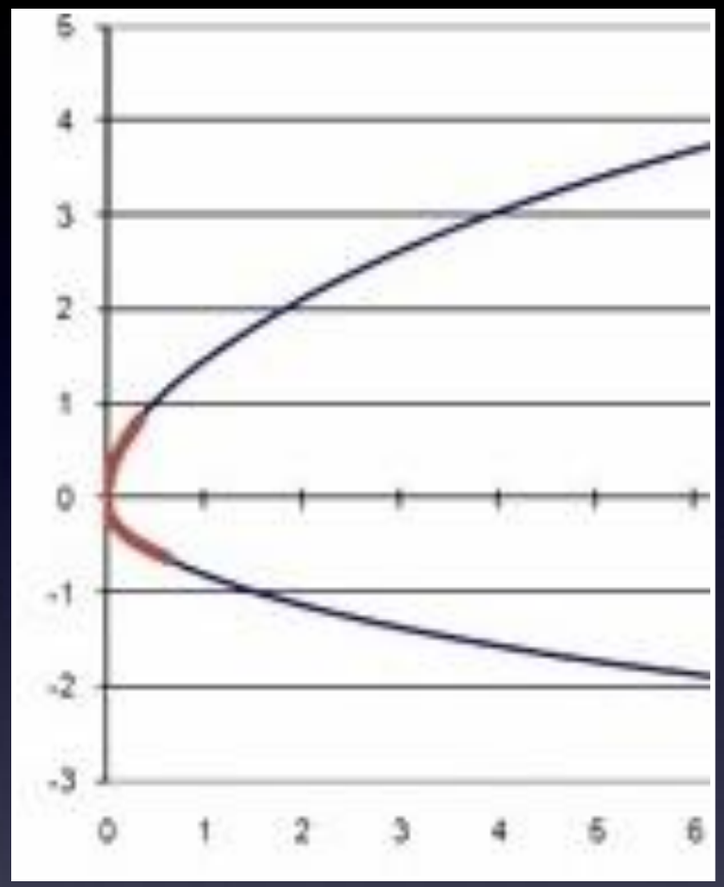
Leading Edge Tape

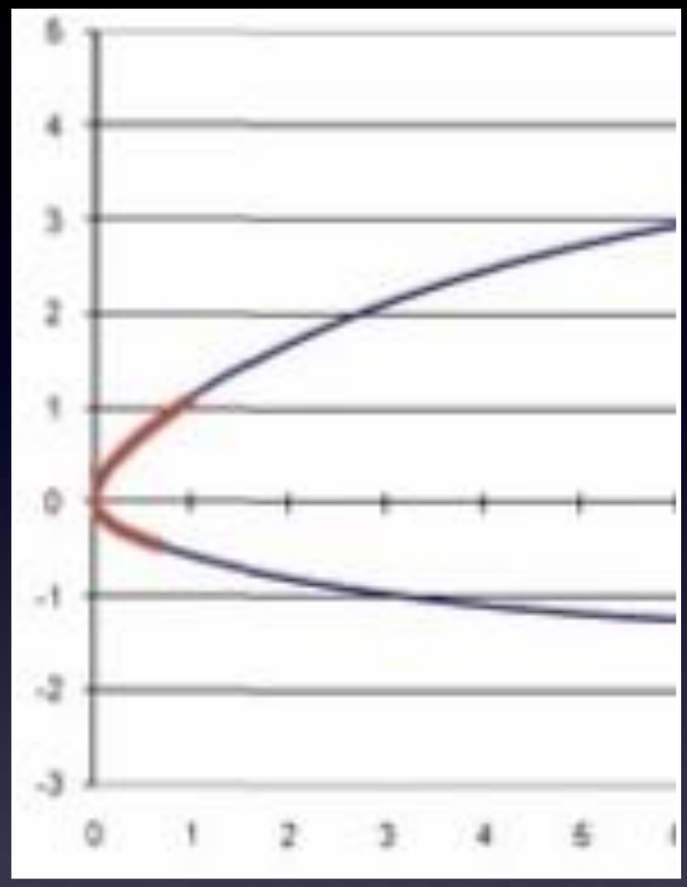
Humidity Dependence

Jim Hendrix
The Deturbulator Project
www.deturbulator.org

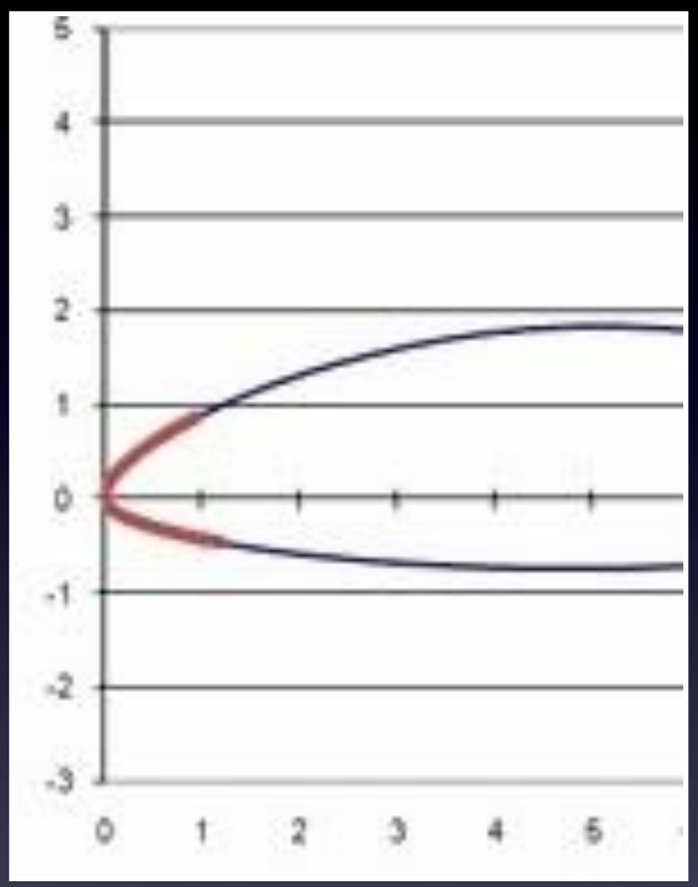
Position of Tape



Wing Root



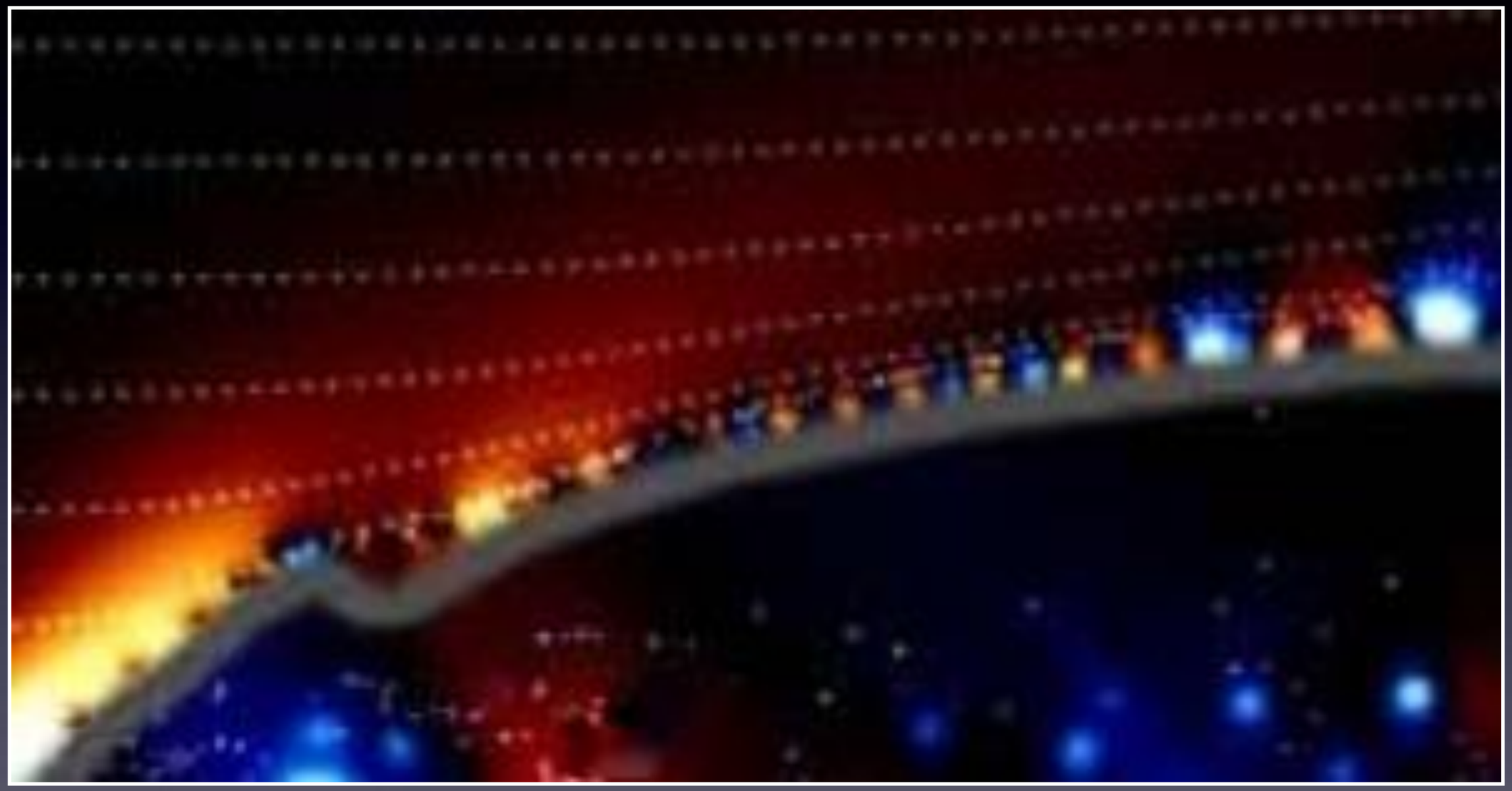
Inboard End of Aileron



Wing Tip

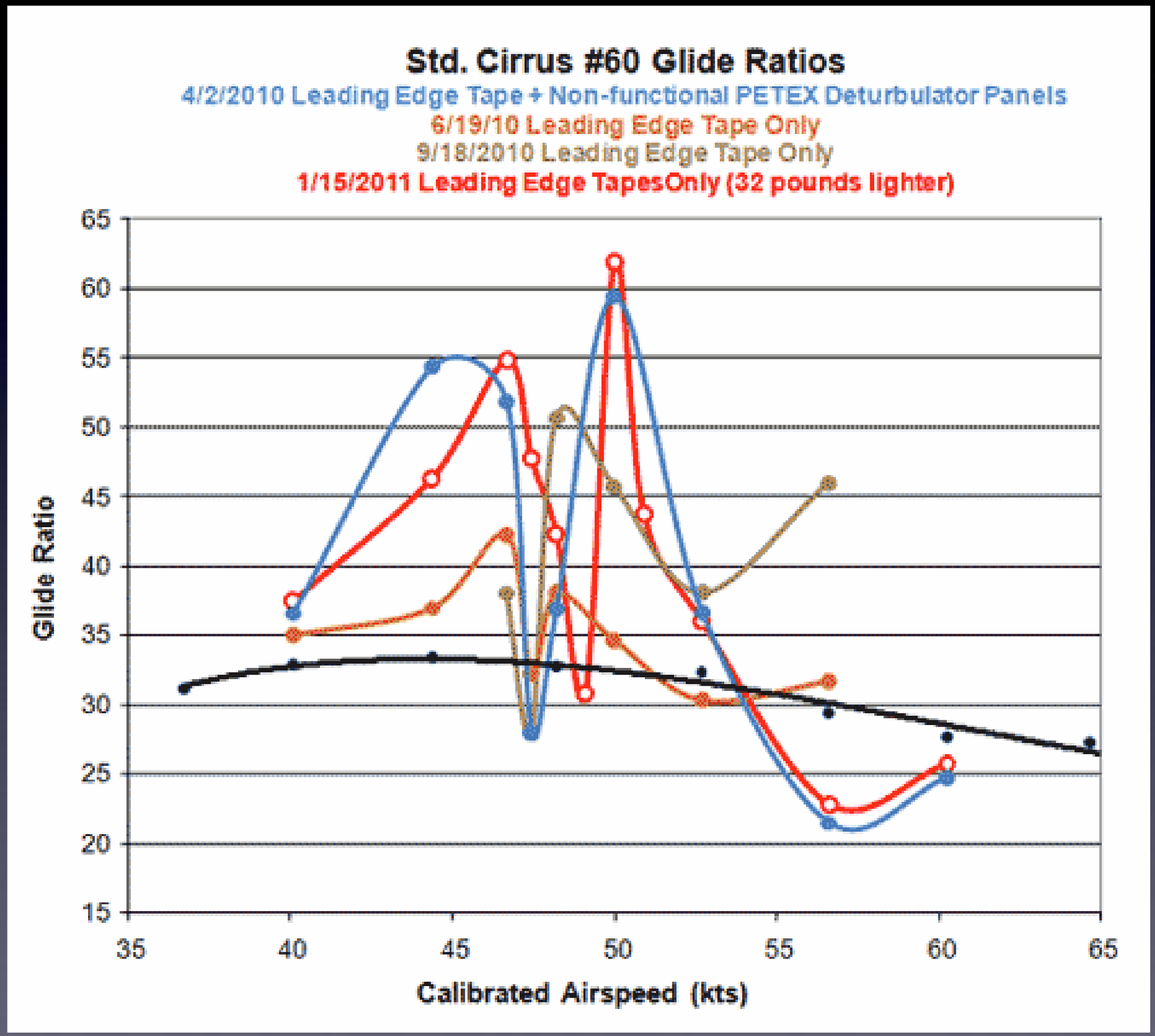
Tape Thickness: .0025"

Demonstration of Hypothetical Vortical Separation Layer

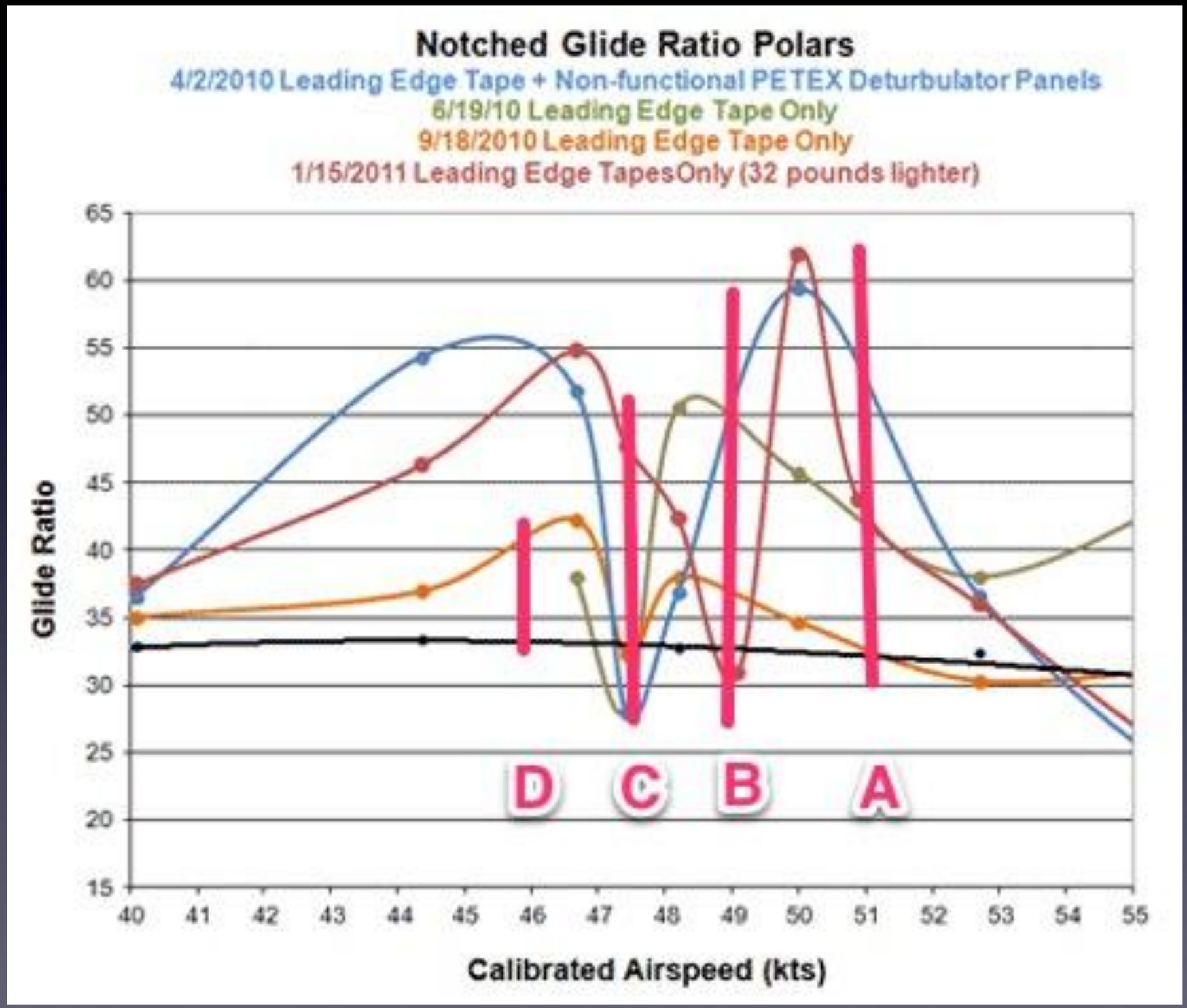


This is not a realistic simulation. It is only a demonstration of the sort of vortical flow that is postulated.

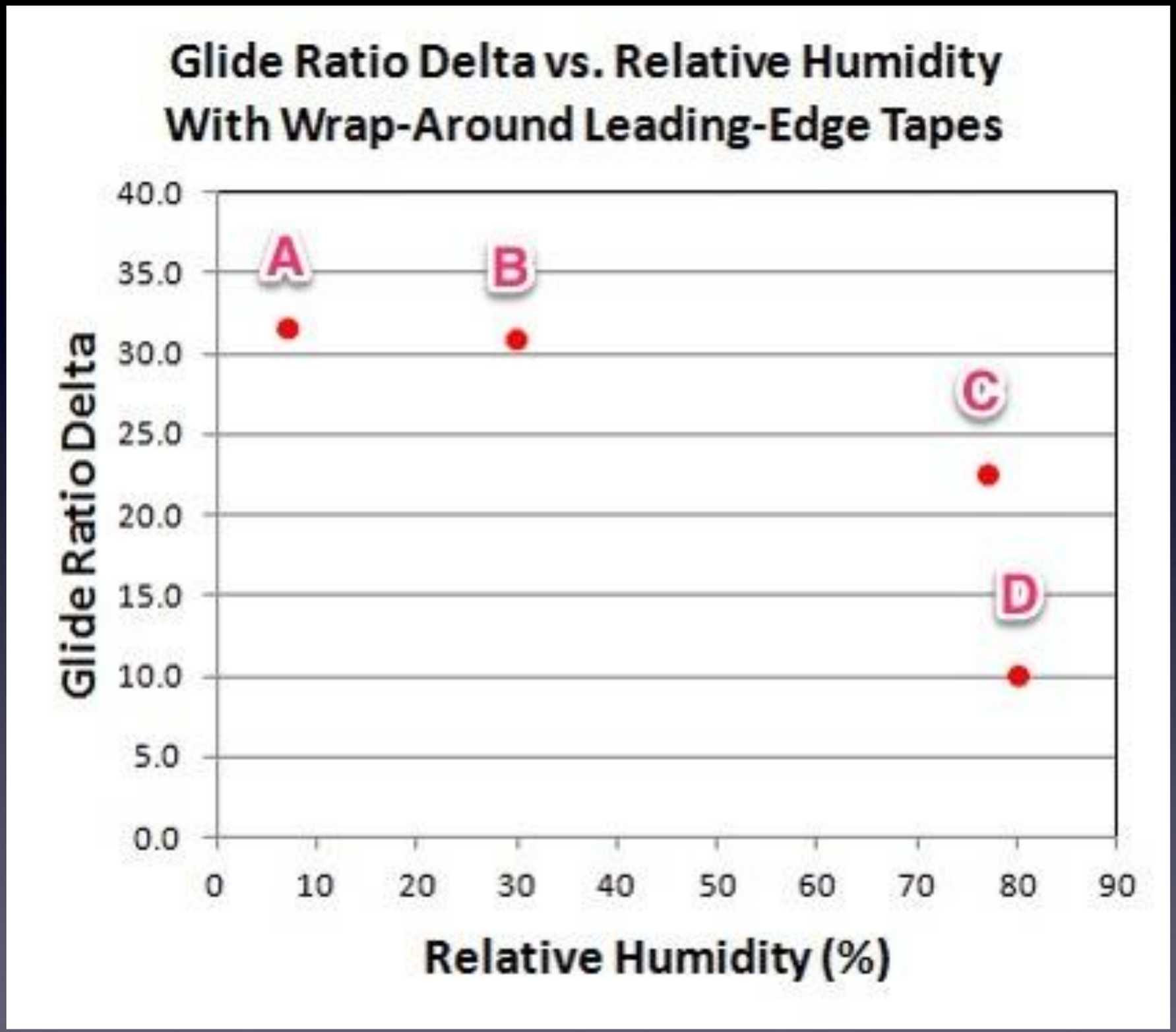
Four Glide-Ratio Measurements



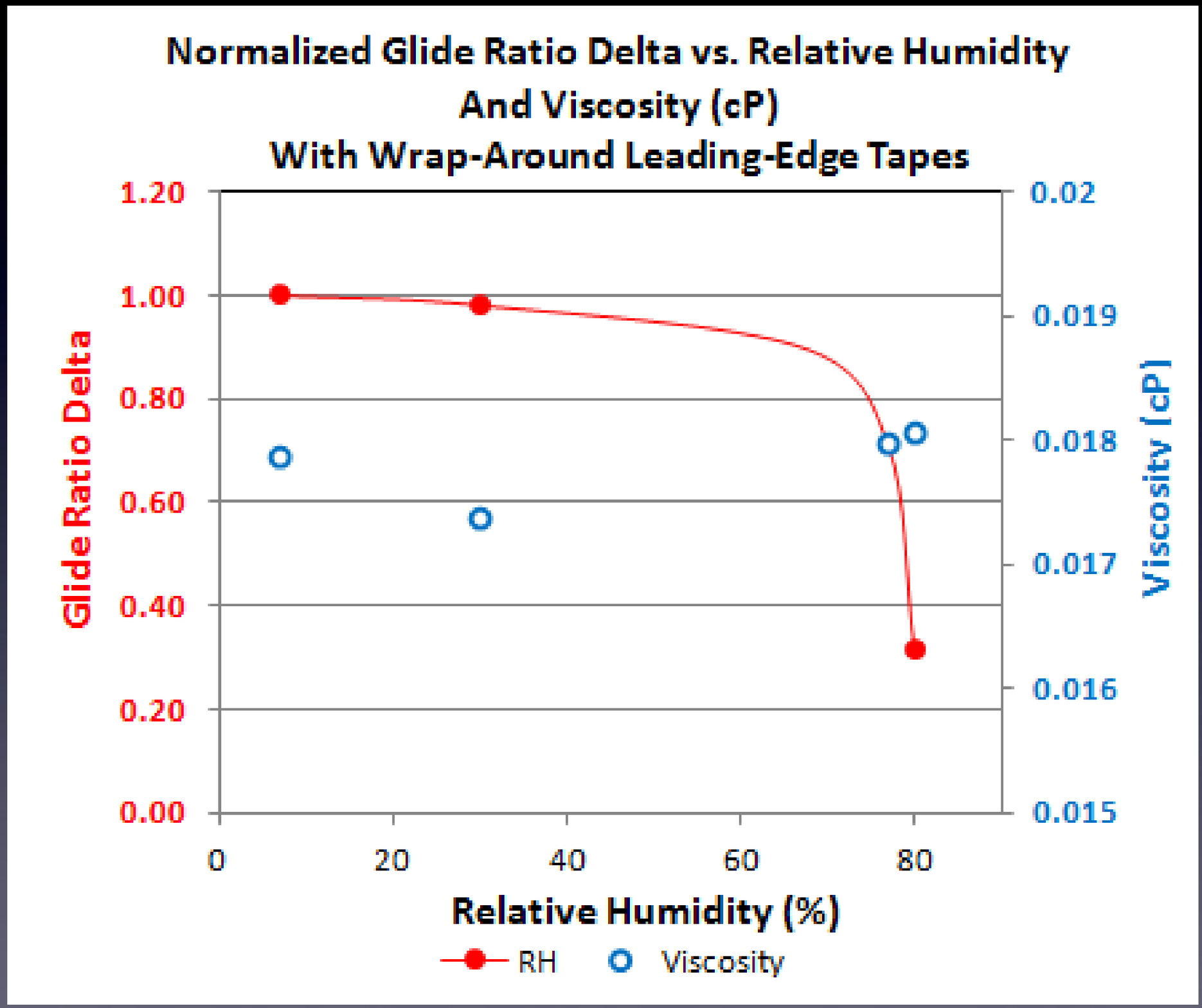
Amplitude Deltas



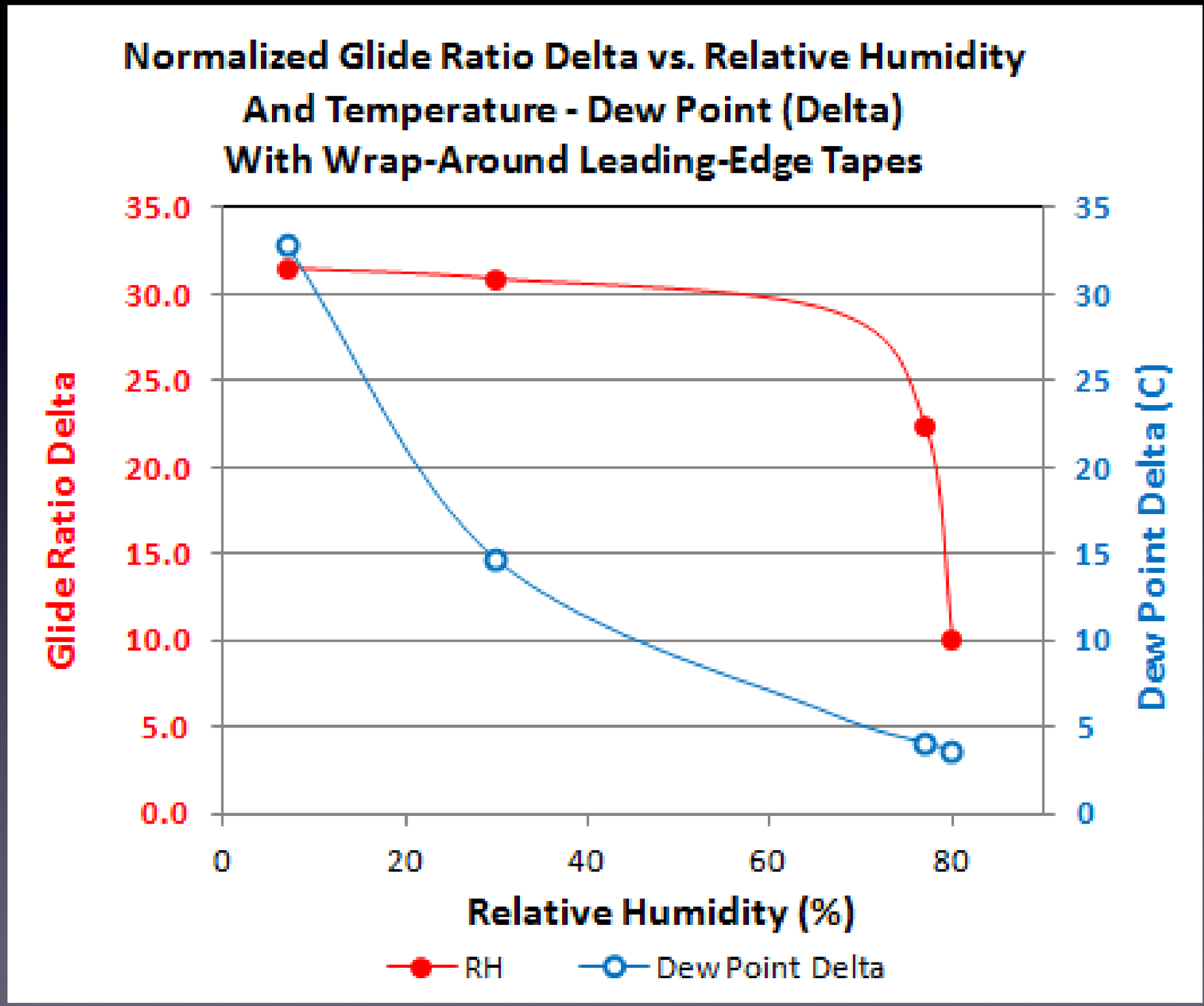
Humidity Dependency



No Viscosity Correlation



(Temperature - DewPoint) Correlation



Observations

- The large swings resulting from an upper surface rear-facing step diminish sharply when relative humidity exceeds 75%.
- This is thought to be due to a failure to generate a thin (.0025") bed of rolling vortexes that maintains detached flow.
- The tiny vortices require large surface friction values on the wing surface behind the tape.
- Viscosity does not correlate with performance amplitude deltas, but proximity of air temperature and dew point temperature does.
- The performance delta falls off sharply when the air temperature is within 4 degrees F of the dew point temperature...near saturation.
- Since viscosity does not correlate, this implies a skin friction loss.

Postulate

- Skin friction is a function of the nano/molecular scale roughness of the polished surface. (Applied Aerodynamics: A Digital Textbook)

- When humidity approaches saturation, H2O molecules adhere to the surface in sufficient quantities to fill nano/molecular scale valleys, thereby smoothing the surface and reducing skin friction needed to generate and sustain tiny rolling vortices behind the tape.

- When this happens, the flow reattaches to the surface behind the tape and behaves normally, causing performance to return to normal values.

- This may be prevented by finishing the wing surface with a mildly abrasive cleanser/polish to enlarge the nano/molecular scale valleys.

End