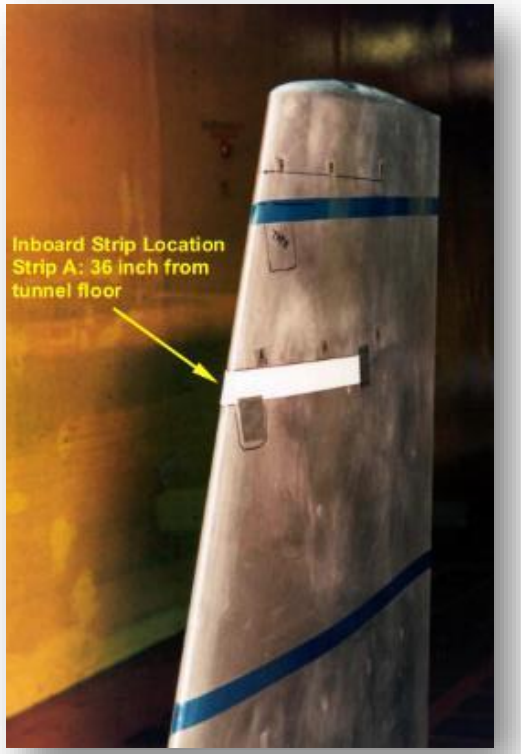
Baseline

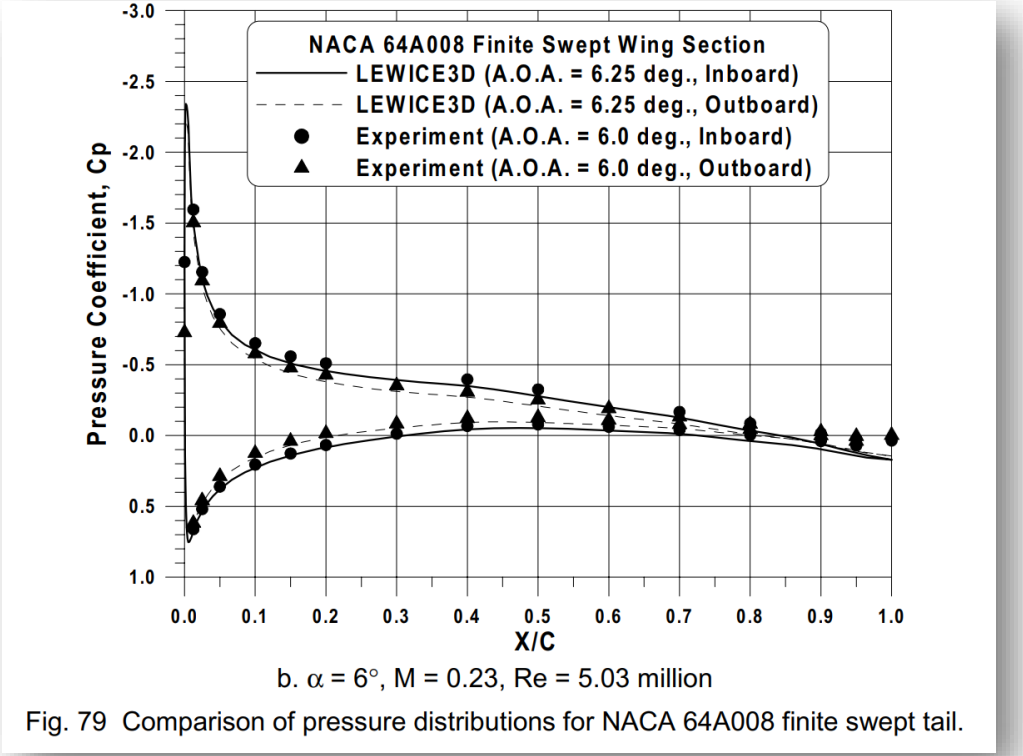
Conditions

- MVD = 21 microns
- Speed = 78.68 m/s (176 mph)
- Mach = 0.23
- Mean Aerodynamic Chord = 37.65"
- Reynolds = 5 million
- Static Temperature = 280K
- Static Pressure = 95147 Pa
- 27-bin distribution

Available CAD and grid files (meters)

- Wing positioned in tunnel with AoA applied
- Unstructured grids in CGNS/UGRID/FENSAP formats
  Prism/tetra and tetra-only using same vertices
- Structured grid in PLOT3D format, unformatted, no IBLANK
- CAD available in IGES format





b. α = 6°, M = 0.23, Re = 5.03 million

Fig. 79 Comparison of pressure distributions for NACA 64A008 finite swept tail.

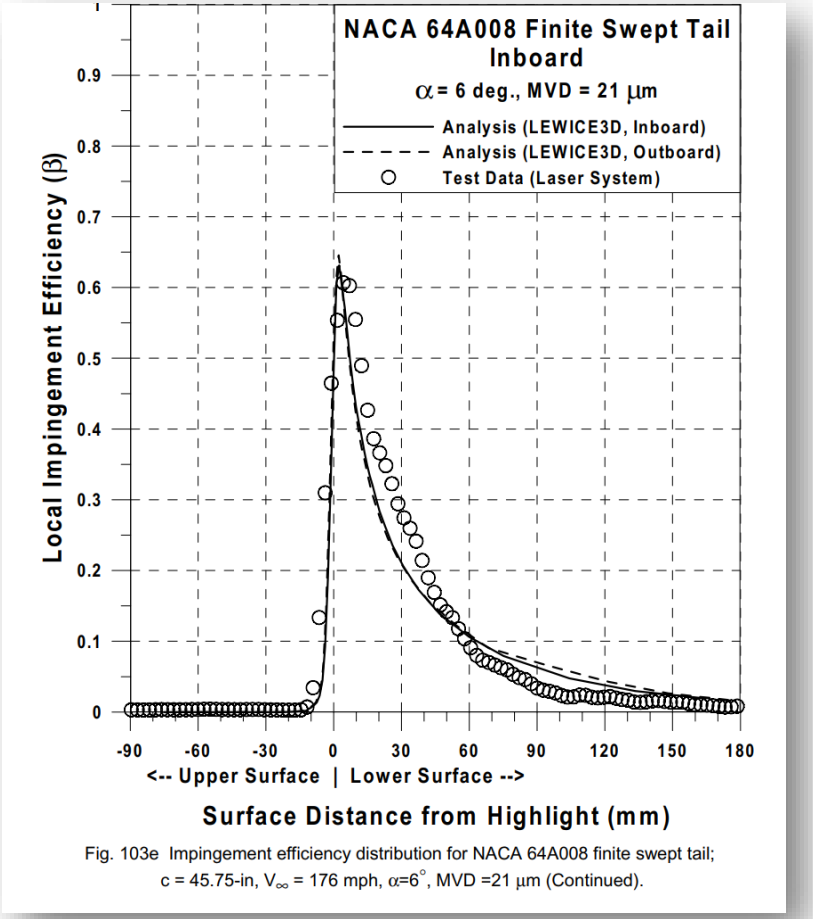


Fig. 103e Impingement efficiency distribution for NACA 64A008 finite swept tail; c = 45.75-in, V_∞ = 176 mph, α=6°, MVD =21 μm (Continued).

Reference: *NASA TM 2002-211700*

Case-112: Droplet Impingement: NACA 64A008 H-Tail, α = 6, MVD 92

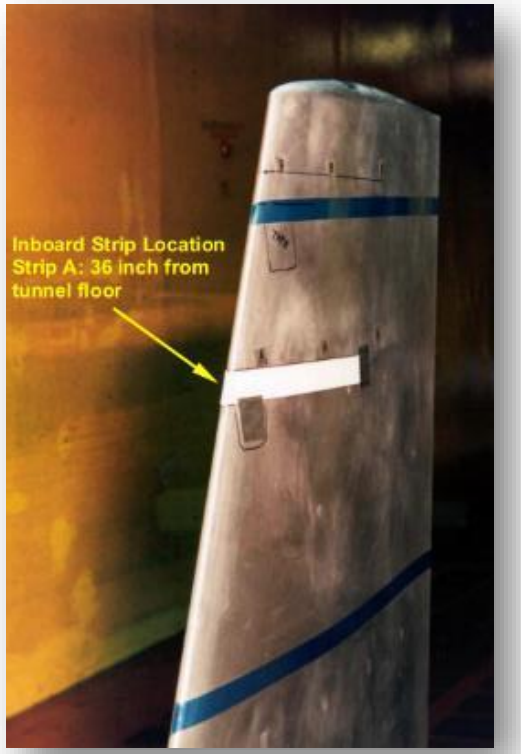
Optional

Conditions

- MVD = 92 microns
- Speed = 78.68 m/s (176 mph)
- Mach = 0.23
- Mean Aerodynamic Chord = 37.65"
- Reynolds = 5 million
- Static Temperature = 280K
- Static Pressure = 95147 Pa
- 27-bin distribution

Available CAD and grid files (meters)

- Wing positioned in tunnel with AoA applied
- Unstructured grids in CGNS/UGRID/FENSAP formats
  Prism/tetra and tetra-only using same vertices
- Structured grid in PLOT3D format, unformatted, no IBLANK
- CAD available in IGES format



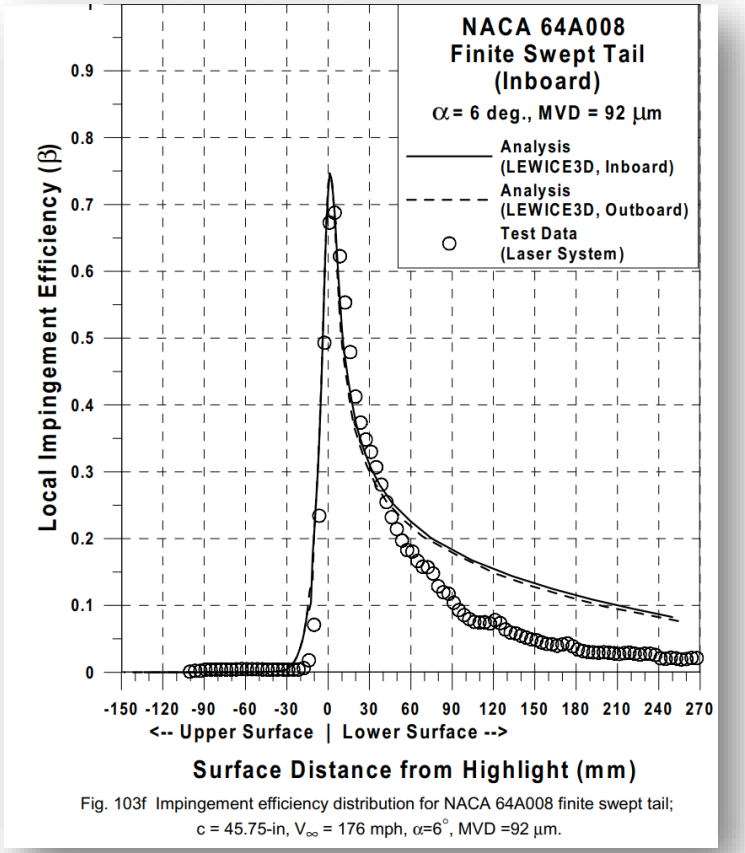
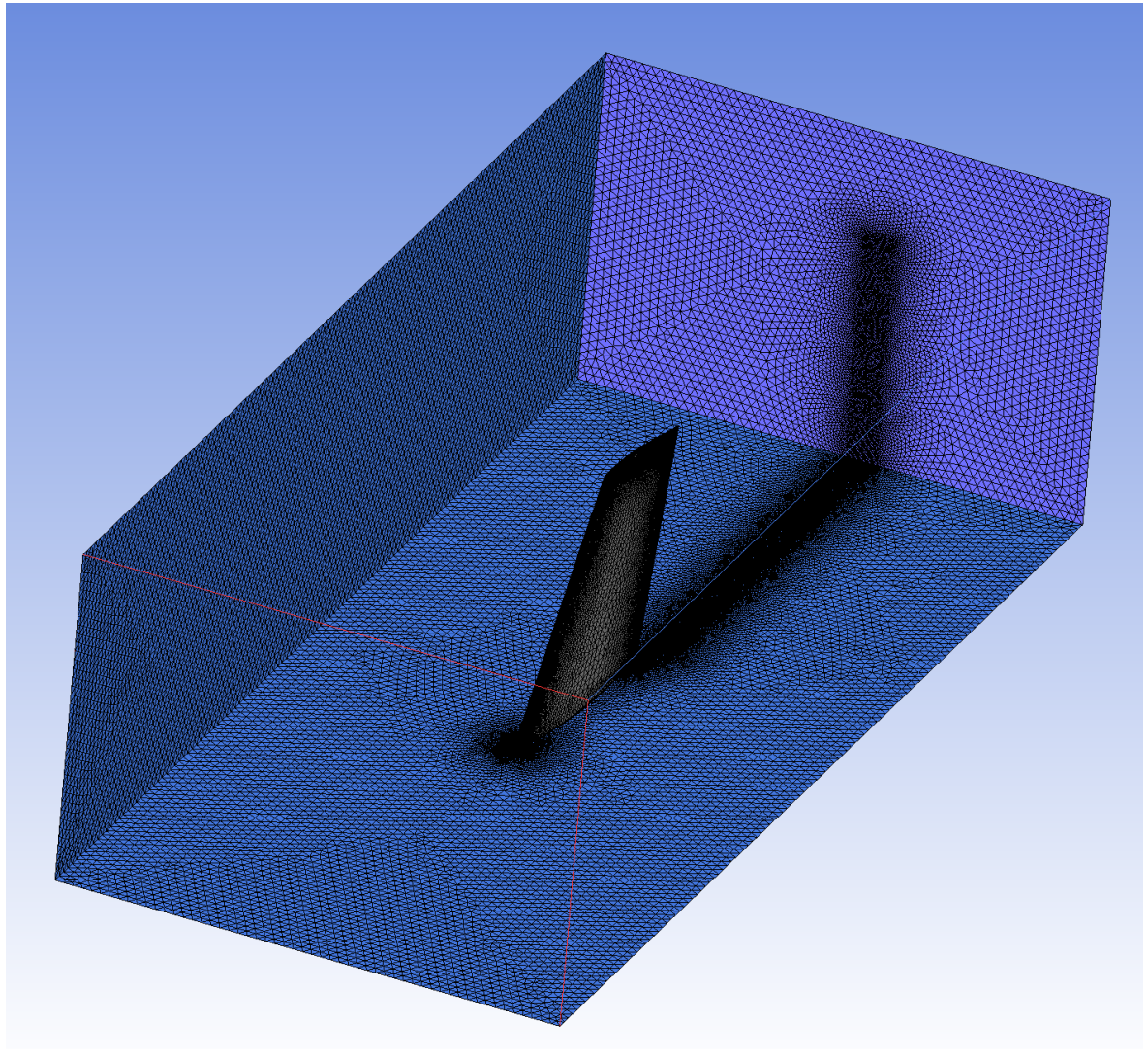
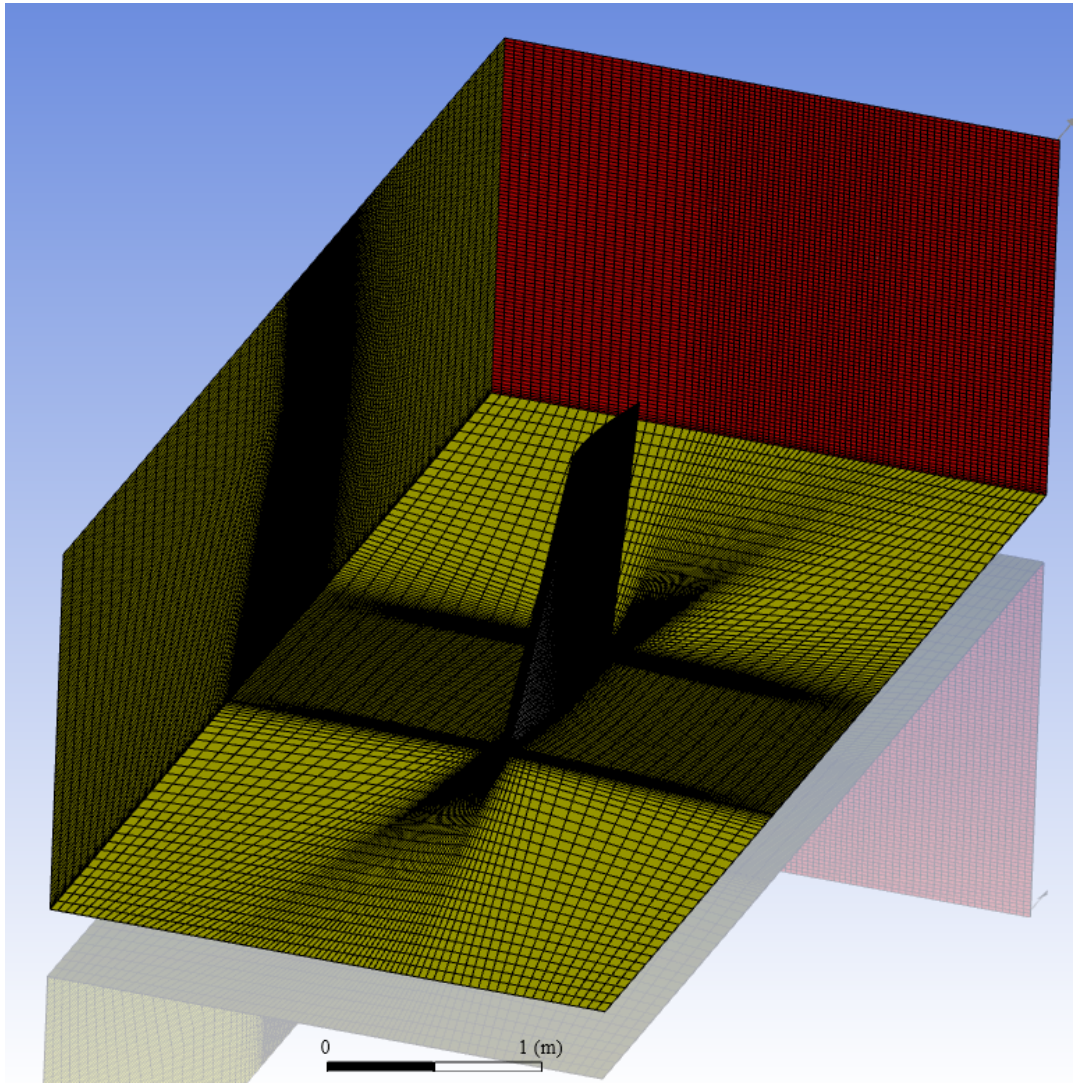


Fig. 103f Impingement efficiency distribution for NACA 64A008 finite swept tail;
c = 45.75-in, V_∞ = 176 mph, α=6°, MVD =92 μm.

Reference: *NASA TM 2002-211700*

NACA 64A008 H-Tail grids





Case-121: Droplet Impingement: Three-element-airfoil, α = 4, MVD 21

Baseline

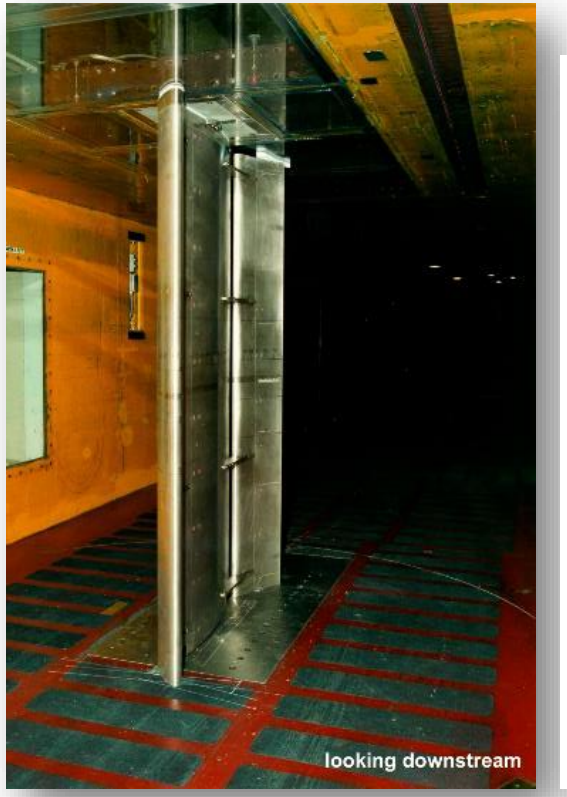
Conditions

- MVD = 21 microns
- Speed = 78.2 m/s (175 mph)
- Mach = 0.23
- Reynolds = 4.9M
- Nested chord = 36"
- Static Temperature = 278 K
- Static Pressure = 95630 Pa
- 27-bin distribution

Available CAD and grid files (meters)

- In-tunnel with AoA applied and far-field versions, 2D
- Unstructured grids in CGNS/FENSAP formats
- Structured grid in PLOT3D format, unformatted, no IBLANK
- CAD available in IGES format
- Element coordinates provided in text files

Experimental pressure data not available for AoA 4



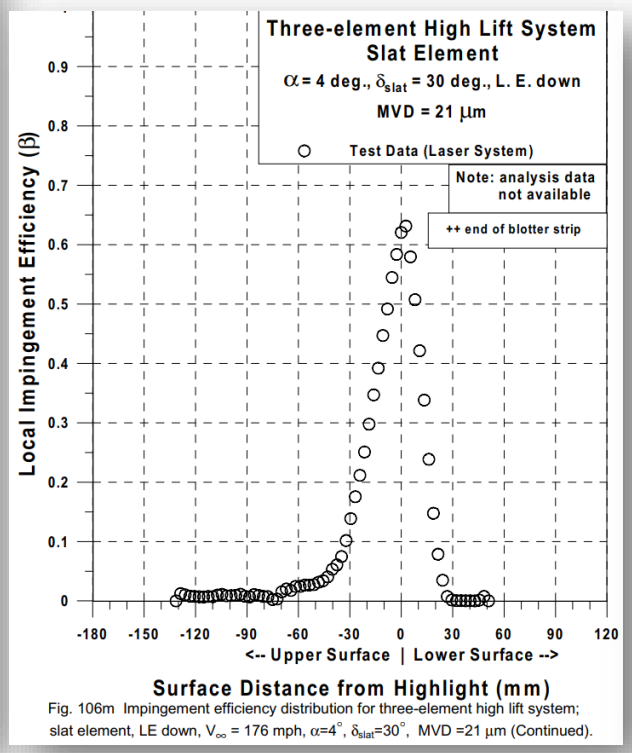


Fig. 106m Impingement efficiency distribution for three-element high lift system; slat element, LE down, V_{∞} = 176 mph, α=4°, δ_{slat}=30°, MVD =21 μm (Continued).

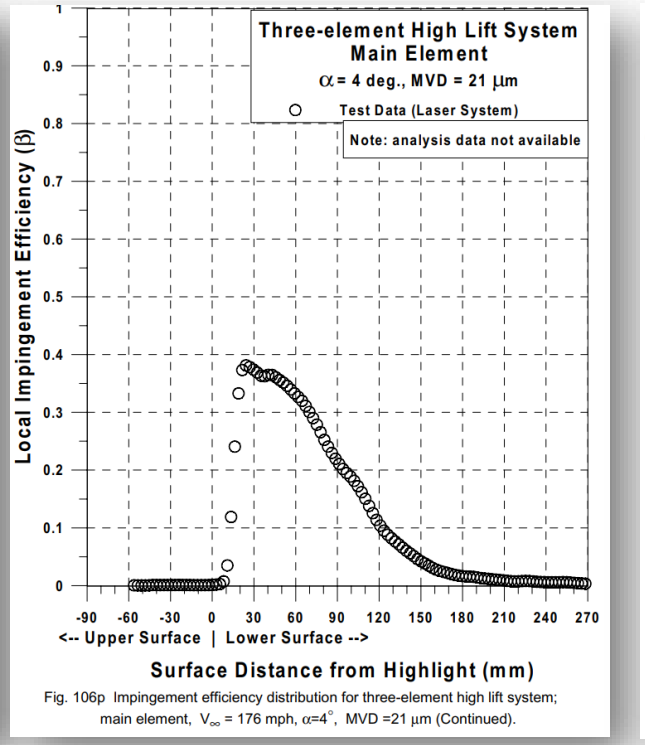


Fig. 106p Impingement efficiency distribution for three-element high lift system; main element, V_{∞} = 176 mph, α=4°, MVD =21 μm (Continued).

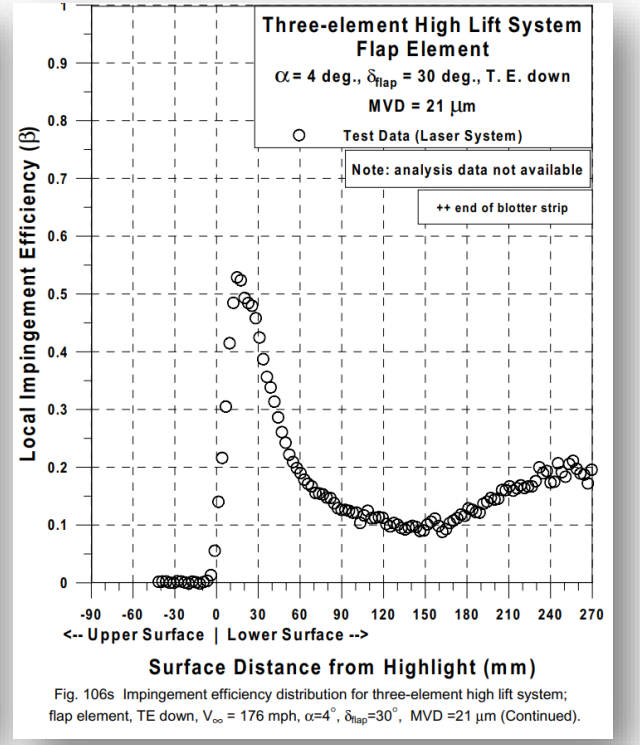


Fig. 106s Impingement efficiency distribution for three-element high lift system; flap element, TE down, V_{∞} = 176 mph, α=4°, δ_{flap}=30°, MVD =21 μm (Continued).

Reference: *NASA TM 2002-211700*

Case-122: Droplet Impingement: Three-element-airfoil, α = 4, MVD 92

Optional

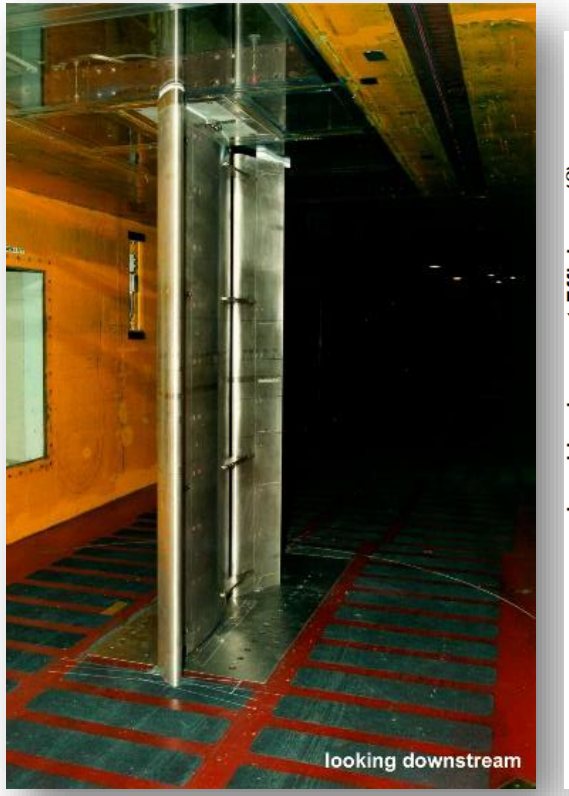
Conditions

- MVD = 92 microns
- Speed = 78.2 m/s (175 mph)
- Mach = 0.23
- Reynolds = 4.9M
- Nested chord = 36"
- Static Temperature = 278 K
- Static Pressure = 95630 Pa
- 27-bin distribution

Available CAD and grid files (meters)

- In-tunnel with AoA applied and far-field versions, 2D
- Unstructured grids in CGNS/FENSAP formats
- Structured grid in PLOT3D format, unformatted, no IBLANK
- CAD available in IGES format
- Element coordinates provided in text files

Experimental pressure data not available for AoA 4



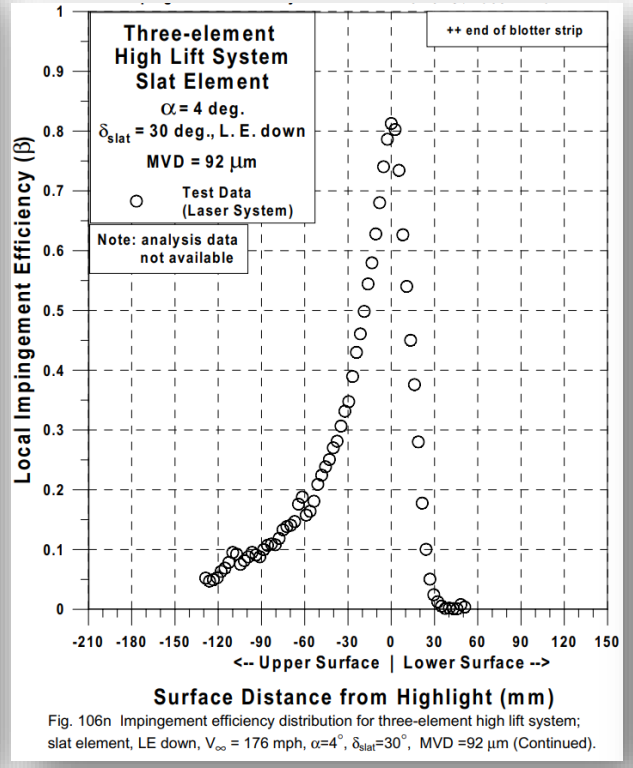


Fig. 106n Impingement efficiency distribution for three-element high lift system; slat element, LE down, V_∞ = 176 mph, α=4°, δ_{slat}=30°, MVD =92 μm (Continued).

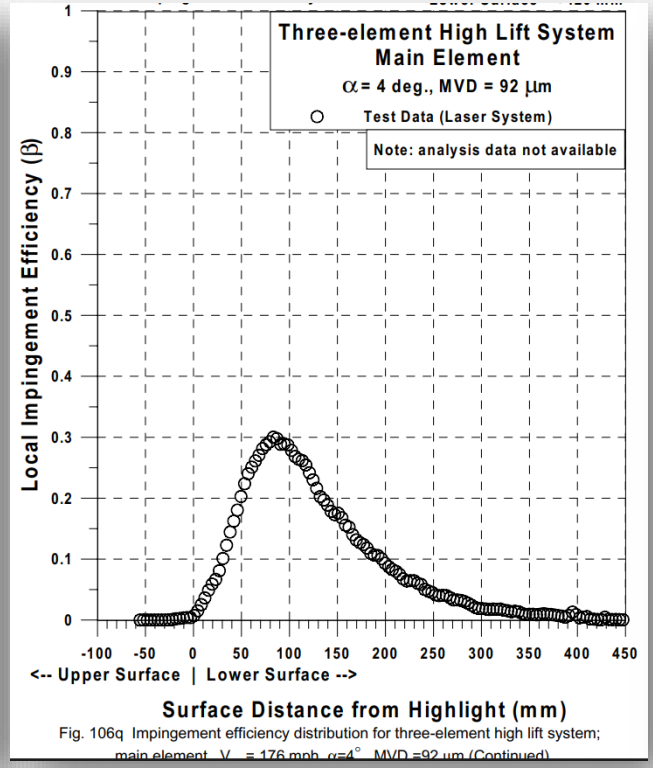


Fig. 106q Impingement efficiency distribution for three-element high lift system; main element, V_∞ = 176 mph, α=4°, MVD =92 μm (Continued).

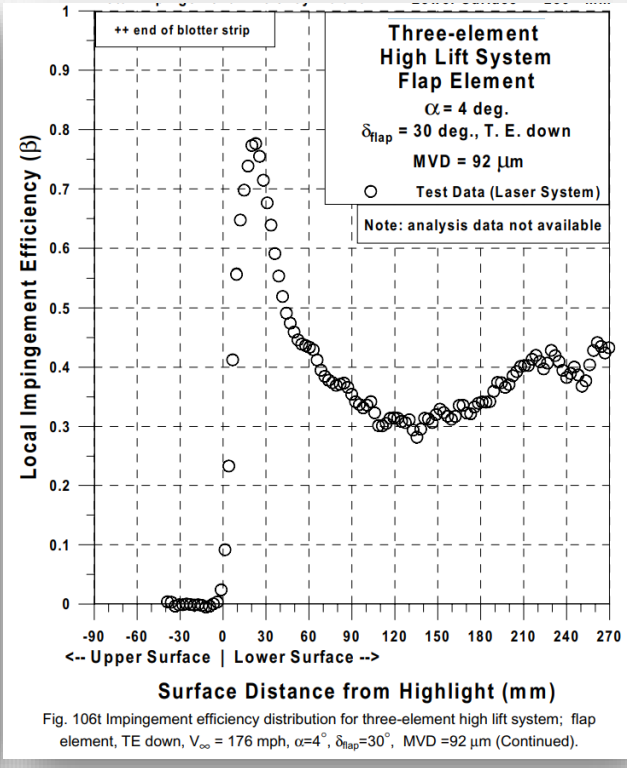
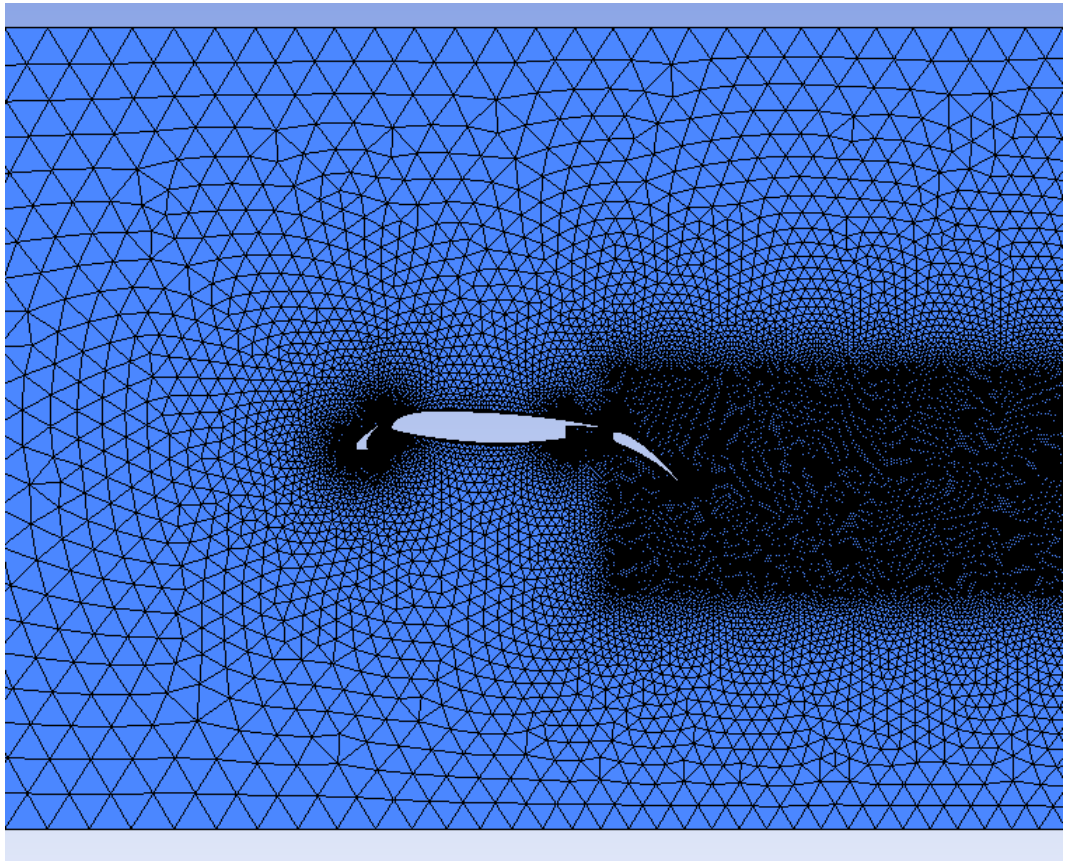
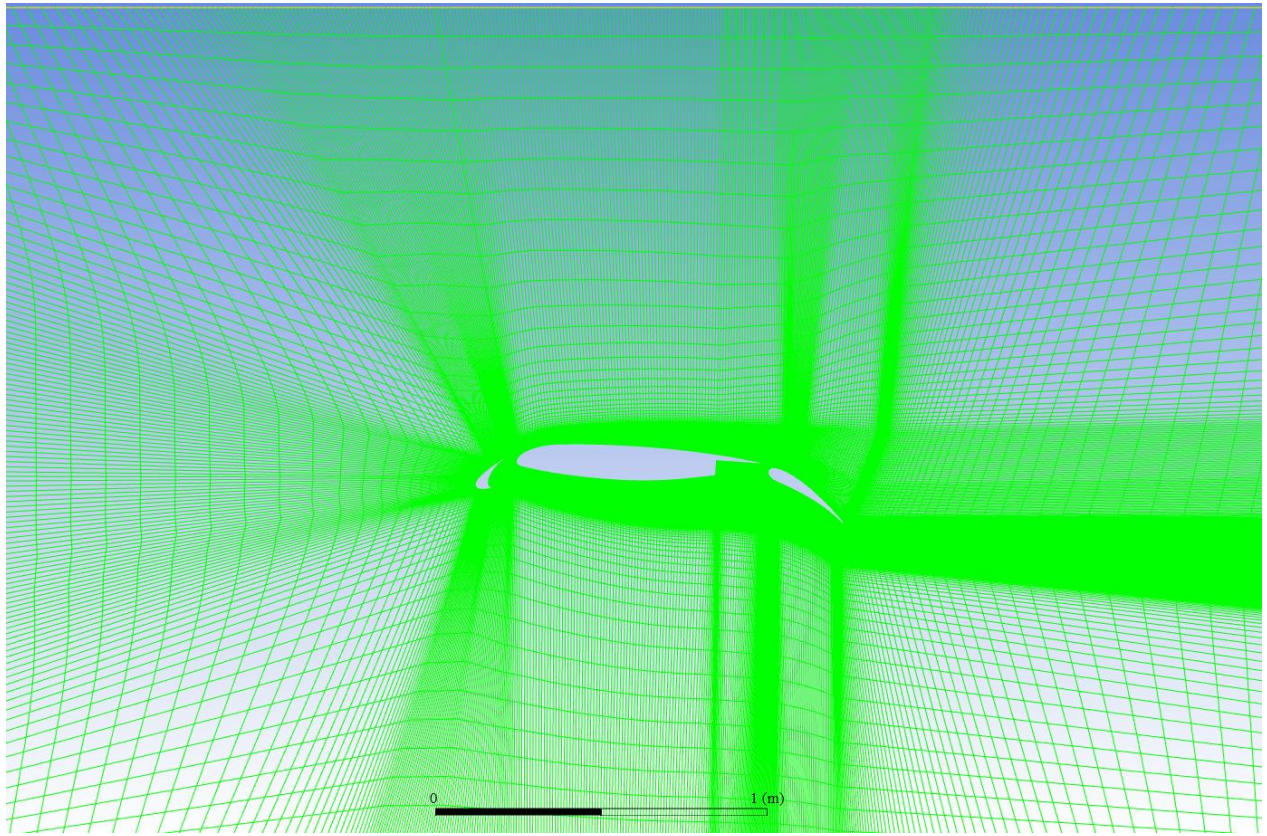


Fig. 106t Impingement efficiency distribution for three-element high lift system; flap element, TE down, V_∞ = 176 mph, α=4°, δ_{flap}=30°, MVD =92 μm (Continued).

Reference: *NASA TM 2002-211700*

Three-element-airfoil grids





Case-131: Droplet Impingement: Axisymmetric inlet, α = 15, MVD 20

Optional

Condition 1

- MVD = 20.36 microns
- Mach = 0.2328
- Static Temperature = 283.15 K (50F)
- Static Pressure = 95492 Pa (13.85 psi)
- Mass flow rate = 7.8 kg/s (17.20 lbm/s)

Available CAD and grid files (meters)

- Nacelle positioned in tunnel with AoA applied
- Suction tube also modeled
- Unstructured grids in CGNS/UGRID/FENSAP formats
  Prism/tetra and tetra-only using same vertices
- Structured grid in PLOT3D format, unformatted, no IBLANK
- CAD available in STL format

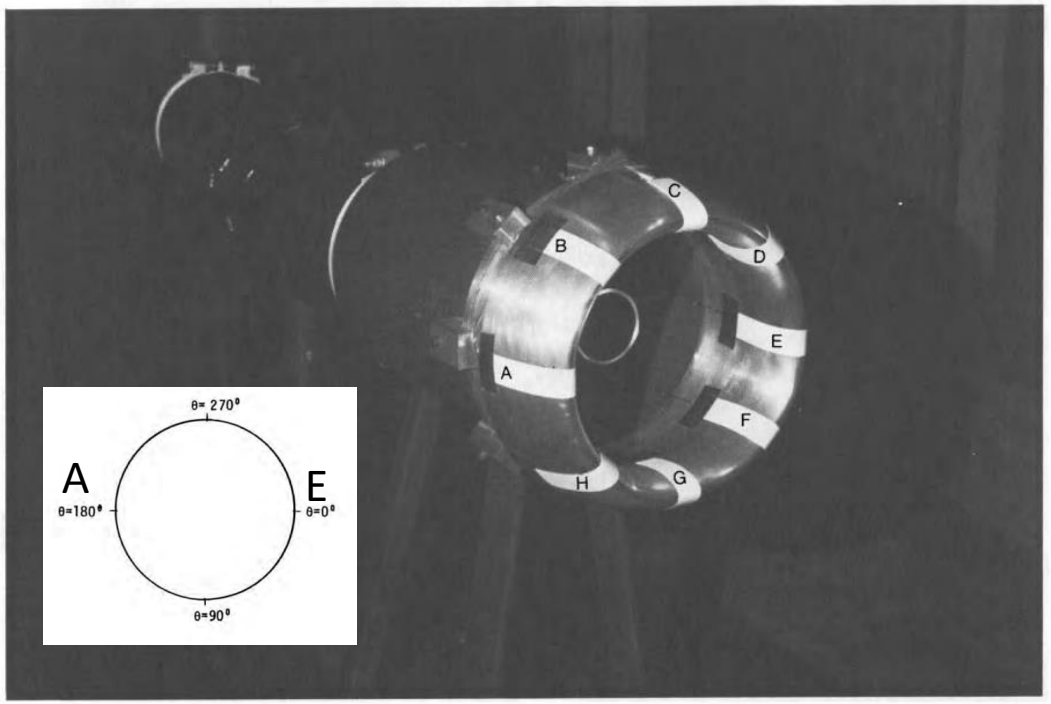


FIGURE 3.22

BLOTTER STRIP LOCATIONS ON AXISYMMETRIC INLET FOR α = 15°.

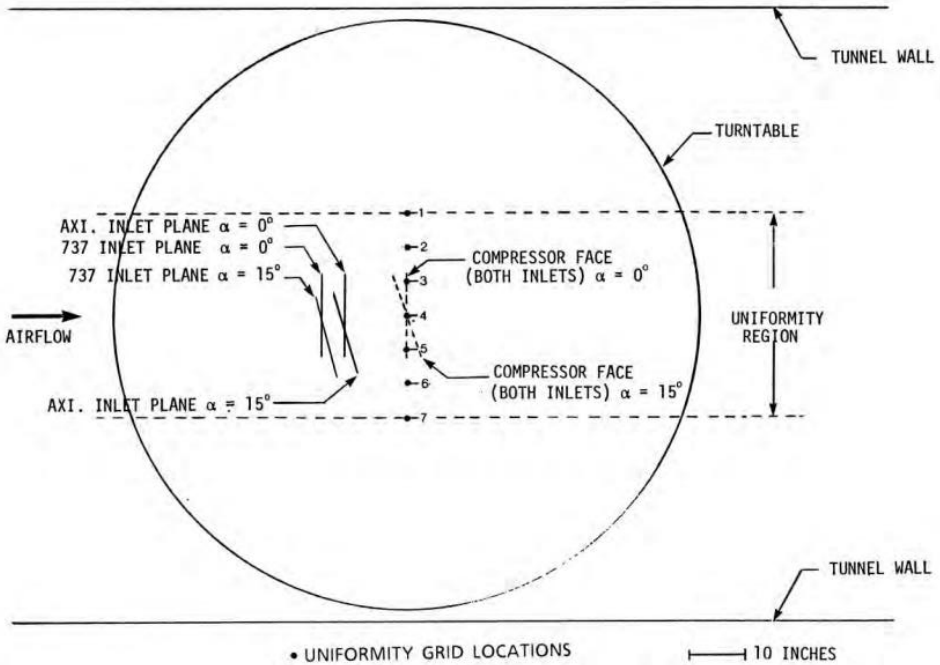


FIGURE 4.8

AXIAL LOCATIONS OF INLET PLANES IN THE IRT TEST SECTION

Reference: *NASA CR 4257*

Case-132: Droplet Impingement: Axisymmetric inlet, α = 15, MVD 20

Optional

Condition 2

- MVD = 20.36 microns
- Mach = 0.2312
- Static Temperature = 279.63 K (43.66F)
- Static Pressure = 95492 Pa (13.85 psi)
- Mass flow rate = 10.41 kg/s (22.96 lbm/s)

Available CAD and grid files (meters)

- Nacelle positioned in tunnel with AoA applied
- Suction tube also modeled
- Unstructured grids in CGNS/UGRID/FENSAP formats
  Prism/tetra and tetra-only using same vertices
- Structured grid in PLOT3D format, unformatted, no IBLANK
- CAD available in STL format

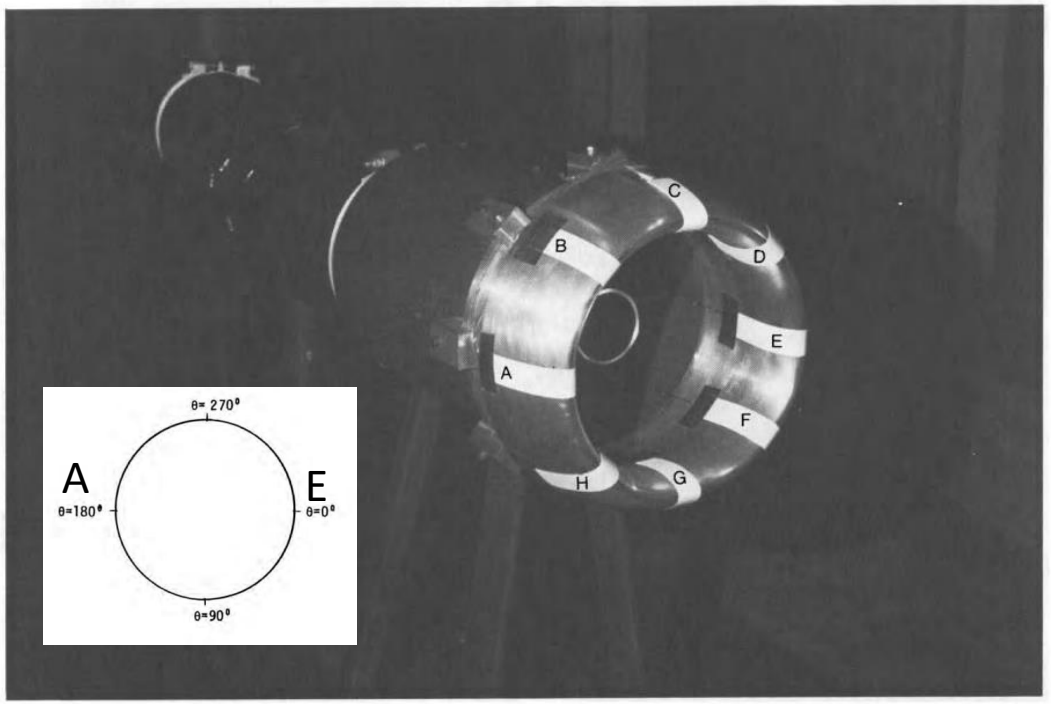


FIGURE 3.22

BLOTTER STRIP LOCATIONS ON AXISYMMETRIC INLET FOR α = 15°.

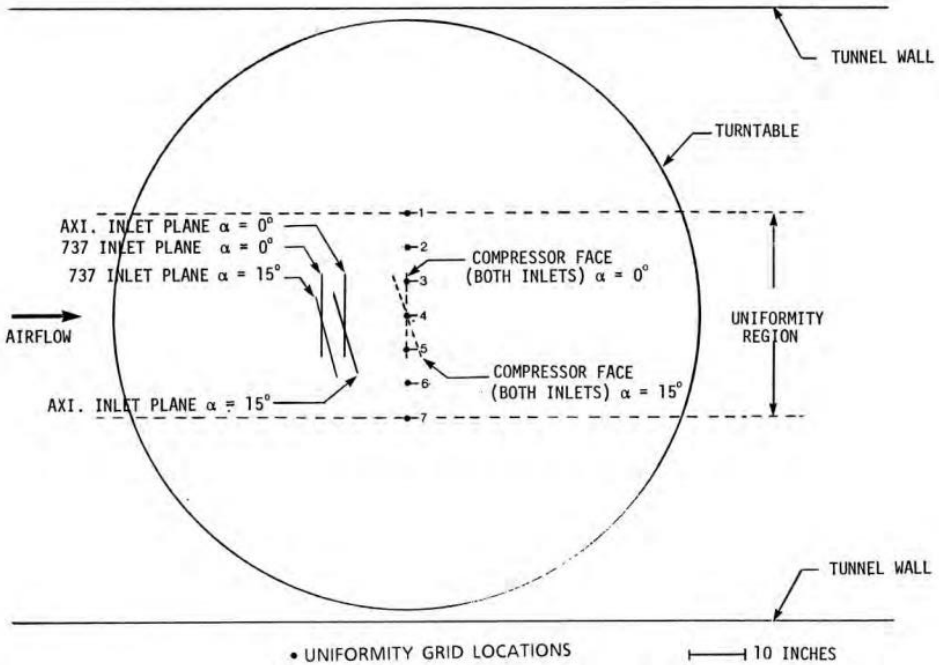
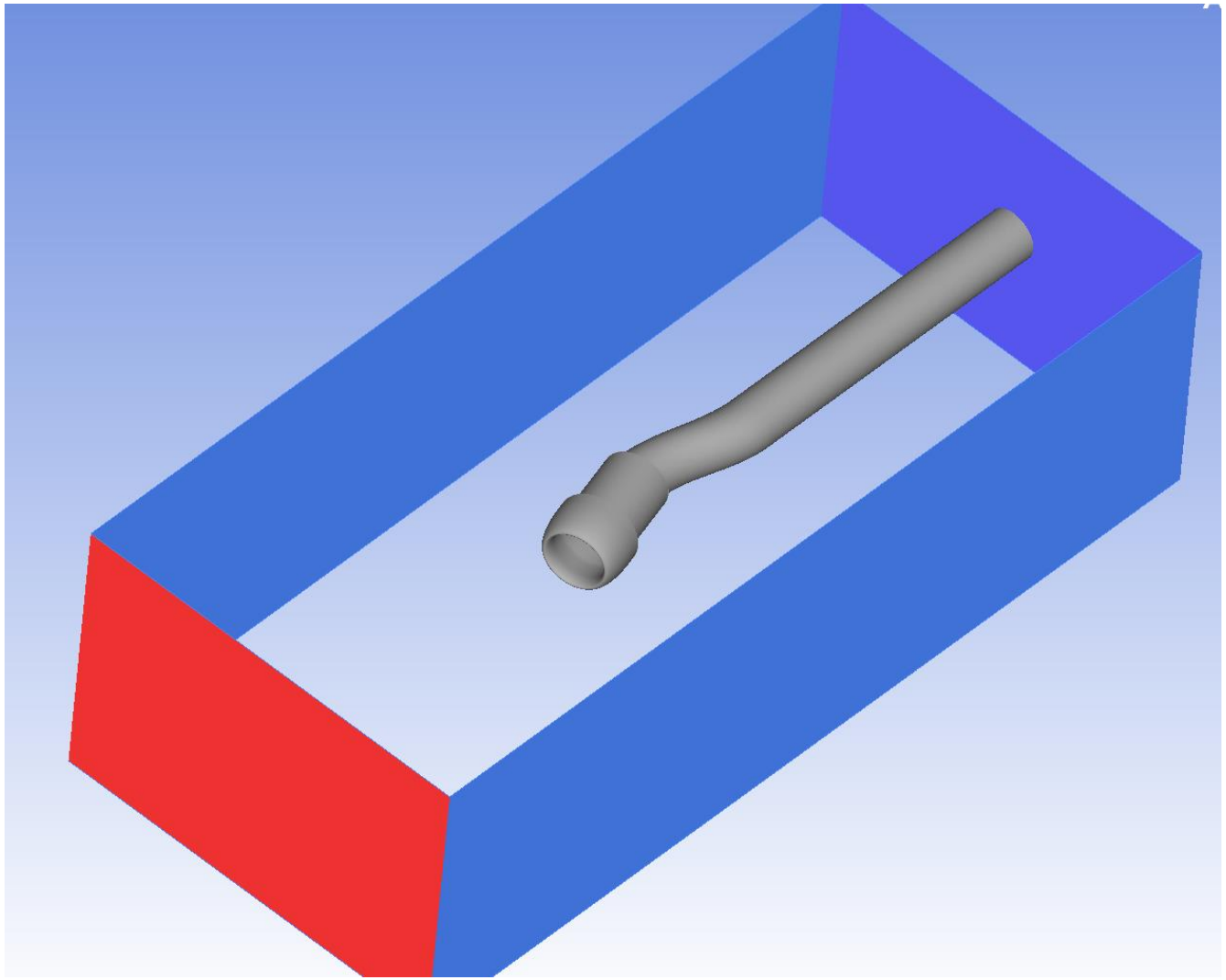


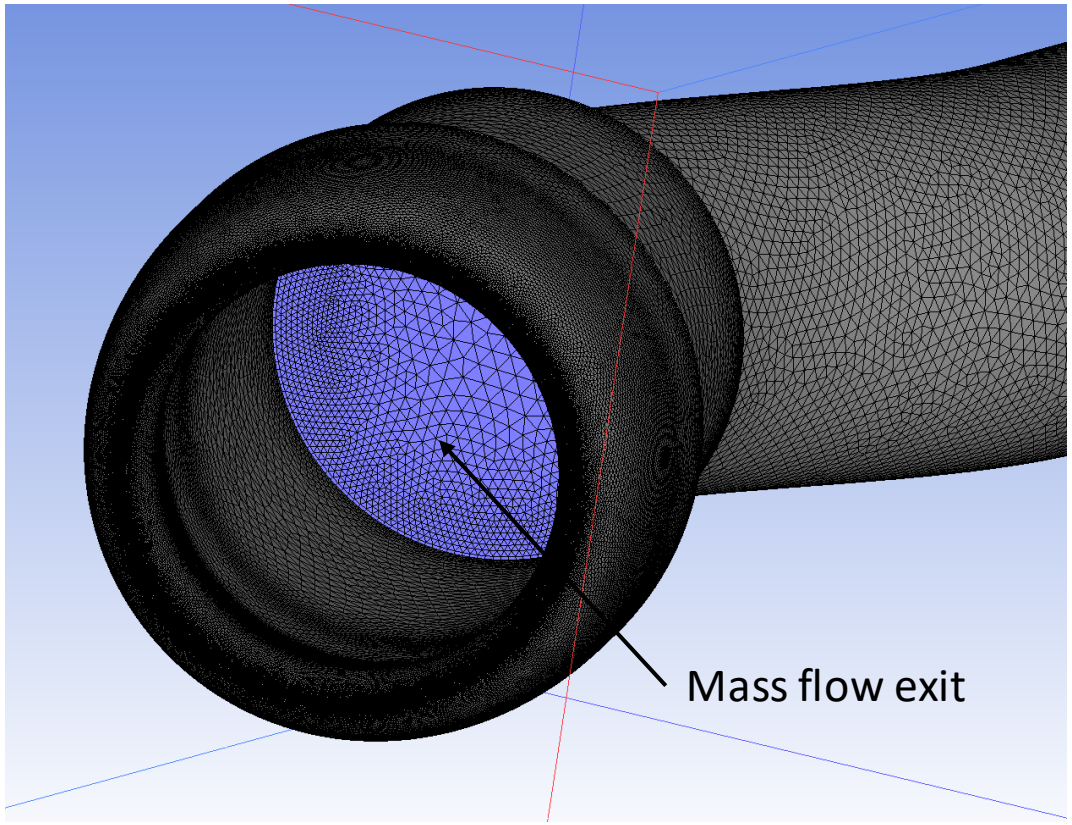
FIGURE 4.8

AXIAL LOCATIONS OF INLET PLANES IN THE IRT TEST SECTION

Reference: *NASA CR 4257*

Inlet geometry with AoA 15





Reference: *NASA CR 4257*

Droplet Impingement: Axisymmetric inlet, α = 15, MVD 20

Optional

Condition 1 surface Mach data

(can be derived using $P_{0,calculated} \approx 99200$ Pa and surface pressures)

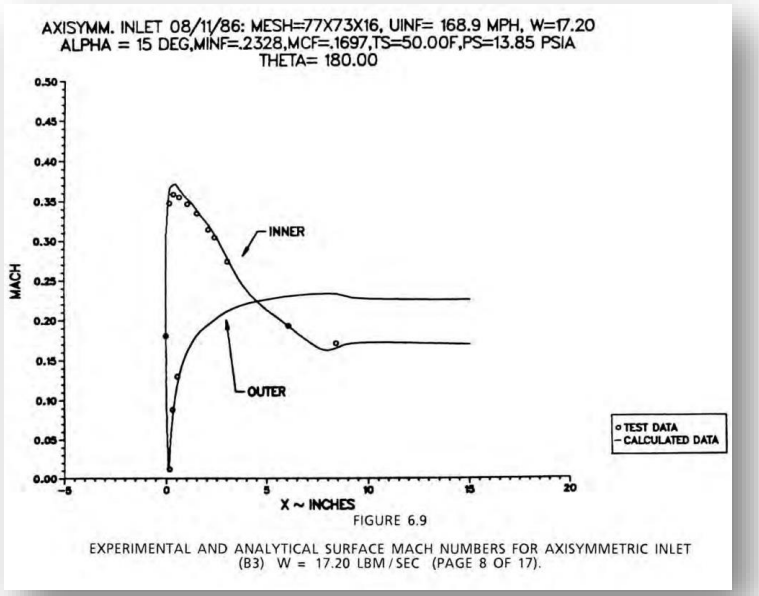


FIGURE 6.9

EXPERIMENTAL AND ANALYTICAL SURFACE MACH NUMBERS FOR AXISYMMETRIC INLET
(B3) W = 17.20 LBM/SEC (PAGE 8 OF 17).

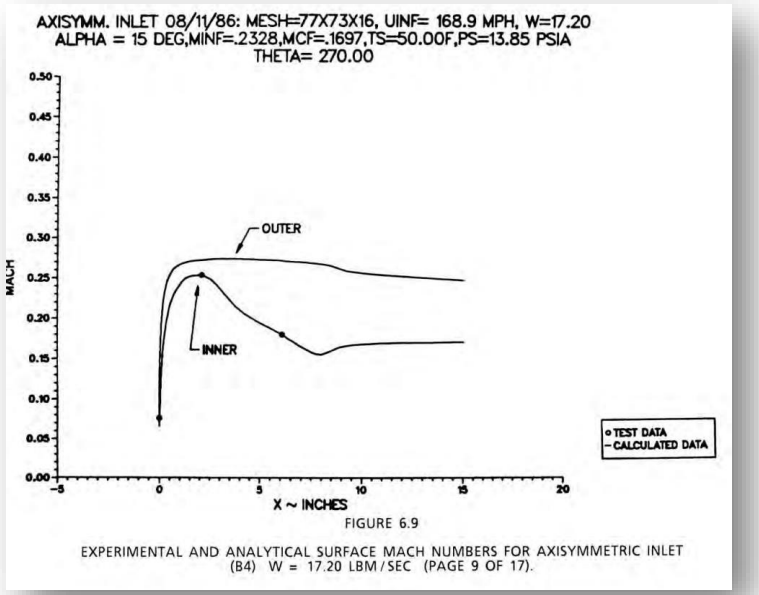


FIGURE 6.9

EXPERIMENTAL AND ANALYTICAL SURFACE MACH NUMBERS FOR AXISYMMETRIC INLET
(B4) W = 17.20 LBM/SEC (PAGE 9 OF 17).

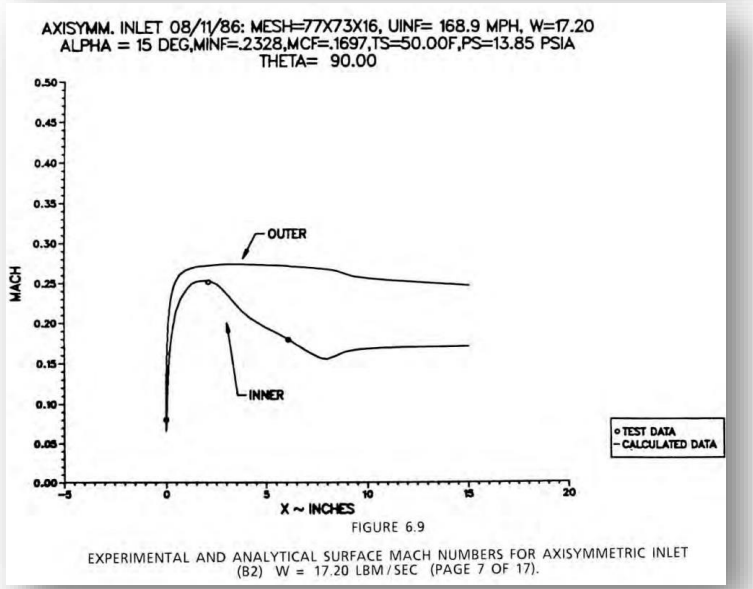


FIGURE 6.9

EXPERIMENTAL AND ANALYTICAL SURFACE MACH NUMBERS FOR AXISYMMETRIC INLET
(B2) W = 17.20 LBM/SEC (PAGE 7 OF 17).

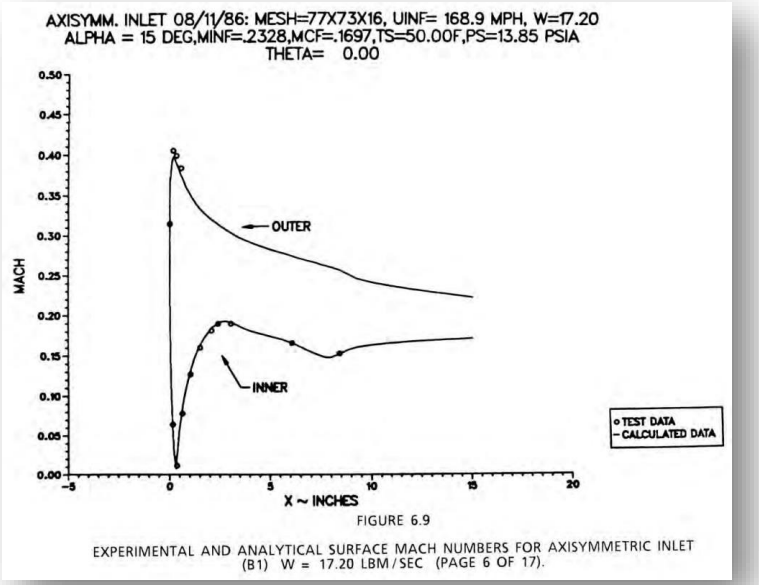


FIGURE 6.9

EXPERIMENTAL AND ANALYTICAL SURFACE MACH NUMBERS FOR AXISYMMETRIC INLET
(B1) W = 17.20 LBM/SEC (PAGE 6 OF 17).

Reference: *NASA CR 4257*

Droplet Impingement: Axisymmetric inlet, α = 15, MVD 20

Optional

Condition 2 surface Mach data

(can be derived using $P_{0,calculated} \approx 99100$ Pa and surface pressures)

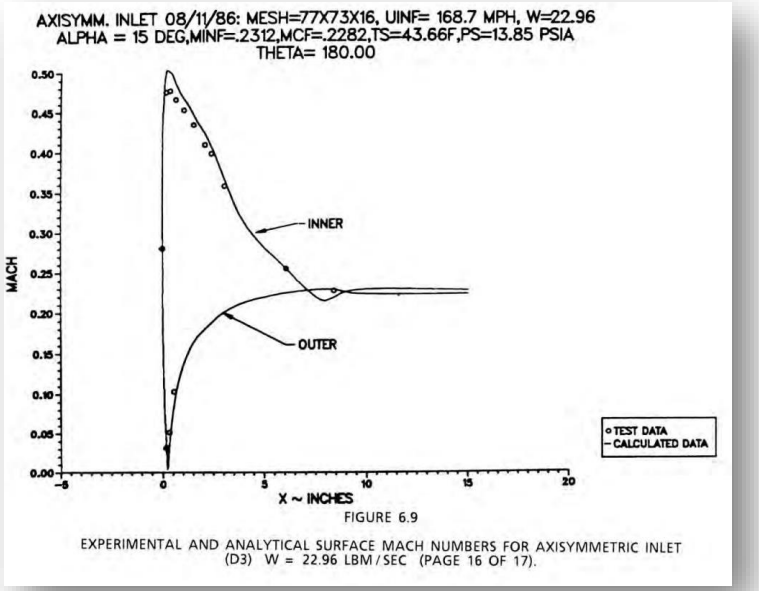


FIGURE 6.9

EXPERIMENTAL AND ANALYTICAL SURFACE MACH NUMBERS FOR AXISYMMETRIC INLET
(D3) W = 22.96 LBM/SEC (PAGE 16 OF 17).

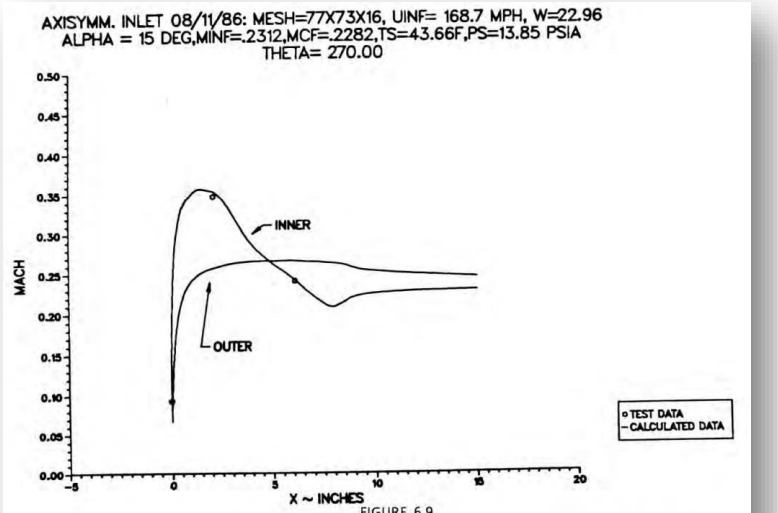


FIGURE 6.9

EXPERIMENTAL AND ANALYTICAL SURFACE MACH NUMBERS FOR AXISYMMETRIC INLET
(D4) W = 22.96 LBM/SEC (PAGE 17 OF 17).

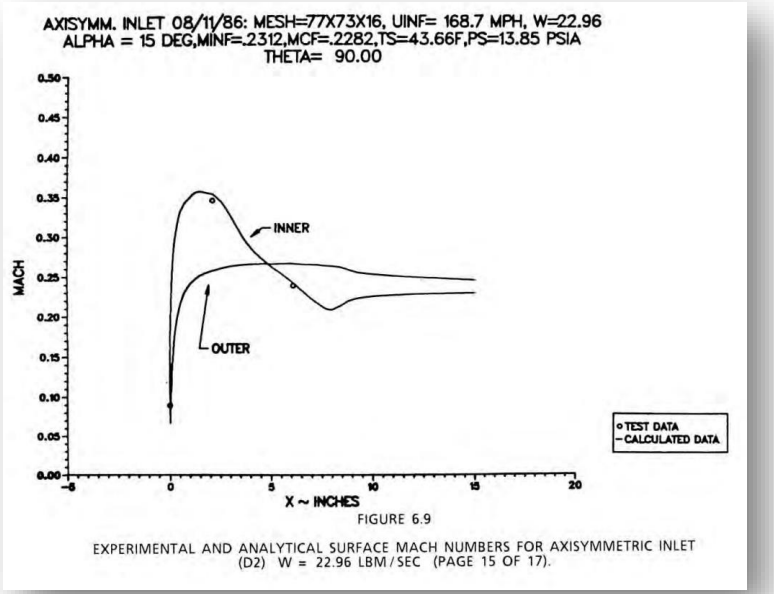


FIGURE 6.9

EXPERIMENTAL AND ANALYTICAL SURFACE MACH NUMBERS FOR AXISYMMETRIC INLET
(D2) W = 22.96 LBM/SEC (PAGE 15 OF 17).

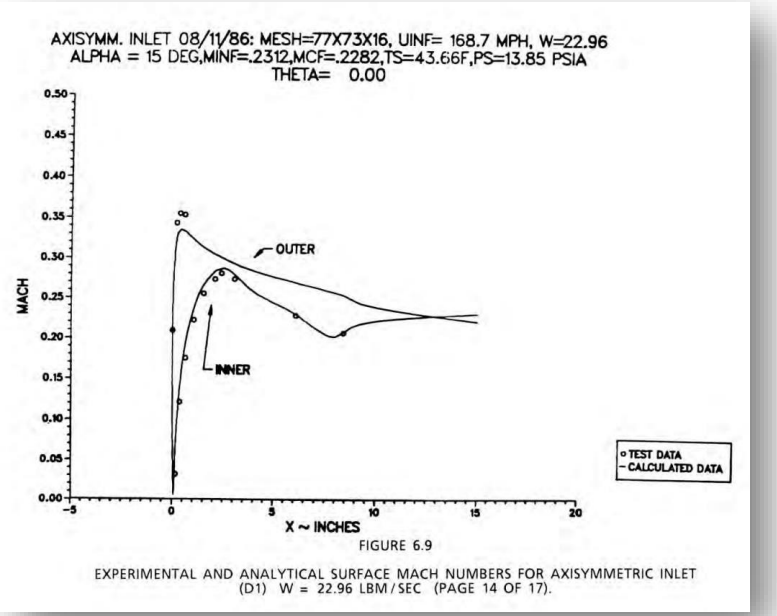


FIGURE 6.9

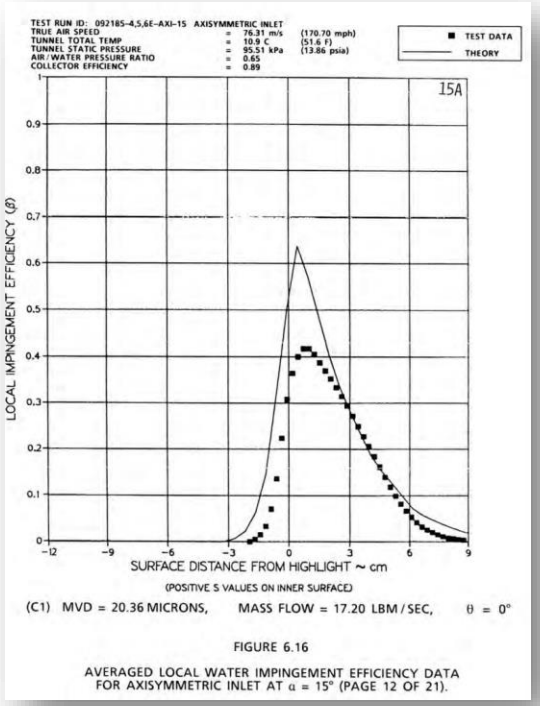
EXPERIMENTAL AND ANALYTICAL SURFACE MACH NUMBERS FOR AXISYMMETRIC INLET
(D1) W = 22.96 LBM/SEC (PAGE 14 OF 17).

Reference: *NASA CR 4257*

Droplet Impingement: Axisymmetric inlet, α = 15, MVD 20

Optional

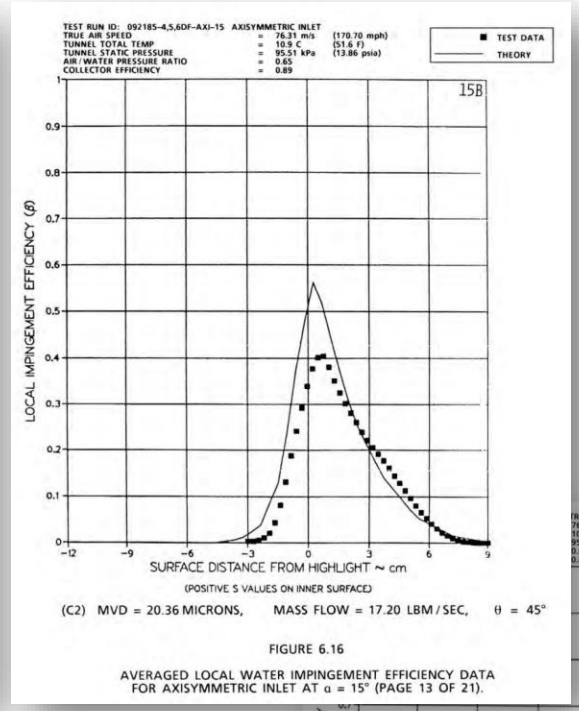
Condition 1 collection efficiency data



(C1) MVD = 20.36 MICRONS, MASS FLOW = 17.20 LBM/SEC, θ = 0°

FIGURE 6.16

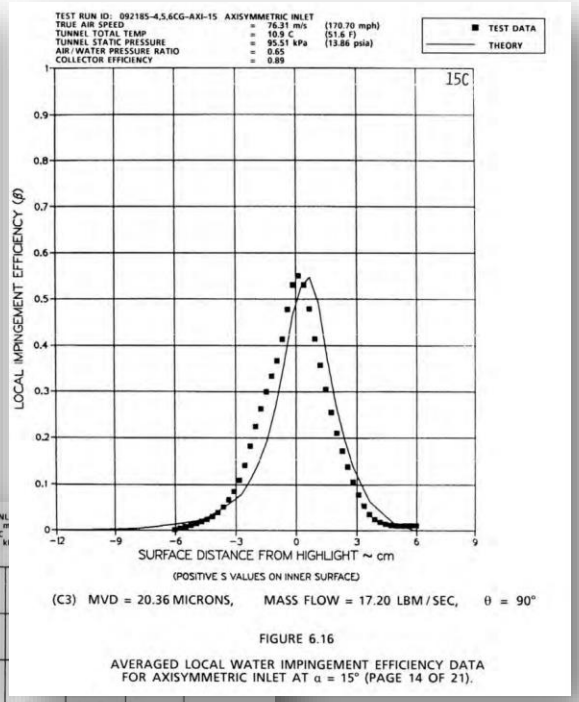
AVERAGED LOCAL WATER IMPINGEMENT EFFICIENCY DATA FOR AXISYMMETRIC INLET AT α = 15° (PAGE 12 OF 21).



(C2) MVD = 20.36 MICRONS, MASS FLOW = 17.20 LBM/SEC, θ = 45°

FIGURE 6.16

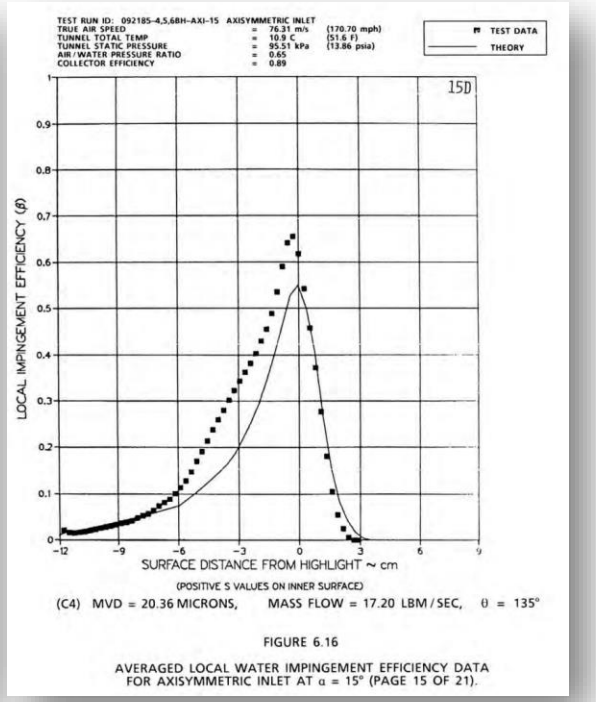
AVERAGED LOCAL WATER IMPINGEMENT EFFICIENCY DATA FOR AXISYMMETRIC INLET AT α = 15° (PAGE 13 OF 21).



(C3) MVD = 20.36 MICRONS, MASS FLOW = 17.20 LBM/SEC, θ = 90°

FIGURE 6.16

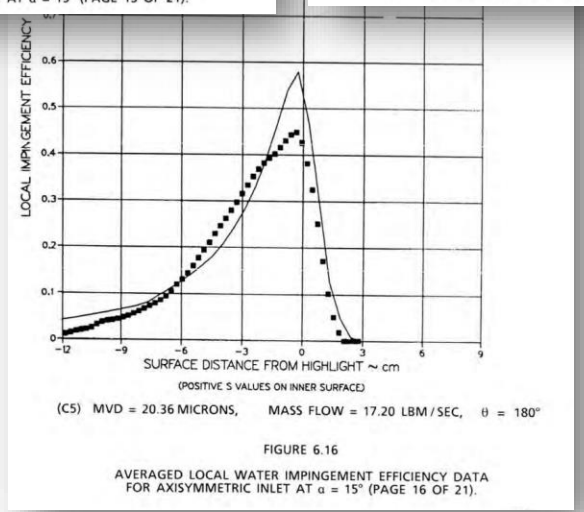
AVERAGED LOCAL WATER IMPINGEMENT EFFICIENCY DATA FOR AXISYMMETRIC INLET AT α = 15° (PAGE 14 OF 21).



(C4) MVD = 20.36 MICRONS, MASS FLOW = 17.20 LBM/SEC, θ = 135°

FIGURE 6.16

AVERAGED LOCAL WATER IMPINGEMENT EFFICIENCY DATA FOR AXISYMMETRIC INLET AT α = 15° (PAGE 15 OF 21).



(C5) MVD = 20.36 MICRONS, MASS FLOW = 17.20 LBM/SEC, θ = 180°

FIGURE 6.16

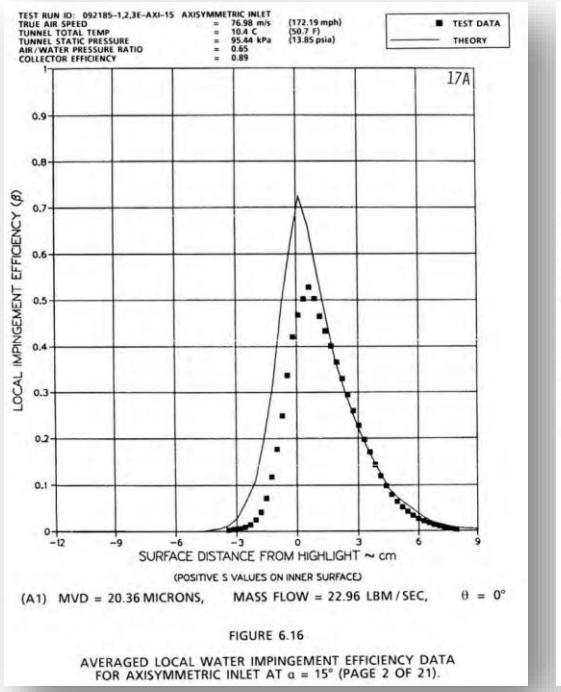
AVERAGED LOCAL WATER IMPINGEMENT EFFICIENCY DATA FOR AXISYMMETRIC INLET AT α = 15° (PAGE 16 OF 21).

Reference: *NASA CR 4257*

Droplet Impingement: Axisymmetric inlet, α = 15, MVD 20

Optional

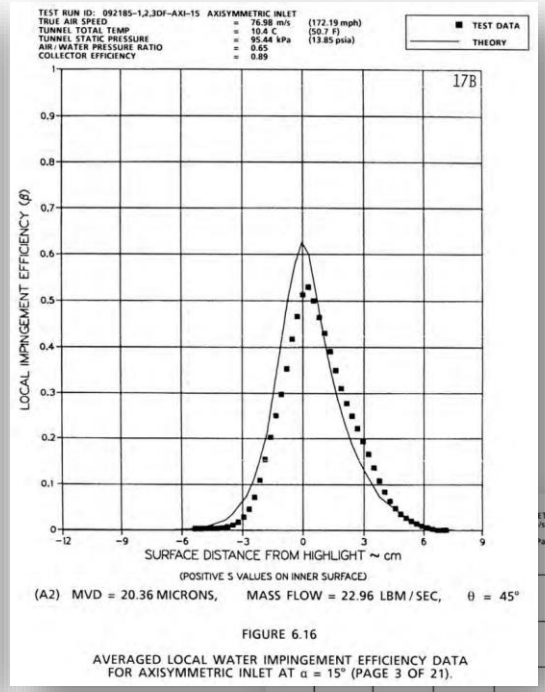
Condition 2 collection efficiency data



(A1) MVD = 20.36 MICRONS, MASS FLOW = 22.96 LBM/SEC, θ = 0°

FIGURE 6.16

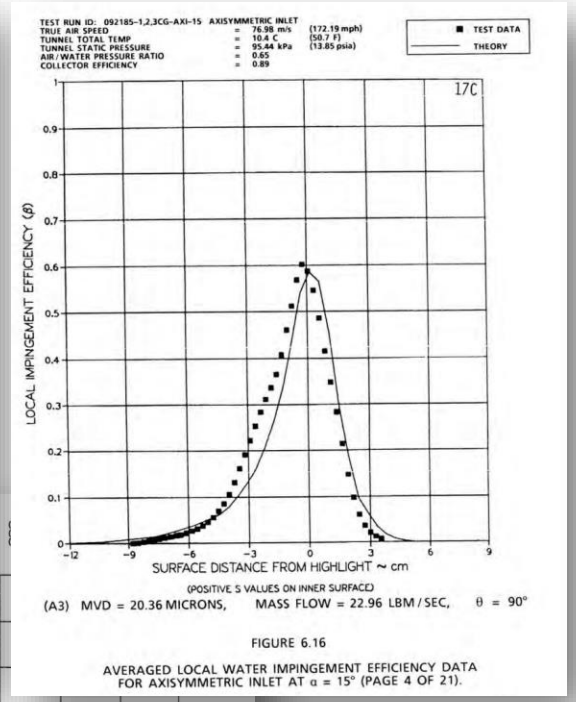
AVERAGED LOCAL WATER IMPINGEMENT EFFICIENCY DATA FOR AXISYMMETRIC INLET AT α = 15° (PAGE 2 OF 21).



(A2) MVD = 20.36 MICRONS, MASS FLOW = 22.96 LBM/SEC, θ = 45°

FIGURE 6.16

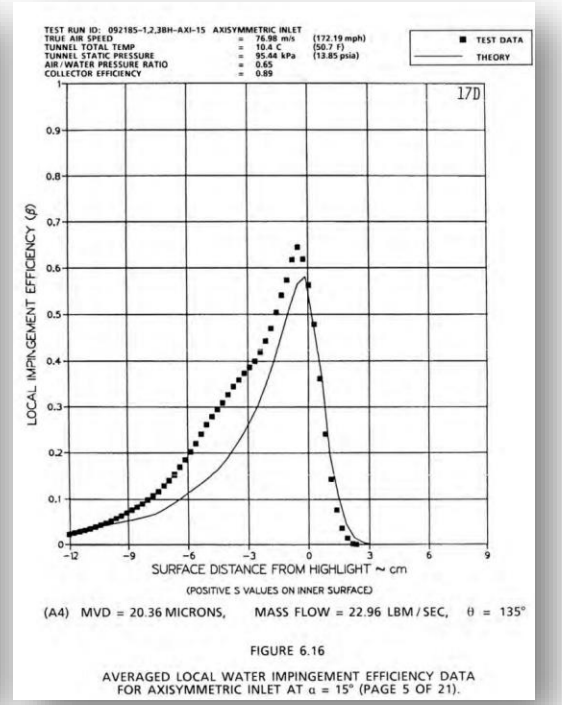
AVERAGED LOCAL WATER IMPINGEMENT EFFICIENCY DATA FOR AXISYMMETRIC INLET AT α = 15° (PAGE 3 OF 21).



(A3) MVD = 20.36 MICRONS, MASS FLOW = 22.96 LBM/SEC, θ = 90°

FIGURE 6.16

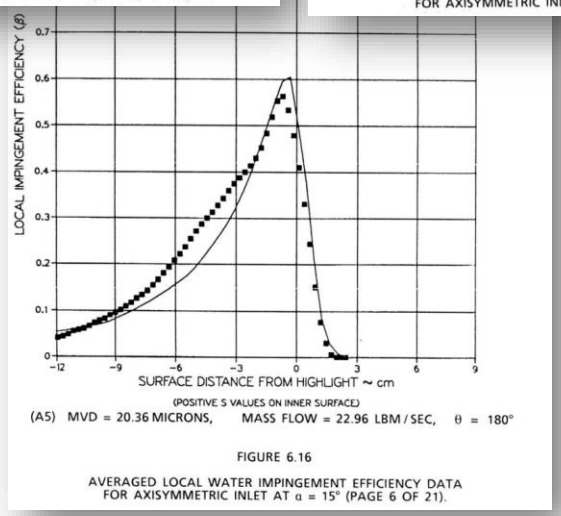
AVERAGED LOCAL WATER IMPINGEMENT EFFICIENCY DATA FOR AXISYMMETRIC INLET AT α = 15° (PAGE 4 OF 21).



(A4) MVD = 20.36 MICRONS, MASS FLOW = 22.96 LBM/SEC, θ = 135°

FIGURE 6.16

AVERAGED LOCAL WATER IMPINGEMENT EFFICIENCY DATA FOR AXISYMMETRIC INLET AT α = 15° (PAGE 5 OF 21).



(A5) MVD = 20.36 MICRONS, MASS FLOW = 22.96 LBM/SEC, θ = 180°

FIGURE 6.16

AVERAGED LOCAL WATER IMPINGEMENT EFFICIENCY DATA FOR AXISYMMETRIC INLET AT α = 15° (PAGE 6 OF 21).

Reference: *NASA CR 4257*

Case-241: 18-in NACA23012 at α = 2, rime ice (ED1977)

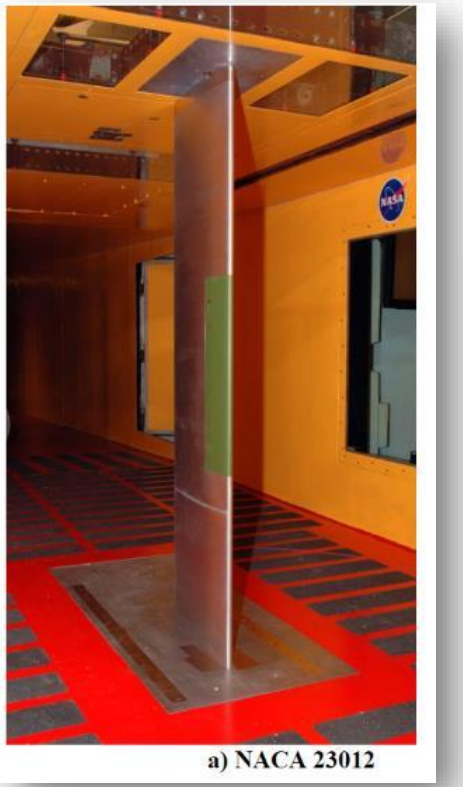
Baseline

Conditions

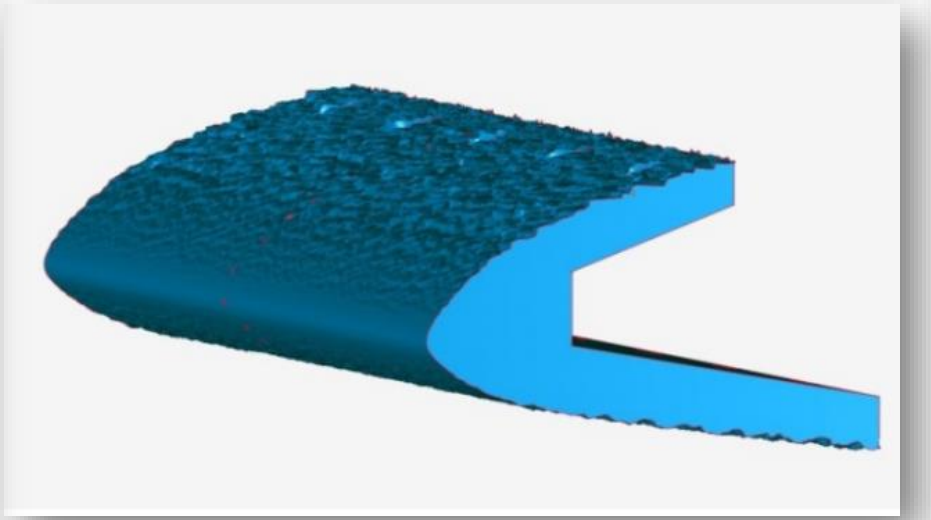
- MVD = 30 microns
- LWC = 0.42 g/m^3
- Speed = 103 m/s (200 kts)
- Mach = 0.325
- Total temperature = -17.8 C
- Static temperature = -23.0 C
- Static pressure = 92528 Pa
- Reynolds number = 3.8 milion
- Spray time = 5 minutes

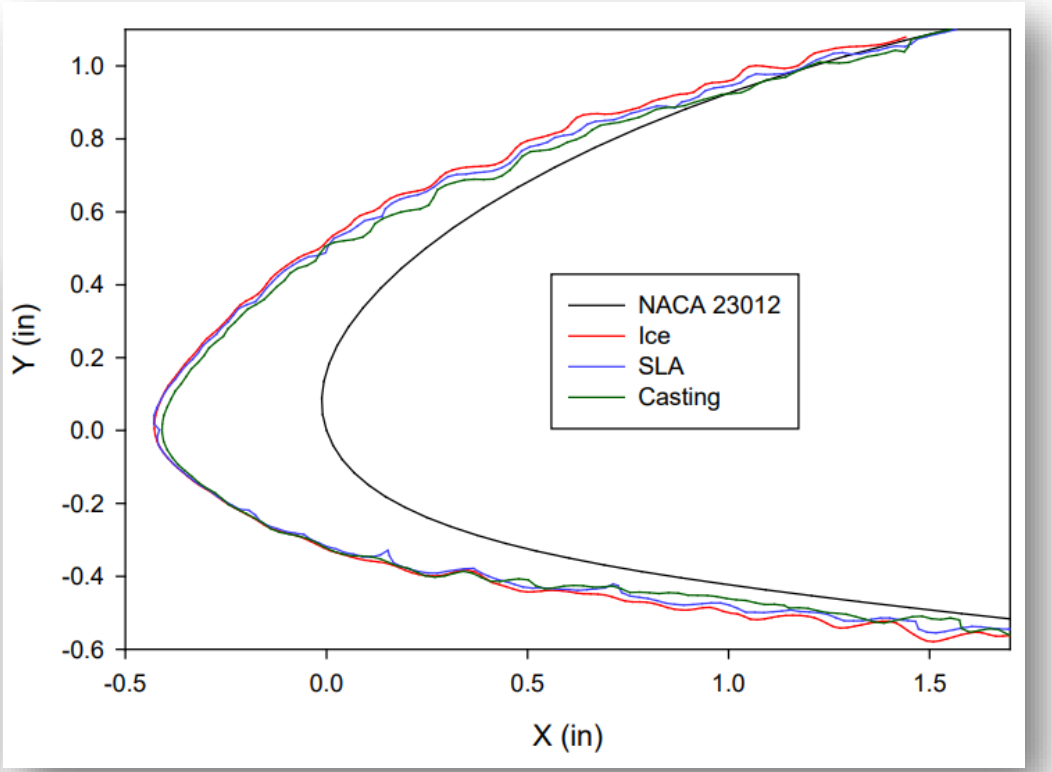
Available CAD and grid files (meters)

- In-tunnel with AoA applied and far-field versions, 2D
- Unstructured grids in CGNS/FENSAP formats
- Structured grid in PLOT3D format, unformatted, no IBLANK
- CAD available in STEP format



a) NACA 23012





Reference: *AIAA 2014 2613*

Case-242: 18-in NACA23012 at α = 2, glaze ice (ED1978)

Baseline

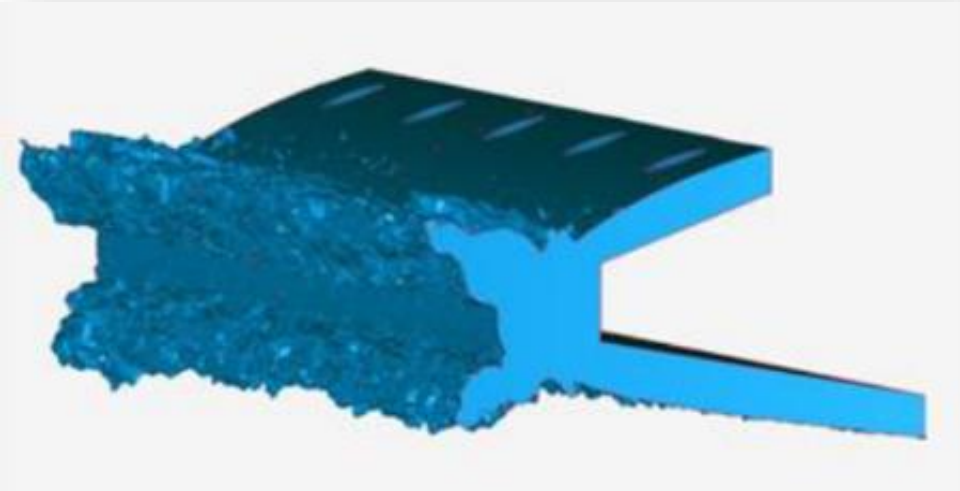
Conditions

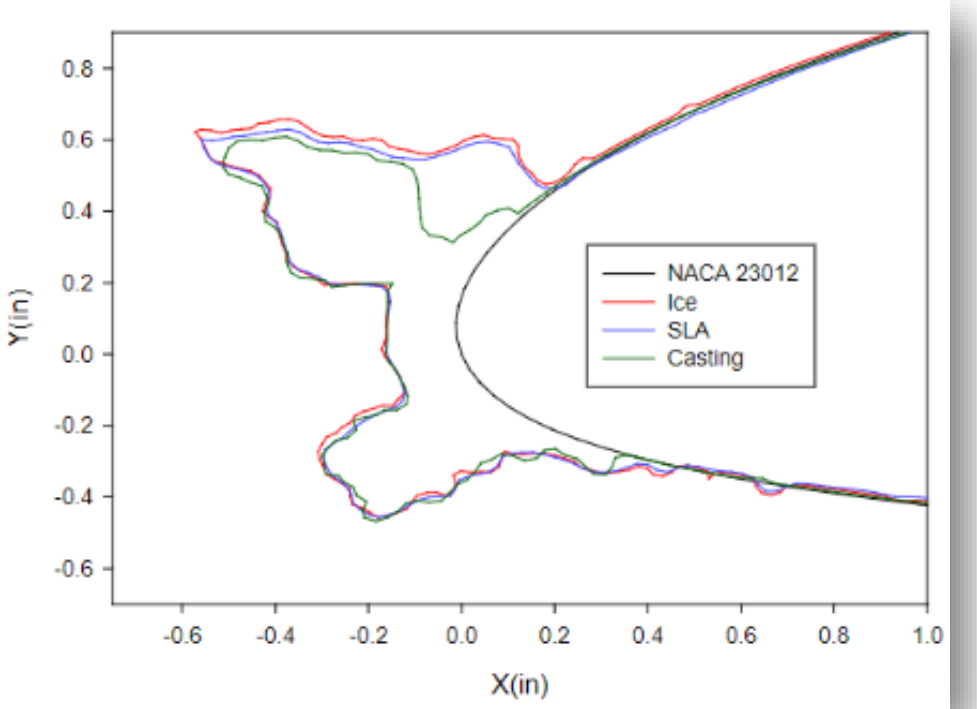
- MVD = 15 microns
- LWC = 0.81 g/m^3
- Speed = 103 m/s (200 kts)
- Mach = 0.31
- Total temperature = -1.9 C
- Static temperature = -7.1 C
- Static pressure = 92941 Pa
- Reynolds number = 3.4 milion
- Spray time = 5 minutes

Available CAD and grid files (meters)

- In-tunnel with AoA applied and far-field versions, 2D
- Unstructured grids in CGNS/FENSAP formats
- Structured grid in PLOT3D format, unformatted, no IBLANK
- CAD available in STEP format

a) NACA 23012





Reference: *AIAA 2014 2613*

Case-251/252: 72-in NACA23012 at α = 2, SLD, monomodal/bimodal

Optional

Conditions

- MVD = 21.5 microns
- LWC = 1.64 g/m^3
- Speed = 103 m/s (200 kts)
- Total temperature = -7.3 C
- Static temperature = -12.6 C
- Static pressure = 91700 Pa
- Spray time = 6.63 minutes

Available CAD and grid files (meters)

- In-tunnel with AoA applied and far-field versions, 2D
- Unstructured grids in CGNS/FENSAP formats
- Structured grid in PLOT3D format, unformatted, no IBLANK
- CAD available in STEP format

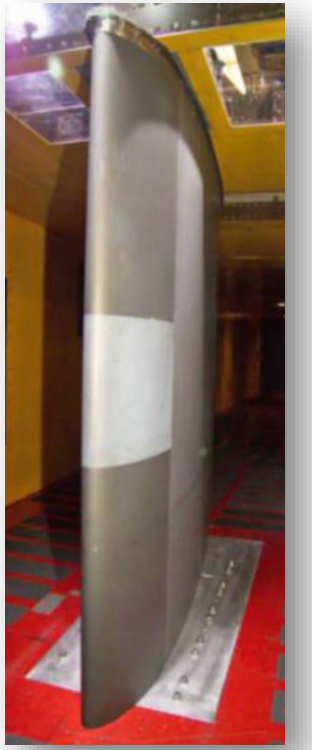
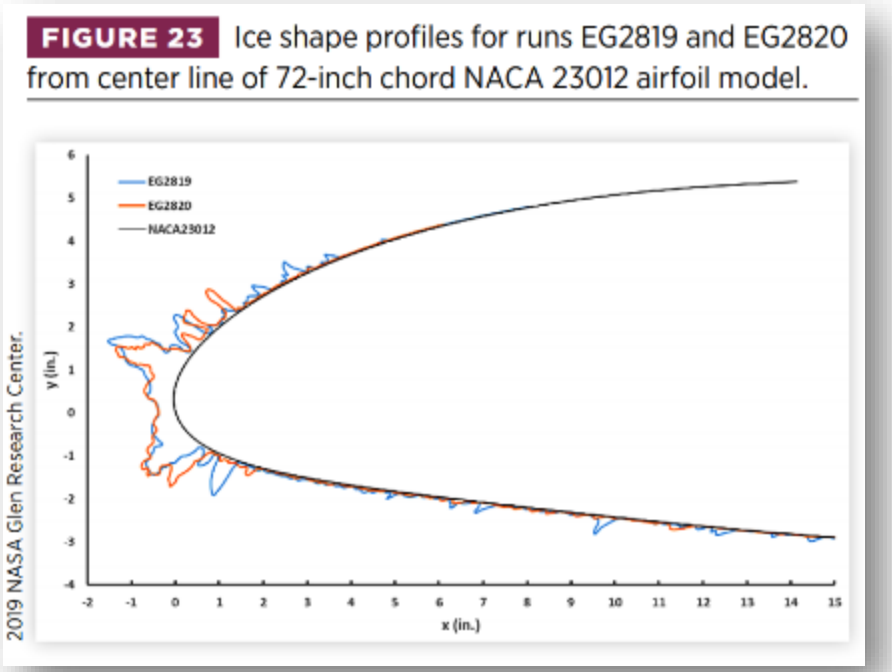
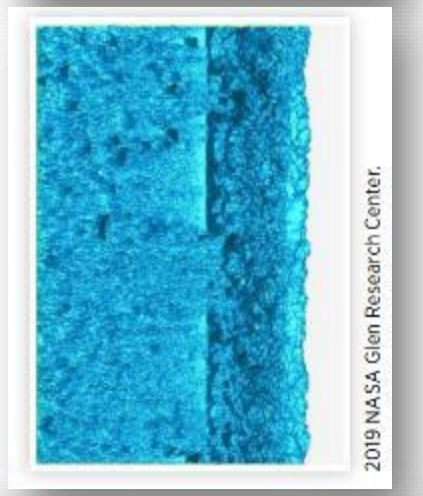


FIGURE 23 Ice shape profiles for runs EG2819 and EG2820 from center line of 72-inch chord NACA 23012 airfoil model.





NACA23012 Airfoil Test Results

Run Numbers	Mass bimodal (g)	Mass monomodal (g)	Δm (g)	Δm (%)	Volume bimodal (in^3)	Volume monomodal (in^3)	ΔVol. (in^3)	ΔVol. (%)	$\rho_{eff,b}$ (g/cm^3)	$\rho_{eff,m}$ (g/cm^3)	$\Delta\rho_{eff}$ (%)
EG2819/EG2820	667.0	549.6	117.4	21.4%	52.47	43.07	9.40	21.8%	0.776	0.779	-0.4%

Reference: *SAE 2019 01 2022*

Case-361: 30-deg-swept NACA0012, rime ice

Baseline

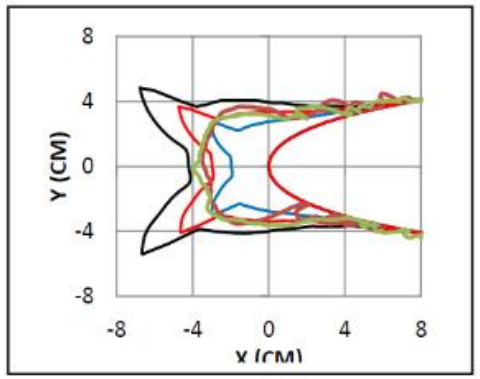
Conditions (AF2146)

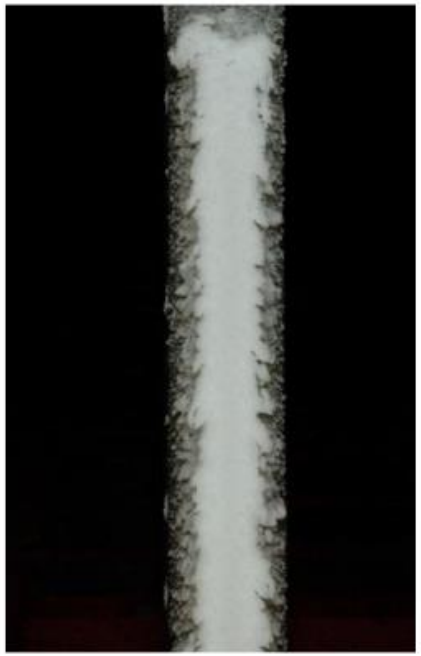
- MVD = 34.7 microns
- LWC = 0.50 g/m^3
- Speed = 103 m/s (200 kts)
- Static Temperature = 257 K
- Static Pressure = 92321 Pa
- Spray time = 20 minutes

Available CAD and grid files (meters)

- Wing positioned in tunnel with AoA = 0
- Unstructured grids in CGNS/UGRID/FENSAP formats
  Prism/tetra and tetra-only using same vertices
- Structured grid in PLOT3D format, unformatted, no IBLANK
- CAD available in STEP format

b) 30° sweep





c) static temperature, 257 K; icing time, 20 minutes

Reference: *AIAA 2014-2200*

Case-362: 30-deg-swept NACA0012, glaze ice

Baseline

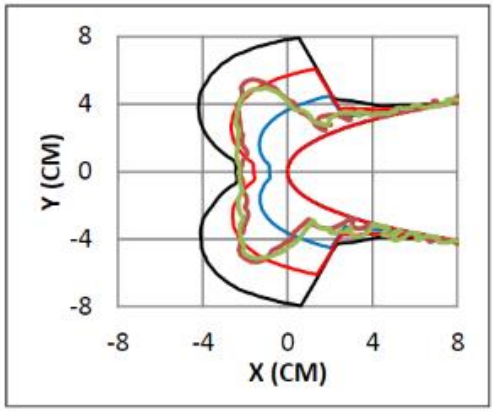
Conditions (AF2145)

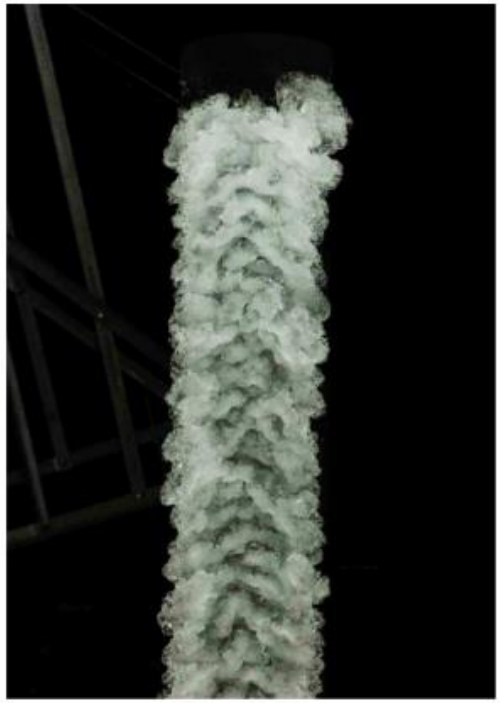
- MVD = 34.7 microns
- LWC = 0.50 g/m^3
- Speed = 103 m/s (200 kts)
- Static Temperature = 266 K
- Static Pressure = 92321 Pa
- Spray time = 20 minutes

Available CAD and grid files (meters)

- Wing positioned in tunnel with AoA = 0
- Unstructured grids in CGNS/UGRID/FENSAP formats
  Prism/tetra and tetra-only using same vertices
- Structured grid in PLOT3D format, unformatted, no IBLANK
- CAD available in STEP format

b) 30° sweep





l) static temperature, 266 K; icing time, 20 minutes

Reference: *AIAA 2014-2200*

Case-363: 30-deg-swept NACA0012 with ice scan

Optional

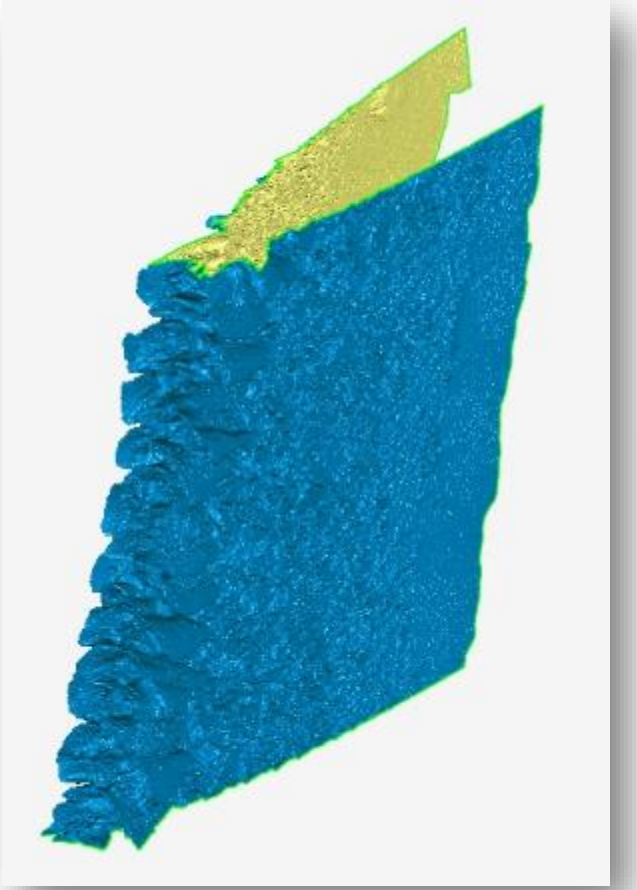
Condition 1 (AF2881)

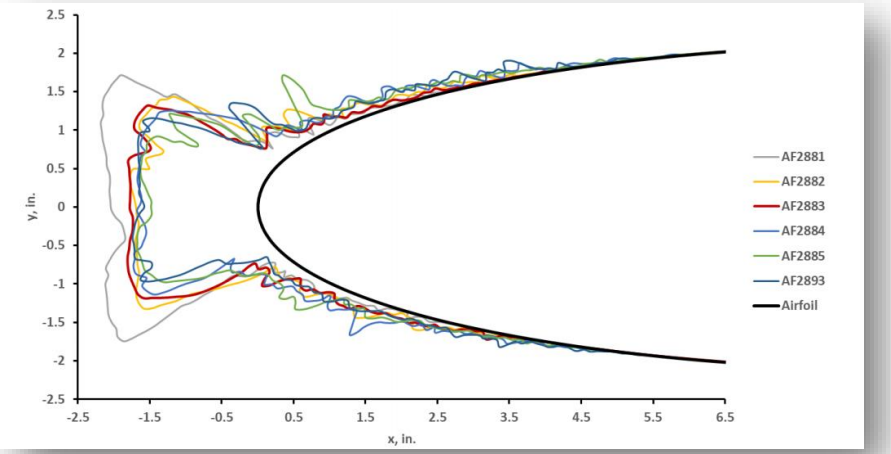
- MVD = 20.5 microns
- LWC = 0.50 g/m^3
- Speed = 115.24 m/s (224 kts)
- Static Temperature = -10 C
- Total Temperature = -3.4 C
- Static pressure = 90321 Pa
- Spray time = 17.7 minutes

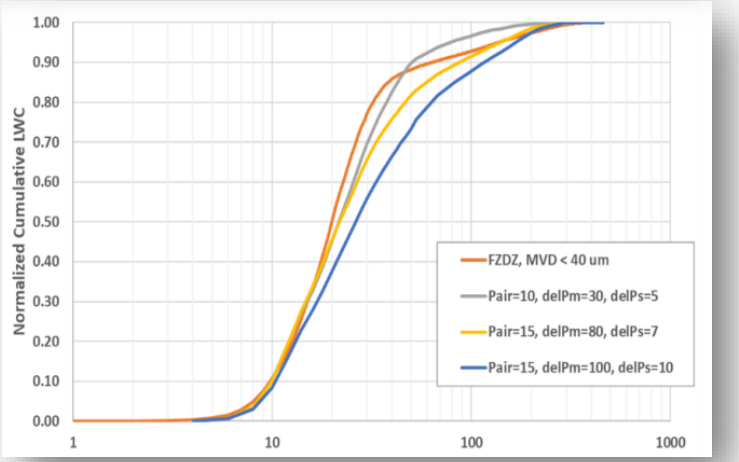
Available CAD and grid files (meters)

- Wing positioned in tunnel with AoA = 0
- Unstructured grids in CGNS/UGRID/FENSAP formats
  Prism/tetra and tetra-only using same vertices
- Structured grid in PLOT3D format, unformatted, no IBLANK
- CAD available in STEP format

b) 30° sweep







Reference: AIAA-2020-2814

Case-364: 30-deg-swept NACA0012 with ice scan

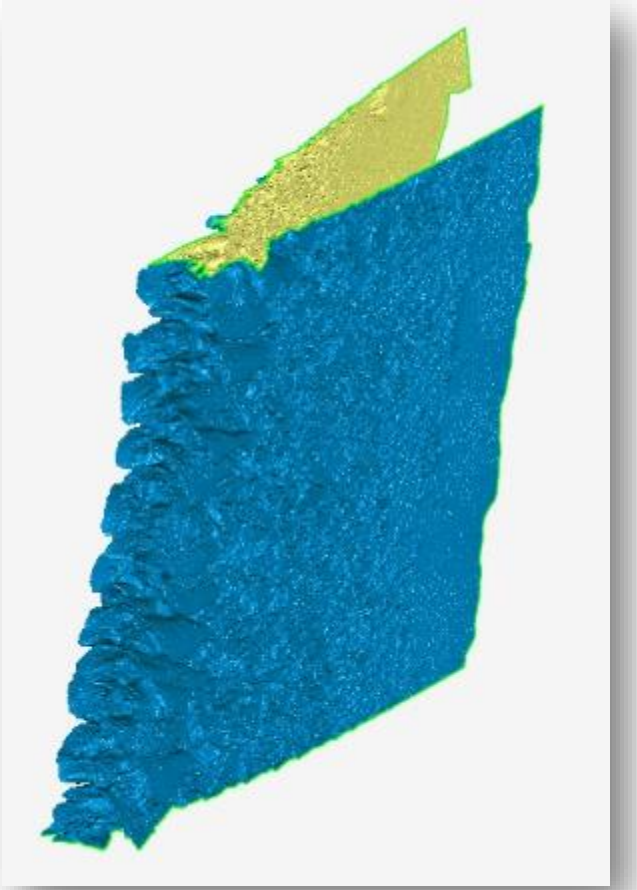
Optional

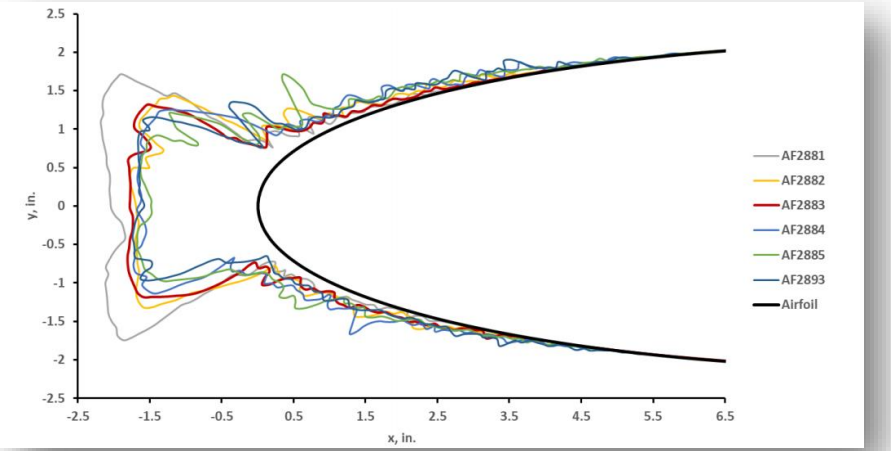
Condition 2 (AF2892)

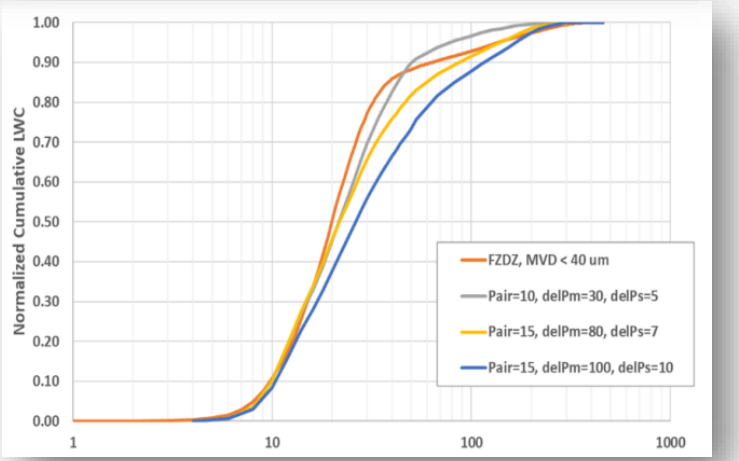
- MVD = 20.5 microns
- LWC = 0.50 g/m^3
- Speed = 114.21 m/s (222 kts)
- Static Temperature = -13.4 C
- Total Temperature = -6.8 C
- Static pressure = 89632 Pa
- Spray time = 17.7 minutes

Available CAD and grid files (meters)

- Wing positioned in tunnel with AoA = 0
- Unstructured grids in CGNS/UGRID/FENSAP formats Prism/tetra and tetra-only using same vertices
- Structured grid in PLOT3D format, unformatted, no IBLANK
- CAD available in STEP format







Reference: AIAA-2020-2814

Case-371: 45-deg-swept NACA0012, rime ice

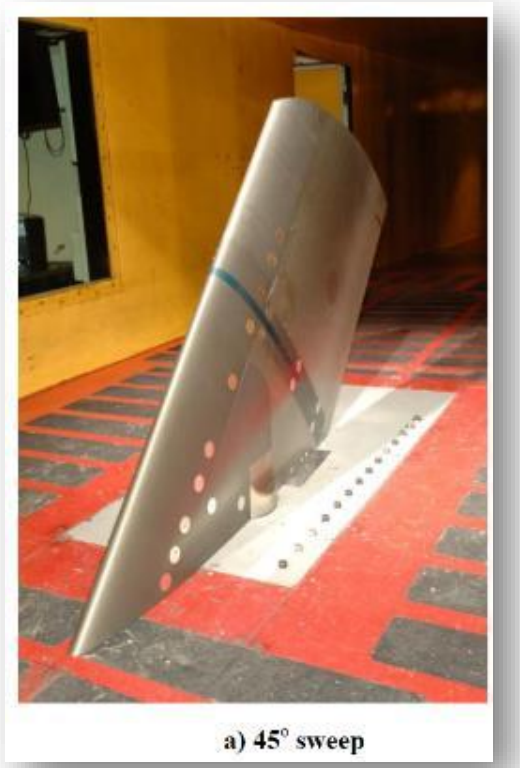
Baseline

Conditions (AF1799)

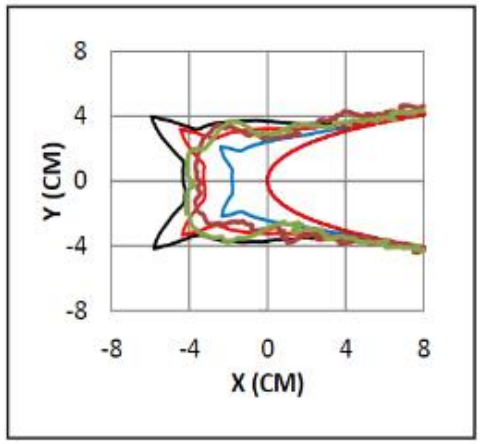
- MVD = 32 microns
- LWC = 0.50 g/m^3
- Speed = 103 m/s (200 kts)
- Static Temperature = 257 K
- Static Pressure = 94463 Pa
- Spray time = 20 minutes

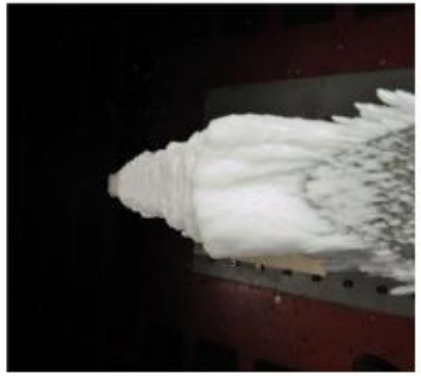
Available CAD and grid files (meters)

- Wing positioned in tunnel with AoA = 0
- Unstructured grids in CGNS/UGRID/FENSAP formats
  Prism/tetra and tetra-only using same vertices
- Structured grid in PLOT3D format, unformatted, no IBLANK
- CAD available in STEP format



a) 45° sweep





a) static temperature, 257 K

Reference: *AIAA 2014-2200*

Case-372: 45-deg-swept NACA0012, glaze ice

Baseline

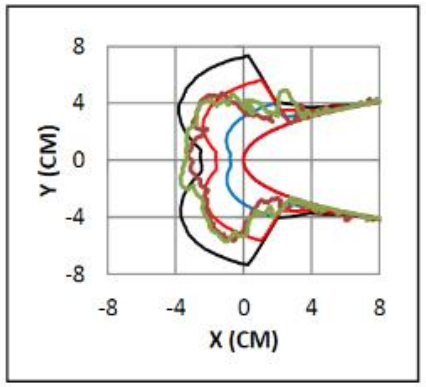
Conditions (AF1795)

- MVD = 32 microns
- LWC = 0.50 g/m^3
- Speed = 103 m/s (200 kts)
- Static Temperature = 266 K
- Static Pressure = 94463 Pa
- Spray time = 20 minutes

Available CAD and grid files (meters)

- Wing positioned in tunnel with AoA = 0
- Unstructured grids in CGNS/UGRID/FENSAP formats
  Prism/tetra and tetra-only using same vertices
- Structured grid in PLOT3D format, unformatted, no IBLANK
- CAD available in STEP format

a) 45° sweep



e) static temperature, 266 K

Figure 13. - Concluded. Ice shape comparisons for 45° swept wing. Icing conditions: airspeed 103 m/s; icing time 20 minutes; liquid water content, 0.45 g/m^3; static pressure, 94463 Pa; MVD, 32 μm.

Reference: *AIAA 2014-2200*