Such rule of thumb guidelines were of course no substitute for the testing of the final models in wind tunnels or for flight testing of the actual aircraft.

NACA ultimately built a series of two free-spinning vertical tunnels at Langley. A 15-foot-diameter spin tunnel was placed in operation in 1935. Langley’s present 20-foot Free Spinning Tunnel began its work in 1941. In all these tunnels, air is drawn upward through the test section by a fan at the top. After passing through the fan, the air circulates through turning vanes that direct it down into an annular return passage and up through the test section again. The current 20-foot free-spinning tunnel has a 1300-horsepower motor that provides 100 foot per second air in the test section. Spin tunnels are extremely simple. No provisions need be made for mounting a model or measuring aerodynamic forces. A rising column of air is all that is needed.

The researcher launches the aircraft model into the rising air by hand from a platform. A flick of the hand imparts a spin and, as the model spins downward, the operator increases the tunnel wind speed until the model’s fall is just balanced by the uprushing air, like a circling hawk buoyed by rising thermals. Then the control surfaces of the model, which are driven by tiny electric servo-actuators, are activated electromagnetically to initiate recovery from the spin.

During World War II, every fighter, light bomber, attack plane, and trainer—over 300 designs—had to be tested in Langley’s spin tunnels. Subsequently, over half of these aircraft were modified in some way to ensure that their controls would be able to pull them out of a spin.

After the war came the jets with their small swept wings and long heavy fuselages. The whole spin recovery picture changed with these bulletlike craft. A set of spin recovery rules had to be evolved in the spin tunnels. But a new problem had arisen. Because of their small sizes, the spin models often exhibited aerodynamic characteristics quite different from their full-scale prototypes. A full-scale spin tunnel to solve this problem was out of the question. But a small spin model could be modified locally (via wing leading-edge radius, fuselage strakes, vortex generators, etc.) to make it behave as if it were of larger scale. The Ames 12-foot pressure tunnel was uniquely suited for

Cross section of the Langley 20-foot spin tunnel. Air flows up through the center and down the annular space between the test section and the building walls. Models are launched into the ascending airstream by hand in Frisbee fashion.

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