SAFETY CONSIDERATIONS IN SAILPLANE COCKPIT DESIGN

by Dr. Harner Selvidge

In his delightful treatise, "On Being a Bird", Philip Wills makes the very pertinent observation that despite protestations of the devotees to the contratry, sailplane flying is undoubtedly m o r e hazardous than stamp collecting. However, when comparing sailplane flying with automobile driving, he points out with equal validity that the safety of the sailplane pilot lies almost entirely in his own bands, while even the most careful automobile driver runs considerable risks from the irresponsibility of other drivers.

Several years of peering into sailplane cockpits as well as sitting in a few of them has lead the author of this article to believe that many sailplane pilots are not taking full advantage of our present knowledge of factors affecting crash safety. As fallible humans, we are sure to make occasional mistakes, and it would seem to be the height of folly not to take all possible precautions to minimize the dangers inherent in accidents. The object of this article is to discuss some of these problems with particular emphasis on the ones of interest to the sailplane pilot, and to suggest what he can do about them.

It has only been within the past 10 or 15 years that the remarkable inherent strength of the human body has been realized. This was first brought to general attention by Hugh De Haven of the Cornell University Medical College in 1942 when he analyzed survivals in falls from heights of 50 to 150 feet. As a result of this and other work, it was found that if properly supported the human body could sustain forces of up to 150 G peak load without serious injury if the duration of the applied force were not too great. When you consider that the normal aircraft structure starts disintegrating at 10 to 15 G, it is apparent that the human body is much stronger than the airframe.

The key to the survival problem is to distrbute the force as uniformly as possible over the body and to protect its structural integrity, particularly the head, from damage due to highly localized loads. In rocket propelled sleds, Lt. Col. John P. Stapp, USAF, has slowed from 632 mph to a complete stop in 1.4 seconds. This involved a peak deceleration of 40 G. Since his body was properly restrained, he suffered no permanent effects.

It is, of course, also highly desirable to keep the peak decelerations in an accident as low as possible. When in motion, the body and the aircraft have a certain amount of kinetic energy which must be dissipated when brought to a stop. The longer the distance used in coming to a stop the smaller will be the peak deceleration. It is obviously safer to land into a hay stack than into a brick wall. Even the brick well, however, can in effect be softened if the aircraft structure is designed so that it will gradually collapse, thus ab sorbing much of the force of the blow.

Summarizing, what is needed for maximum safety is a structure ahead of the pilot which will gradually collapse, thus absorbing as much energy as possible; a cockpit capsule which will retain its structural integrity; a method of anchoring the body in such a way that it will not fly around and strike hard, unyielding objects; and a type of construction which will prevent spears and splinters stabbing the pilot, or loose objects breaking off and acting as projectiles. Details of structural design of sailplanes are not of interest to the average sailplane pilot, and need only to be considered by those actually engaged in such design work. However, there are a number of safety features in which all pilots should be interested for their own protection, and which will be discussed in the following paragraphs:

Padding

Since it is inevitable that the ordinary cockpit will have a considerable number of braces, panels, etc., consideration should be given to padding those portions which might be struck by head, arms, or knees. Following the premises laid down in the previous paragraphs, such a padding should be capable of distributing the applied force over the widest possible area and to soften the blow by resisting gradually the applied force. Curiously enough, except for very minor impacts, the ordinary foam or sponge rubber is not a very good material for this purpose. Not only is it usually too soft to give much protection for high forces, but its resilience means that it "pushes back" after being compressed upon impact, thus effectively almost doubling the time the force is applied to the head or other object striking it.

A very much better material is foam polystryrene such as can be purchased in many stores for decorative purposes, particularly around Christmas time. It is inexpensive, but has a disadvantage in that once it has been compressed, its cellular structure is destroyed and it must be replaced. A somewhat better but more expensive material is made of unicellular polyvinal cloride[1]. It was developed for padding sunvisors and dashboards in automobiles as well as for use on the inside of football helmets and for padding on the floor in boxing rings. A similar product is a semi-rigid urethane foam material[2]. Both resemble a rather firm foam rubber, and can be obtained in sheet stock of various thicknesses.

Belts and Harness

One of the oldest and most useful safety devices in aviation is the seat belt. Its effectiveness, however, has been increased many fold in recent years by the widespread adoption, in all but commercial aircraft, of the shoulder harness. This improvement was pioneered by the military when it became apparent that a very high percentage of fatal accidents were caused by head injuries which occurred when the upper part of the body was thrown forward under severe deceleration even thought the seat belt held. The main objection to shoulder harness is its restrictive action on normal movement in the cockpit. In the case of sailplanes, however, the

1. Marketed by the U. S. Rubber Company, Mishawaka, Indiana, under the trade name of Ensolite, Type A.
2. Marketed by Nopco Co., 4858 Valley Blvd., Los Angeles 32, California.