EASA
European Aviation Safety Agency

Introduction: De-icing process and fluids

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Workshop presentation of DIFT research project

Cologne, 23rd March 2015

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Introduction: De-icing process and fluids

- Aircraft need to be uncontaminated (clean) for adequate performance (e.g. take-off). In winter condition, this implies aircraft with no ice/frost/snow… (legal mandate for the airline, e.g. CAT.OP.MPA.250).

- Adequate performance of a clean aircraft is assessed during the type investigation process, conducted by aviation authorities.

Introduction: De-icing process and fluids

De-icing:

- An aircraft contaminated with frost/ice/snow needs therefore to be de-iced before take off

- If available at the airport, de-icing is typically performed with a heated Type I fluid. These fluids are based on glycols and are not viscous.

- Type I fluids are compliant with SAE AMS1424.

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Some times SAE type I fluid (only) is not adequate:

- De-icing can also be performed with Type II or IV, when type I is not available.
- Type II or IV could also be applied as overnight protection when it is expected frost during the night.
- **Under freezing precipitation conditions, aircraft are treated (e.g. two steps application) with type II or IV fluids so the aircraft are protected against contamination (anti-icing) for a certain period (Holdover time).**

  (Type I fluids provide minimal Holdover time protection)

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- Hold-over time protection is mainly achieved using non-Newtonian fluids based typically on glycols (freezing point depressants), named as Type II, III and IV in specification SAE AMS 1428, widely accepted.

SAE Aerospace An SAE International Group	AEROSPACE MATERIAL SPECIFICATION	SAE AMS1428	REV. G
		Issued 1997-08 Revised 2010-12 Superseding AMS1428F	

Fluid, Aircraft Deicing/Anti-Icing, Non-Newtonian (Pseudoplastic), SAE Types II, III, and IV

RATIONALE

This specification has been revised to incorporate the following: A reference to ARP5718, Qualification Process for SAE AMS1428 Type II, III, and IV Fluids (1.5); changes to the inspection of the plates in the Dry-Out by Exposure to Cold Dry Air (3.2.2.3) and the Thin Film Thermal Stability (3.2.2.5) tests; changes to the Hard Water Stability (3.2.2.8) test to make it more consistent with the Thermal Stability (3.2.2.1) test; changes to the Lot Acceptance Tests (4.2.1) to allow viscosity to be tested at 0 °C or 20 °C; and changes to The Successive Dry-Out And Rehydration Test (Appendix A).

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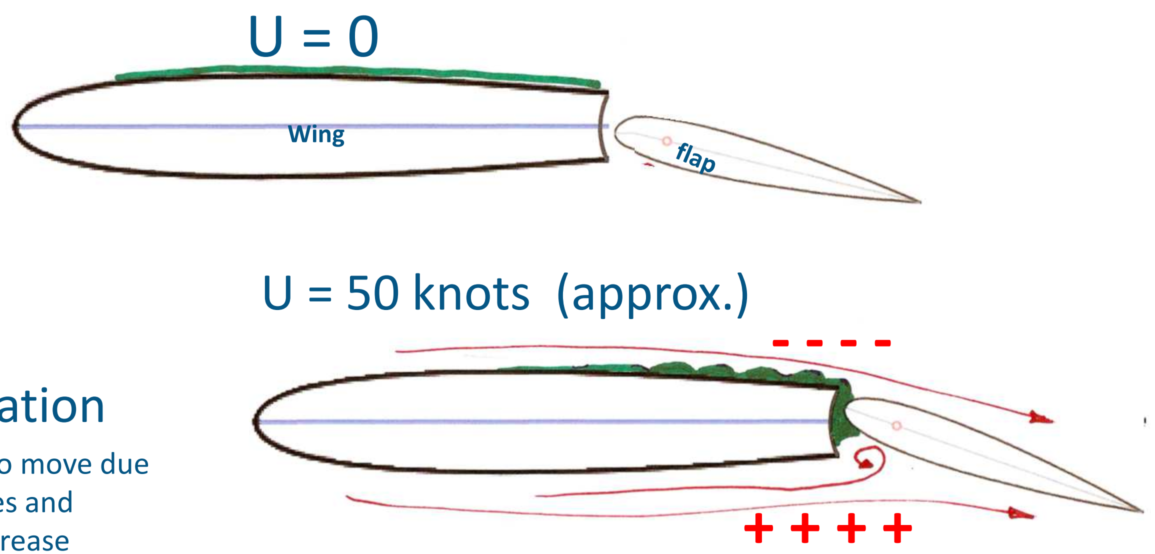
- The fluid specification AMS 1428 contains requirements for:
  - Fluid stability to simulate: long term storage, dry air overnight exposure, thin film heated, successive dry out and rehydration (residue problem)…
  - rheological properties
  - anti-icing performance
  - aerodynamic acceptance

Classification of a fluid as a Type II, III or IV depends on the results of these two latest tests.

- Aerodynamic acceptance is assessed with a test described in SAE AS5900.



Acceleration

Fluid starts to move due shering forces and viscosity decrease

SAE Aerospace An SAE International Group	AEROSPACE STANDARD	SAE AS5900	REV. B
		Issued 2003-02 Revised 2007-07 Superseding AS5900A	

(R) Standard Test Method for Aerodynamic Acceptance of
SAE AMS 1424 and SAE AMS 1428 Aircraft Deicing/Anti-icing Fluids

1. SCOPE

1.1 Objective

This SAE Aerospace Standard (AS) establishes the aerodynamic flow-off requirements for SAE AMS 1424 Type I and SAE AMS 1428 Type II, III and IV fluids used to deice and/or anti-ice aircraft:

a. with takeoff rotation speeds exceeding approximately 100 knots, with time from brake release to rotation speed greater than 20 s, typical for large transport type jet aircraft. This procedure is referred to as the High Speed Ramp Test.

   and/or

b. with takeoff rotation speeds exceeding approximately 60 knots, with time from brake release to rotation speed greater than 15 s typical for commuter type aircraft. This procedure is referred to as the Low Speed Ramp Test.

   NOTE: When compensating measures, such as increase in rotation speed, are used in the aircraft takeoff procedure, the High Speed Ramp can apply.

The objective of this standard is to ensure acceptable aerodynamic characteristics of the deicing/anti-icing fluids as they flow off aircraft lifting and control surfaces during the takeoff ground acceleration and climb.

NOTE: These test methods are based on glycol-based fluids, additional testing may be required for non-glycol-based fluids.

S5900	REV. B
2003-02	

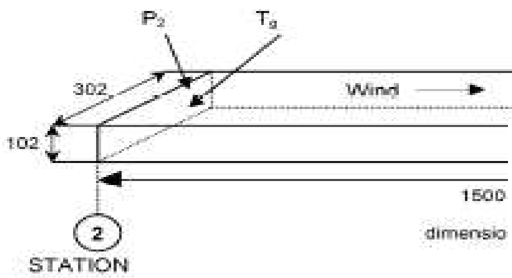


FIGURE 1 - TEST

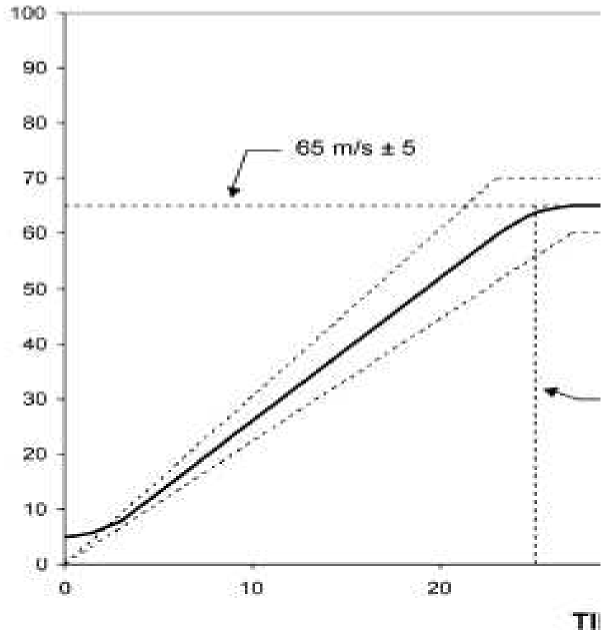
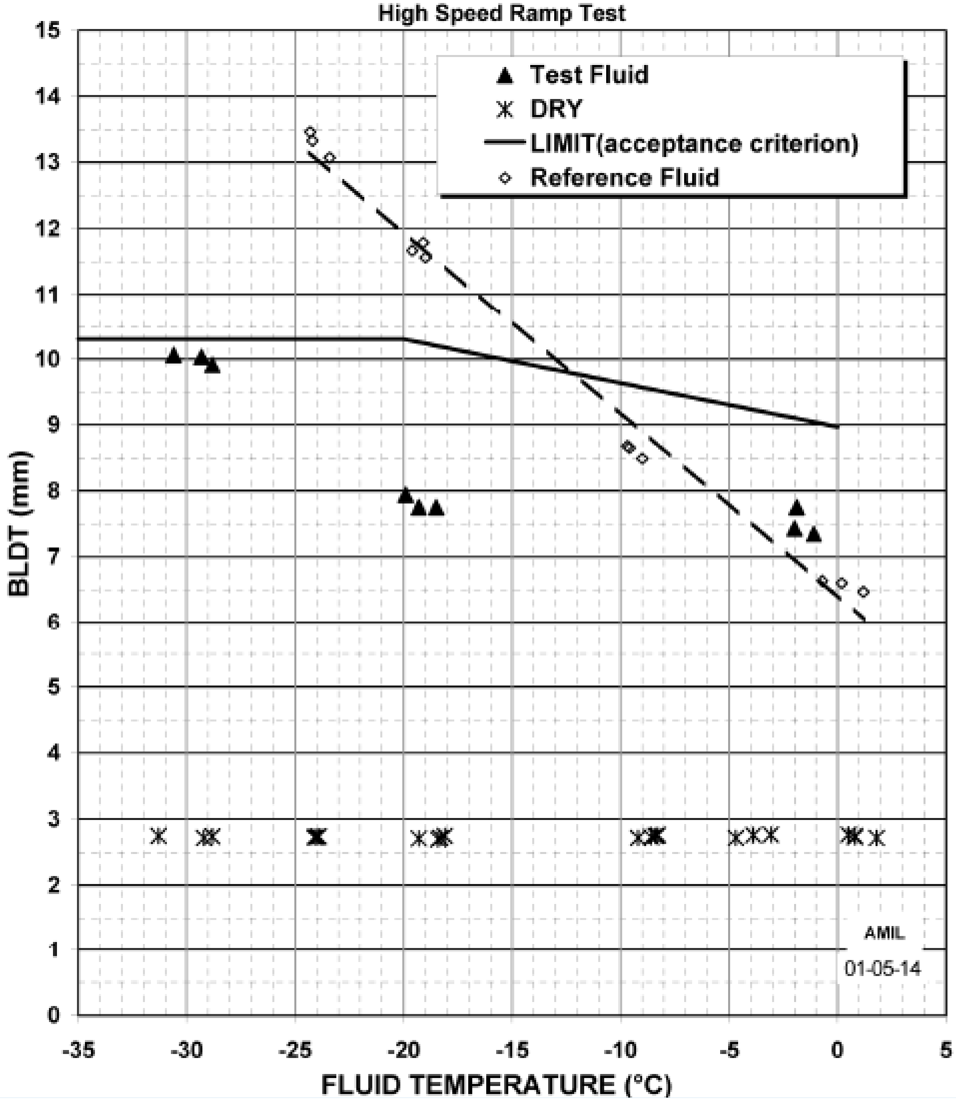


FIGURE 2 - TAKEOFF GROUND ACCELERA

Test Fluid



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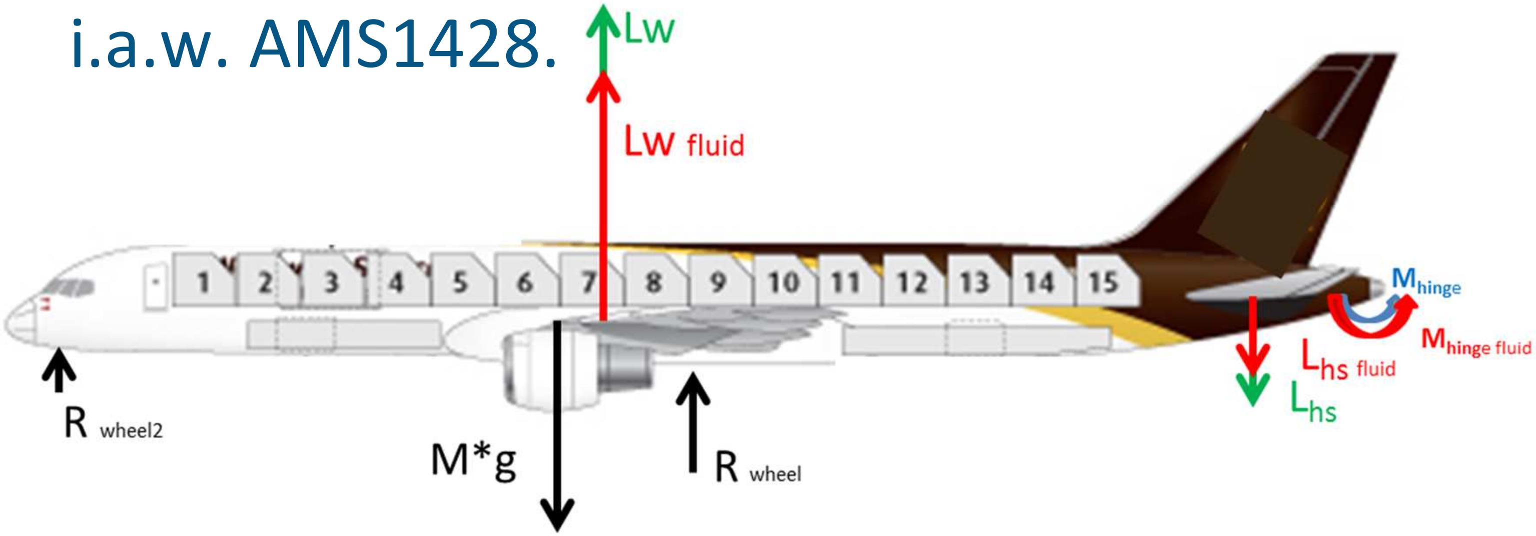
- AS5900 only aims to evaluate the lift degradation of the treated wing.
- The effect of the fluid on the Horizontal Stabiliser is not assessed as part of the of the fluid qualification i.a.w. AMS1428.



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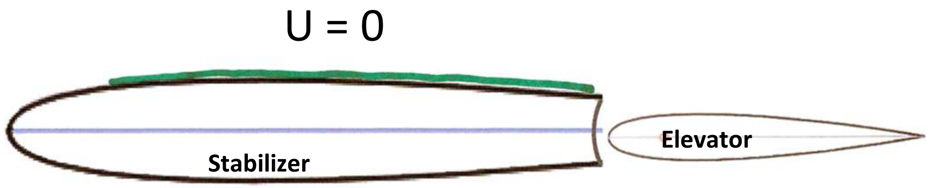
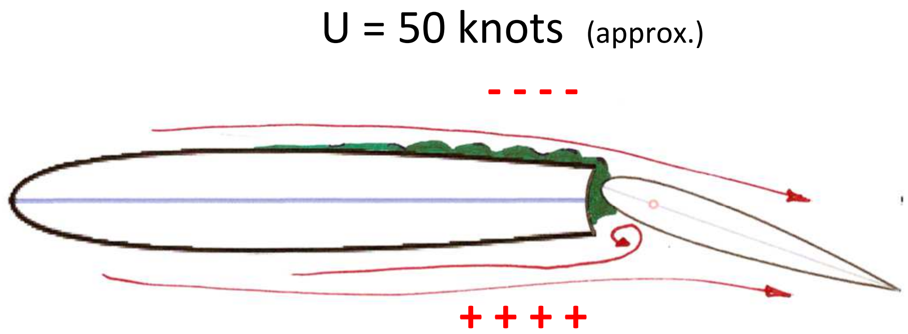
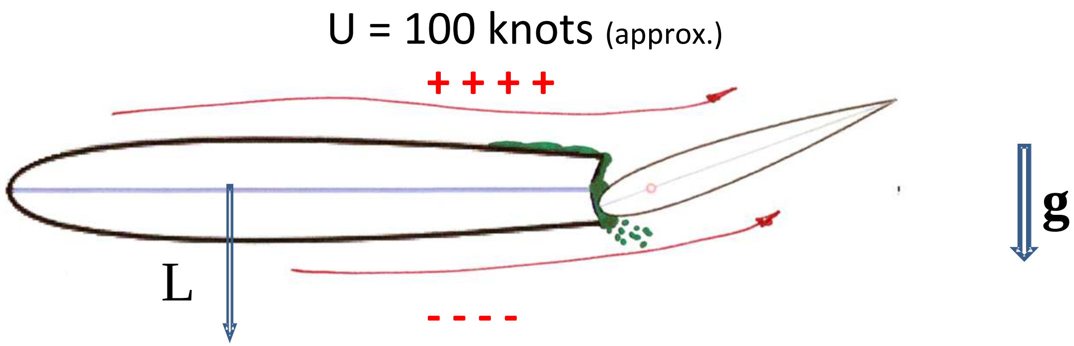




Acceleration

Fluid starts to move due shering forces and viscosity decrease



Rotation

Fluid migrate to the lower side of the elevator

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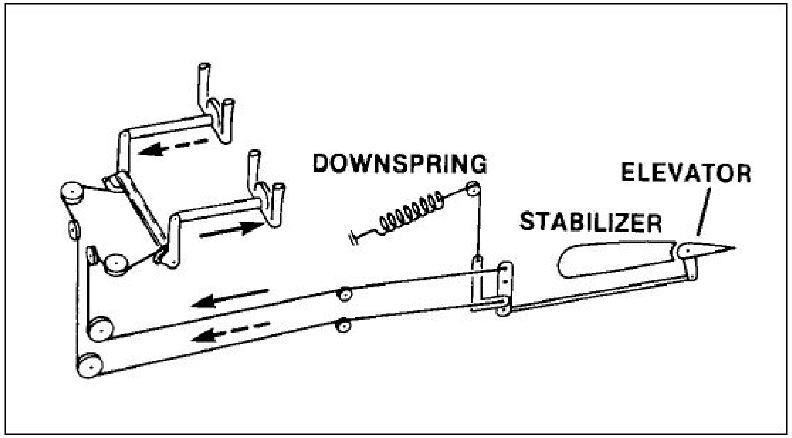
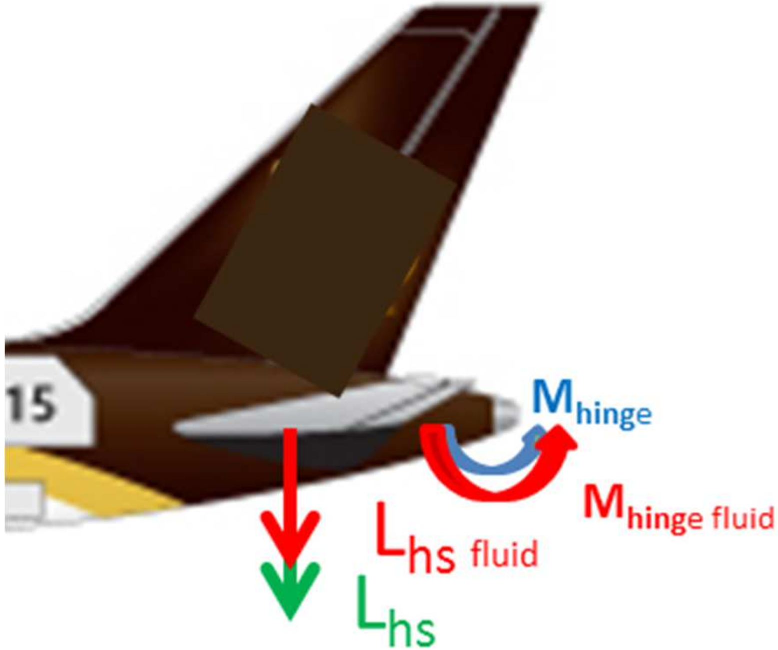




DIFT: De-icing process and fluids

- In recent years, a number of incidents have been reported where aircraft have had difficulty rotating during take-off after the application of thickened anti-icing fluids on the horizontal stabilizer.
- Swedish AIB (SHK) issued a SR to investigate tightening requirements for demonstrating that the aircraft has full manoeuvrability during all phases pf the takeoff procedure after the anti-icing.
- EASA launched the DIFT research project, aiming to understand the effects of anti-icing fluids on a horizontal stabilizer during take-off rotation.
- The project was awarded to NRC in late 2013 and finalised in early 2015.

DIFT: De-icing process and fluids

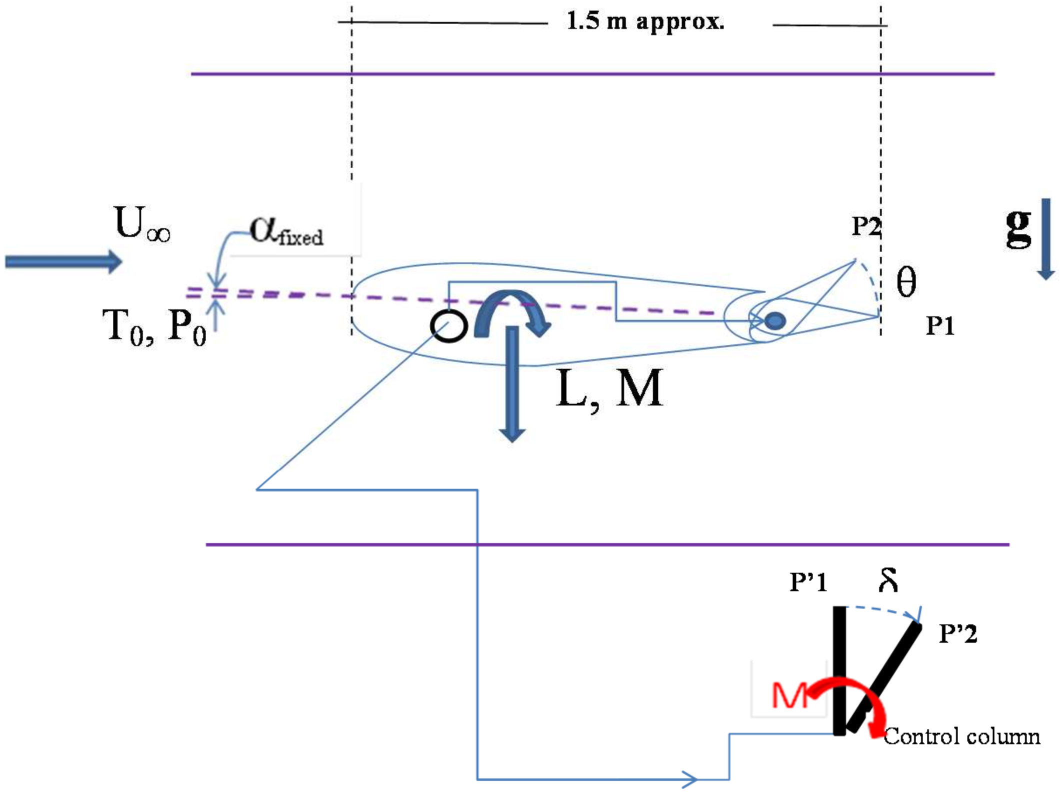
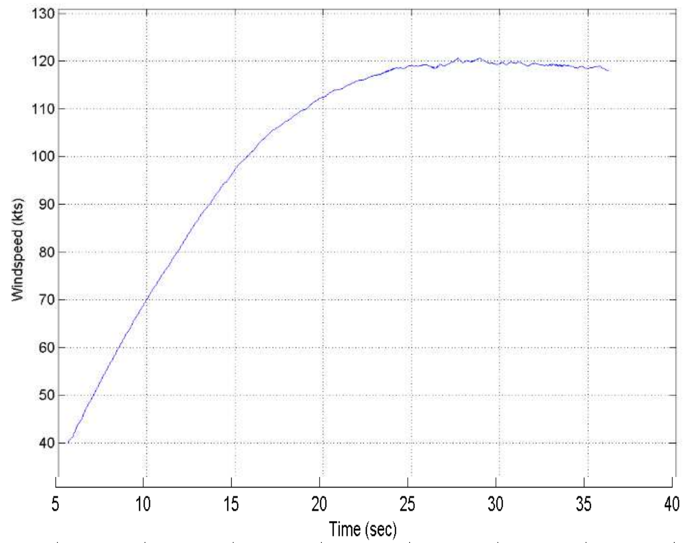
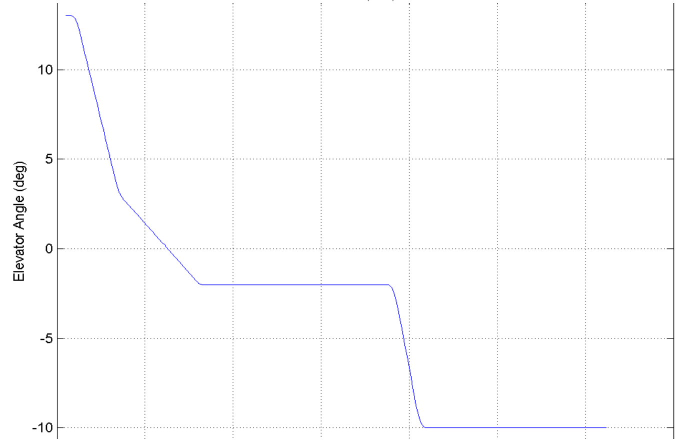


Figure 1 – 2D representation of the aerodynamic profile in the tunnel and most considered.





- Other organisations have studied this phenomena before…

but mitigations found so far may not be sufficient – (incidents are still being reported)

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- … in a difficult environment.

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End of introduction

Thank you for your attention!

Any questions….?