L/D….The *Frosting* on Your Cake

Winter is upon us and many of us will be traveling to real winter locations such as Colorado, Utah, and even northern Arizona. All pilots should know that one does not even attempt a takeoff unless *all* the morning frost and snow has been removed. We learned in basic ground school that ice, snow, and frost will result in a less efficient airfoil. The end result will be the loss of required lift and a successful take-off will be questionable. But what about just a little frost left on the wing? Does the frost affect lift? Will that matter? At the other end of the aerodynamic spectrum, what about dead bugs on the leading edges of the wing? Will that impact aerodynamic efficiency? The efficiency of a wing can be expressed in the Lift/Drag ratio (L/D). Increasing lift without increasing drag is a primary goal of an aeronautical engineer. Your goal as a pilot is to assure the wing fly's as it was designed.

NASA funded a research project in 1984 developed by the Mooney Aircraft Company to address laminar flow characteristics of the efficient low drag Mooney wing. The drag/speed and speed/power testing was performed using a Mooney 231 modified with an engine torque meter, calibrated airspeed boom, sensitive airspeed indicator and a good amount of precision flying techniques. Testing was performed starting with an unpainted "rough" wing. The smoothness was gradually increased with polish and wax. Additionally, imperfections were introduced-dead bugs on the leading edges. To detect changes in the laminar and turbulent flow on the upper surfaces of the wing, a fluid called Spraylat was applied to both upper and lower surfaces of the wing. Any turbulent (non-laminar) flow variations would effectively remove the white Spraylat from the surface. Correlation to the recorded airspeed could be

made and the effects of non-laminar flow would then be realized. Loss of laminar flow increases the drag, thus speed and lift are affected.

The results were an eye opener. Small imperfections in the wing from bug "splats" to panel screws slightly exposed would interrupt the laminar flow and loss of speed was detected. The laminar flow on a perfectly smooth Mooney wing could be maintained to 35-40% of chord. If the wing was well waxed, the result was an increase of 2-3 Kts compared to a dirty wing. Waxing aft of the main spar did not result in any increased efficiency.

The take home message is that applying a bit of "elbow grease" and keeping the wing well-polished, all screws flush will result in a performance increase and lower fuel costs over the year of flying. Now back to winter. If a few dead bugs will cut your speed and wing efficiency by 1-2 kts, what do you expect with a wing covered by frost, even partially? It's a disaster waiting to happen-at the far end of the runway. If you can't wait for the sun to melt the frost, or its overcast, get the plane in a heated hanger. Either the night before or the morning of departure. As frost is an indicator of temperatures below freezing, you engine will appreciate you getting the plane in the heated hangar the evening before departure. This will assure the oil will start flowing to all those metal parts that are wearing excessively until they are oiled. If the cost of the heated hangar is an issue, consider the cost of an engine overhaul that is needed because of excessive wear contributed by the pilot not pre-heating the engine.

Enjoy winter flying. The reduced density altitude from the crisp cold air and your well waxed wings will amaze you.

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