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In case we have an opportunity to suggest corrections to attached please review for factual accuracy. I picked you for review because you are very familiar with all stall-spin aspects.

thanks.

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Date: 6.22.83
Spinproof by Design?

NASA Langley's Stall/Spin Program

It was a sunny April afternoon when the single engined Beechcraft C-23 Sundowner seemed to fall out of the sky. Once twice its wings glinted in the sunlight as it pulled up, struggled as if to fly and then rolled over before turning in a spiral dive back to earth. Nervously I watched it on the monitor. The calm voice of NASA's test pilot Phil Brown still came over the speaker, loud and clear. 'One turn..... two..... I can't get her to spin anymore, she's recovering....'

Relieved I and the NASA scientists in the telemetry room at NASA Wallops Flight Center on the east coast of the United States, watched the Beechcraft Sundowners recovery from the spin. Daniel J. Di Carlo a NASA Project scientist shrugged almost subconsciously and reached to tear off the new computer data strips emerging from the printer. Spin research was for him routine. But despite his casualness, the tension during each test remained. 'We try!....he confessed, glancing at the new data charts...' We try to give Phil as much of a safety margin as possible. Initiation altitude for the spin is 9500', recovery by latest 6,000'. Should available controls not get him out, there are the fluoride rockets on the wing tips. If they fail to initiate the recovery, then we have the drag chute and finally it is always possible for him to leave the aircraft... We haven't lost an aircraft on this program yet, and it is seldom that we need the recovery parachute'. With that said he showed
me the aircraft's stall point on a graph plotting lift coefficient versus angle of attack. That point where the air passing over an aircraft's wing is no longer able to generate the lift required to keep the aircraft flying.

An unintentional aircraft stall can quickly lead to a dangerous situation for any pilot. For if not recognised for what it is, it can prove fatal to all on board. Surprising therefore remains the fact that in the USA and here in the Federal Republic of Germany, spins are not part of a private pilot's curriculum. Not that today's general aviation aircraft are easily stalled or spun unintentionally. Stalling and spinning, however, still account for over 28% of the total number of fatalities in general aviation accidents. Examinations of the circumstances involved showing that the majority of these stall/spin accidents occur at low altitude and high workload, e.g. terminal type situations where there is not sufficient height available for a recovery.

The stall/spin flight tests at NASA Wallops Airbase are only one part of a larger NASA program to improve the stalling and spinning characteristics of light general aviation aircraft. NASA's Langley Research Center, 30 minutes flying time south of the Wallops Airbase is the lead center for this program. Here special spin wind tunnel research work, the flying of scale radio controlled models, and helicopter model drops, supplement the flight testing done at Wallops.

First results from this program now indicate a revision of earlier beliefs. In the '70's Scientists thought that the tail geometry was the governing factor determining spin mode and recovery of a particular aircraft type. Now after a long and extensive period of tests one has concluded that the wing - airfoil design is all very important and can significantly
Influence airplane spin and recovery characteristics to the extent that these can on occasion even overpower the effects of tail design.

The use of the special spin wind tunnel at NASA Langley. A vertical rather than horizontal wind tunnel, where the airflow comes from below, together with a special rotary balance, makes it possible to assess aerodynamic characteristics in a rotational flow or spin-like environment. Different scale models of aircraft, high and low wing, were tested as were different tail configurations. Wing leading-edge modifications were made, in particular drooped leading-edge wing extensions, and these proved successful. The wing leading-edge modifications were then added to 1/5 scale powered radio controlled models and after a long period of experimentation and verification in which full-span, partial span and segmented leading-edge droops and flaps were tested one concluded that a partial span outer panel modification significantly improved the stall and spin characteristics of the models. Flight tests were soon to follow on a variety of aircraft.

'I am ready for another run' came Phil's voice over the open radio channel.

'Check, cameras on' the technician called.

'Cameras on,' came Phil's crisp reply, referring to the special onboard cameras which filmed the tufts glued to the wings and so captured the flow pattern during every test. Daniel J. Di Carlo and I turned from the graphs he had been explaining to me and watched the monitor on which the Beechcraft Sundowner was clearly visible.

'Trying now...'

To an observer it seemed as if Phil was thrashing that aircraft about the sky.

'She won't spin on this one,' and no wonder for the Beechcraft Sundowner
had the leading edge outer droop modifications attached to its wings. Only occasionally and then for one or two turns at a maximum was Phil able to get it into a spin and hold it before recovery. The correct length of the modification on the leading edge was crucial for both the stall characteristics and the spin recovery. A modification which had taken a long time and a lot of hard work to come about. Much work still being needed before one would have developed parameters which would be applicable to different aircraft designs to finally make them spinproof.

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HM/6/83

TILL SUCH TIME PILOTS WILL HAVE TO RELY ON "OPPOSITE Rudder, Stick Forward and a Prayer" THAT THERE IS ENOUGH ALTITUDE LEFT FOR A RECOVERY