NOTES ON THE DEVELOPMENT PROGRESS OF THE SAILPLANE ADASTRA

by RICHARD H. JOHNSON

The Adastra sailplane is a spare time, home built, experimental sailplane that was designed principally for two-place distance flying. Its name is derived from the Latin "ad," meaning "toward," and the Greek "astra," meaning "stars" or "heavens." Liberally interpreted it means "the sky is the limit." Except for the "Y' tail configuration and the highly laminar experimental Eppler 146 wing airfoil section, its layout was not unusual.

The construction is basically of spruce structural members with mahogany plywood skins. Part of the wing spars are of white ash because a material more dense than spruce was desirable for the inboard portion of the spar.

It was expected that this sailplane should ultimately achieve a glide ratio of approximately 44, when it had been developed to the state comparable to that of the R-J-5 sailplane as of its 1952 tests. However, as flown during its first season in 1960, it did not approach this performance and design changes were indicated.

As it flew during its first season (1960), its principal faults were: (1) It was considerably overweight and tail heavy, principally because sufficient attention was not paid to the effect of design changes made after the original weight and balance analysis was performed years before.

(2) Its drag was excessive when flown at moderate and high lift coefficients, due to airflow separation on the top aft surface of the experimental Eppler 146 airoil used.

(3) Its wing incidence was too low, requiring 55 knots airspeed for liftoff. This was an inexcusable error on my part, probably because I was too anxious to get the machine built to do a satisfactory analysis of details such as this. The wing design was changed 3 times since the original layout in 1954.

(4) It buffeted excessively when the parallelogram type speed brakes were extended, principally because the inboard brakes were located too close to the fuselage. It was believed that because of the "Y" tail arrangement it would be permissible to install the brakes closer to the fuselage than customary. This did not prove to be true. Subsequent flight tests indicated the brake turbulence buffeted not the horizontal tail but the fuselage and vertical tail. Increased brake ventilation did not help significantly.

During 1960 competitions it flew relatively well under good conditions, but when the thermals became weak and small, I was usually the first one down. Adastra's cruising performance was fairly good, having a maximum glide ratio of 34.6 at approximately 60 knots. However, because of the relatively heavy wing loading and high wing drag at low airspeeds, its climb performance was miserable. While flying in Germany during the 1960 International Competition, I found that everything, including the Grunau Baby types, could outclimb it.

Since the 1960 flying season I have effectively rectified most of the above mentioned faults by (1) carefully designing and constructing an entirely new empennage, and (2) modifying and rebuilding the aft portion of the wings.

The new empennage is conventional in layout and is structurally designed to meet the United States C.A.R. Part 3, Utility Catagory, airworthiness requirements. A weight saving of 20 pounds was achieved, principally in the vertical surface, and although the new horizontal surface weighed the same 23 pounds that the original one did, its surface area was 80 percent greater. The 20 pound weight saving allowed the removal of the 58 pounds of lead that previously had to be carried in Adastra's nose for balance reasons. The net result of this tail change was 78 pounds of weight and greater longitudinal stability. This configuration was flight tested in March of 1961.

After these test flights in March, the more important problem was tackled. In all fairness to Dr. Richard Eppler, the airfoil designer, the Eppler series of airfoils are excellent and basically are superior to NASA 6 series airfois in regard to high maximum lift and low minimum drag. This has been proven by the 1959 flight tests carried out on the original Phoenix sailplane at Mississippi State University. The airfoil used on the Phoenix is the Eppler EC86(-3)-914. The Eppler 146 airfoil used on Adastra was designed for higher cruising speeds, in that it had less camber. Also the newer experimental 146 section had slightly more hump in its upper aft surface in an attempt to induce more extensive laminar flow. Although extensive testing was not performed with Adastra to determine the mechanics of the subsequently encountered flow separation problem, there is not much doubt that the airflow could not quite remain attached when it reached the strong adverse pressure gradient aft of the hump. Dr. Eppler has shown during recent windtunnel and flight tests in Germany that the 146 airfoil with its top surface hump reduced approximately .01c, does achieve its design

The Adastra sailplane as it appeared during the 1961 National Soaring Championships at Wichita, Kansas, in August.
Photo by Henry M. Dittmer