Helicopter Low Speed Testing

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QinetiQ Flight Test Organisation

With the ability to deliver rapid and customer focused solutions to a range of flight test challenges, QinetiQ's Flight Test Organisation (FTO) has CAA approval to conduct all categories of flight test on fixed and rotary wing aircraft.

Find out more at: www.QinetiQ.com/FTO

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Introductory Remark

After 25 years of flight test the biggest lesson I have learnt is that flight test is incredibly simple…….

…….until you actually come to do it.

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Why do we do helicopter low speed testing and what's low speed?

Helicopters have a low speed envelope, typically up to ~30 to ~50 kn

Low speed performance

- Hover wind effects
- OEI minimum speeds
- Dynamic OEI 'flyaway and reject'

To define the low speed envelope

- Control margins, typically TRP
- Engine performance (recirculation) or systems performance

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Low speed reference system

Key requirement is to know the airspeed/relative wind speed at which the aircraft is traveling.

Traditionally a ground ‘pace vehicle’ has been used.

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Typical risks and mitigation

Hazard	Considerations	Risk Reduction measures
Vehicle operating in close proximity to aircraft in flight.	Collision with pace vehicle during low speed manoeuvres leading to: Loss of aircraft, crew, and pace vehicle occupants.	1. Testing will be briefed and conducted iaw the Pace Vehicle SOP. 2. Follow pace vehicle procedures where applicable. 3. Pace vehicle crew to attend pre-flight brief. 4. Pace vehicle crew to be suitably experienced and qualified. 5. The handling pilot and aircrewman to keep the pace vehicle in sight at all times during the test. 6. The pace vehicle to be in two way communications with the aircraft at all times. 7. A minimum of 2 rotor spans clearance to be maintained between the aircraft and the pace vehicle.
Operations close to or at limits of LSFE whilst at low level.	Loss of control authority in any axis whilst testing at low speed causing collision with obstacles or loss of control, leading to: Loss of aircraft and death/injury to personnel.	1. Incremental approach to testing. 2. Control margins to be monitored in real time. The FTI system displays change colour to give additional warning of approaching aircraft limits. 3. HOWGOZIT plot to be used, if appropriate. 4. 'Knock it off' control margins to be defined based on control axis, aircraft height and other factors. 5. Testing to be conducted in an area free of obstacles.
Operations outside of OEI flight envelope whilst at low level.	Loss of engine power whilst operating at low speed without single engine capability causes aircraft crash. 1. Aircraft ballasted for high AUM. 2. Environmental conditions decrease fly-away performance LSFE testing involves protracted operations at low level. Leading to: Loss of aircraft and death/injury to personnel.	1. Low speed flight limitations and OEI performance to be briefed. 2. Advanced single engine recovery techniques to be practised (Sim. & aircraft) i.e. workup training for all test low speed flight conditions. 3. Captain to brief crew on actions in the event of an engine failure. 4. Testing to be carried out over a suitable landing area. 5. Crew to have accurate wind speed and direction information. 6. LHS crewmember to monitor power margin.

Pace vehicle issues

Accuracy

- Is the aircraft actually in formation with the vehicle?
- The relative wind at the vehicle may be different from at the aircraft (wind measured at ~10ft, aircraft at ~120ft?)

Safety

- Need to avoid pace vehicle
- Avoiding pace vehicle when off test point and getting into formation increases workload
- Relatively high workload, mental arithmetic

Rate of data acquisition

- Need to wait for pace vehicle to get on condition
- Even with a long runway, difficult to test multiple conditions on a single run

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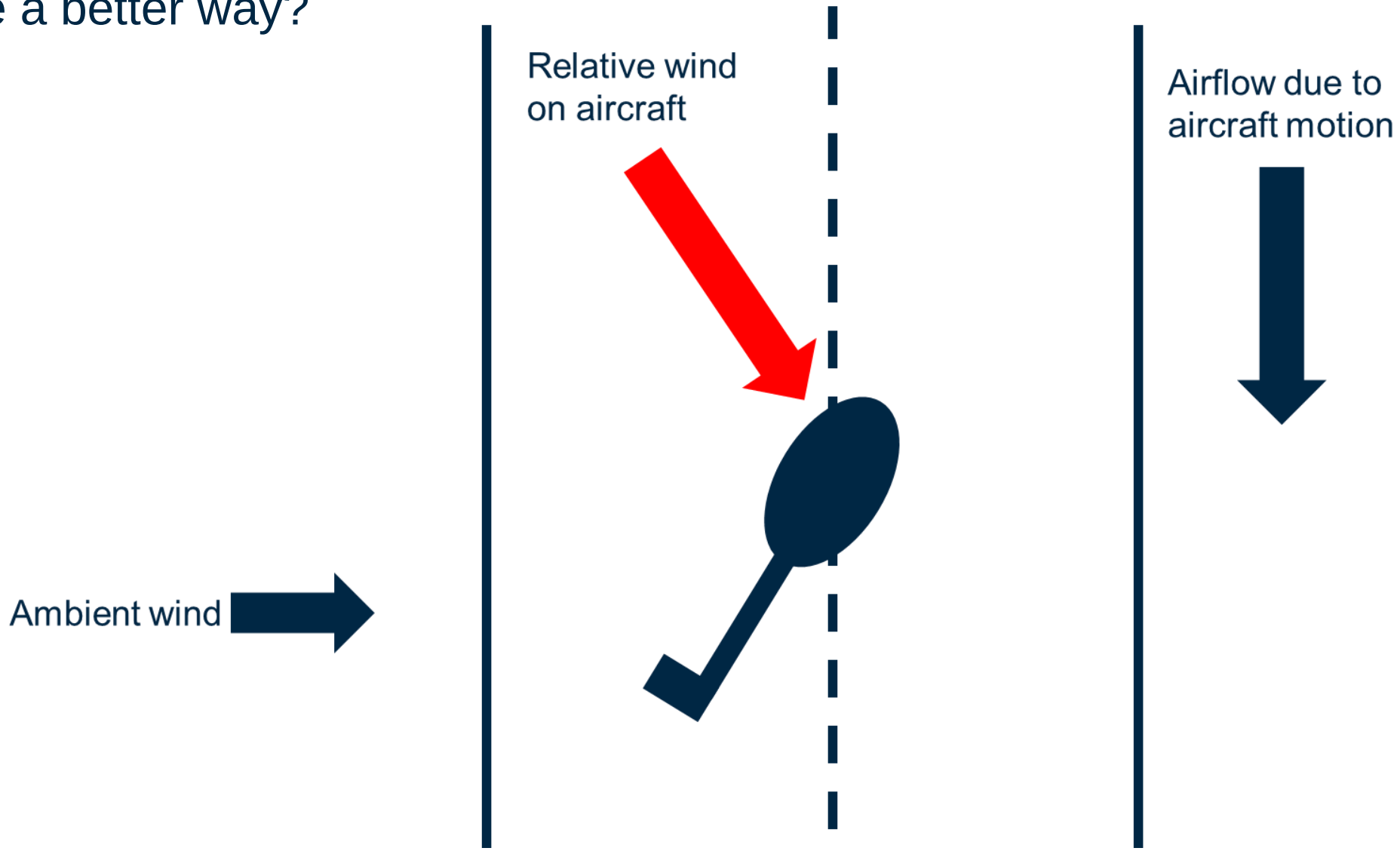
Is there a better way?



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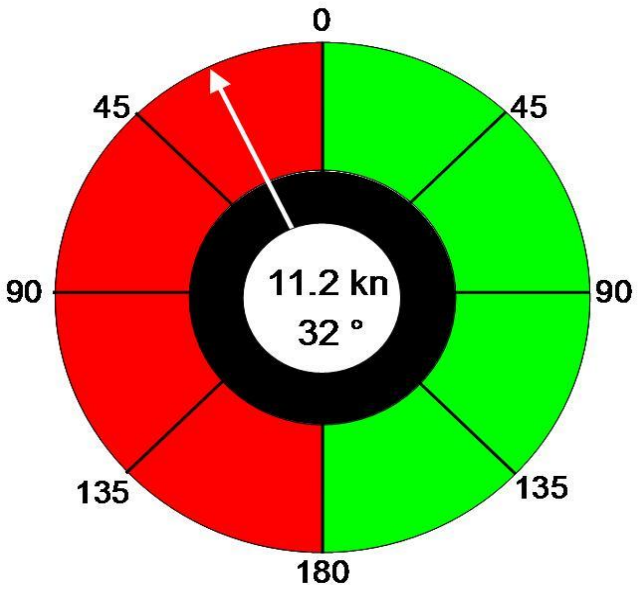
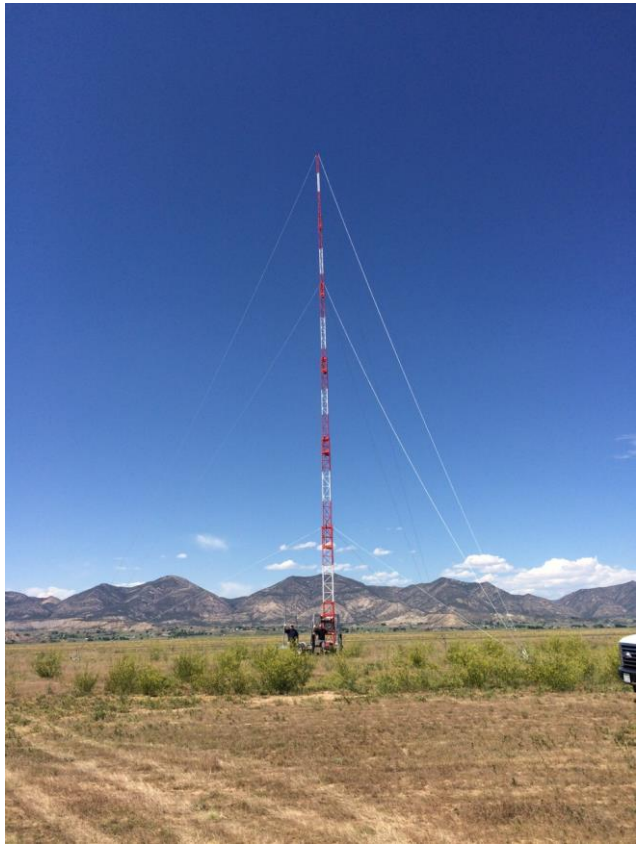
Low speed testing





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Advantages (and disadvantages)

Higher resolution, apparent increase in accuracy

- Relative wind calculated at aircraft height
- An easier flying task

Safer – no vehicle

Quicker

- At least twice as quick as pace vehicle technique
- Multiple different test points per run (change speed or azimuth)

Ambient wind measurement is displaced from the aircraft so local variations on the airfield can negatively affect accuracy.

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