

C14. Bell X-1B Wedges on the Ailerons.

This curiosity arises because of the Bell X-1B on display at the Air Force Museum. The wedges are shown in a photo from the NASA photo gallery and my own photo taken at the museum.

So why are they there and what purpose do they serve? I've wondered about this for a number of years and through a correspondence with NASA Historian Christian Gelzer at Edwards AFB (NASA Armstrong?) we have the answer. It makes for an interesting and definitely curious story. Figures 1 and 2 show the wedges.



Figure 1. Bell X-1B on the lake at Edwards AFB



Figure 2. A close up view of the wedges as displayed in the Air Force Museum.

I was searching the NASA Technical Report Server and found almost nothing.¹ Searching with Google over the full internet I discovered a paper by Christian Gelzer on the NACA development of reaction control systems, intended to be developed on the X-1B and eventually to be used on the X-15 and other vehicles when the dynamic pressure was too low for aerodynamic control (they were thinking of high altitudes, but remember reaction control is needed for hover on planes like the Harrier and the F-35). Here's the wedge story as sent to me by Gelzer:

“... and finally found the following in Jim Hansen’s *First Man* biography of Neil Armstrong:

“...Armstrong sought a possible fix to a problem known as aileron ‘buzz.’ ... Neil’s fix involved fitting peculiar shaped wedges to the ailerons to see if they might solve the buzz.”

—James R. Hansen, *First Man: The Life of Neil A. Armstrong*, p. 146 (footnote).

[It turns out that Jim's information is only partially correct, as you'll see below.]

The flight reports indicate the following:

On Neil's last flight in 1957 he reported "aileron buzz." On landing he shears off the nose gear, requiring 6 weeks to fix. Jack McKay flies it next, on November 27, 1957.

There were two flights in January and "aileron buzz was encountered on both flights."

A memo dated Feb. 3, 1958, to the station chief (and many others) reported "incorporating aerodynamic aileron buzz fix with subsequent mass balancing."

A memo from April 4, 1958 reports: "strux material has been added to the upper and lower surfaces in an attempt to eliminate aileron buzz."

The aircraft never flew again, however, and the so the wedges on the airplane never flew.

Negative no. E58-03583 (dated April 3, 1958), an NACA (Armstrong) photograph, shows an engineer looking at the wingtip RCS being tested in the hangar at the center. There appear to be no wedges on the ailerons in this image. Negative no. E58-04109 (dated July 30 1958) shows the wing's aileron with the wedges on it.

So that's the story. Aileron buzz had been a problem since it was found on the P-80 (it is also called control surface buzz and has occurred on vertical tails.² On the A-4 it was solved by removing the skin on the rudder, the so-called splitter plate rudder,³ shown in Fig. 3). It arises when the normal shocks on the control surface hinge line start to oscillate back and forth, causing a 1-D flutter. On the P-80 the control boost was on the centerline of the airplane and the control wasn't stiff enough. It was solved by installing hydraulic dampers on the hinges (this info came from Abzug and Larrabee, Kelly Johnson says increasing the tension in the control cable solved the problem⁴). On the X-1B there was no boost. The wedge idea was intended to keep the shock from oscillating.

For airplanes with irreversible control and hydraulic actuators at each aileron there shouldn't be a problem. By the time Armstrong identified the problem on the X-1B the A4D has essentially found the problem and the fix.



Figure 3. Douglas A-4 Skyhawk rudder, photo take at the Pima Museum, Arizona

¹ John A. Wyss, Robert M. Sorenson, and Bruno J. Gambucci, "Effects of Modifications to a Control Surface on a 6-Percent -Thick Unswept Wing on the Transonic Control-Surface Flutter Derivatives," NACA RM A58B04. May 1958.

² Malcolm J. Abzug and E. Eugene Larrabee, *Airplane Stability and Control*, Cambridge Univ. Press, 1997. pp. 212-214.

³ Edward H. Heinemann and Rosario Rausa, *Ed Heinemann – Combat Aircraft Designer*, Naval Institute Press, 1980. Pg. 224, and attributed to North American.

⁴ Clarence L. "Kelly" Johnson, "Development of the Lockheed P-80A Jet Fighter Airplane," *JAS* Vol. 14, No. 12, 1947, pp. 659-679.