

Good research paper about aircraft spoilers

[Engineering](#), [Aviation](#)



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Introduction

Spoilers may be defined as control surfaces that may be raised or lowered to interrupt the smooth airflow over the airfoil. This causes the separation of flow behind the spoiler. Flow separation causes a reduction in the lift of the airfoil, increasing its drag. When applied properly, these effects may be useful and may improve the flying qualities and controllability of the airplane (Mohammad, Ferdous, and Ome 1). Spoilers are hinged; plate-like structures installed to flush with the upper surface of an aircraft wing. The spoilers are hinged at one end to allow for a pivoted movement. When in action, spoilers are deployed about 50° from their flush position. Spoilers have various functions but perhaps the most important ones are in-flight air-braking to cause speed reduction; air-braking on the ground in lift dumping, in-flight roll control, which augments the aileron function; and banking (SKYbrary 1). This paper provides information on aircraft spoilers in terms of what they are; how they function and how they are used.

The working of airplane spoilers may be explained through the principles responsible for flight. The shape of an aircraft wing, also known as an airfoil is very critical for flight. It is special because it is designed to cause lift. As

the wing glides through the air, it splits the air into two currents passing below and above the wing (NASA 1). The upper surface of the wing is curved so that it spreads the air at the upper side of the wing, while that at the lower side flows in a straight path. The air below the wing pushes the wing into the lower air pressure created above the wing, causing the entire airplane to lift (SKYbrary 2). This means that shortening the distance covered by air on the upper surface of the wing reduces the lift (Mohammad, Ferdous, and Ome 1). Reduction of lift is achieved through spoilers. When engaged, spoilers rise upward to interrupt the flow of air at the top side of the wing (NASA 1). There are various uses for airplane spoilers.

First, spoilers are used for approach-slope control. This comprises controlling the glide slope or descent in a landing approach. The pilot modulates lift-to-drag ratio (L/D) of the airplane. In this case, spoilers function as negative throttles (Powerpacspoilers. com 1). The more the spoiler is raised, the quicker the rate of descent is. Closing the spoiler at this time regulates the descent rate to make the glide shallower.

Figure 1: elliptical wing showing position of spoilers

This is important because it allows the pilot to land the plane to a specified point on the ground. Then advantage with spoilers is that if the pilot misses the approach and retracts the spoilers, lift is achieved immediately, and the drag caused by the open spoiler is also lost quickly. Spoilers eliminate the risk of stalling or sinking since the plane begins to accelerate and lift. As shown in figure 1, the pivots of the spoilers are located almost midway through the width of the airplane wing for them to be effective. Opening the spoilers increases the drag and reduces the lift.

The second function of the spoilers is airspeed control in airplane descent. Pilots flying at high speeds and high altitudes face the challenge of planning their descent. This involves lowering the altitude while maintaining a safe airspeed and avoiding steep descents. Steep descents may cause unwanted acceleration that is beyond the airspeed limit, which is 250 knots for planes flying below 10, 000 feet (NASA 1). Opening spoilers enables jet transporters to increase the drag, enabling the plane to descend in a steep angle while maintaining a safe speed. On many aircraft that have spoilers, the spoiler panels have a function known “ speed-brakes.” This function involves symmetrical extension of the wing panels by the pilot. The maximum deflection angle of the panels during flight is less than that of the deflection obtained in the ground spoiler function. The speed-brake function is activated automatically when the plane reaches a particular airspeed. Wing spoilers should not be activated during the last phase of the landing approach because the stall speed will be higher than normal and may cause a hard landing.

The third function of spoilers is lift dumping. After the airplane touches down, its capacity to decelerate is controlled by how easily it can brake. Braking action is made possible by the landing gear wheels and their brakes. Brake efficiency is achieved by placing as much weight on the wheels as possible and as quickly as possible. Since the weight of the plane is constant, additional down-force is achieved by reducing the lift as much as possible. During landing ground roll or a rejected takeoff, all spoilers are opened to the maximum angle possible. The spoilers for this function are referred to as ground spoilers. Their main function is to maximize the efficiency of the

wheel brakes by reducing the lift. An advantage of using spoilers over flaps is that they can be deployed quickly, and they become effective as soon as they are opened. For very light aircraft, open spoilers reduce the likelihood of being blown over by strong winds. Ground-only spoilers reduce wind loads and reduce the likelihood of being damaged while on the ground.

For braking and dumping, spoilers are used symmetrically. Symmetrical use of spoilers ensures that the plane brakes or “ dumps” in a straight line. This keeps the plane in the required flight path. However, deploying spoilers on one wing of the aircraft achieves banking. This is whereby one wing tip moves upward while the other moves downward. This causes an unbalanced side component of force to change the orientation of the plane.

Figure 2: asymmetrical deployment of spoilers (Source: <https://www.nasa.gov/www/k-12/airplane/spoil.html>)

The asymmetrical deployment of spoilers and the resulting motion is shown in figure 2. Spoilers may be used to control the orientation of the plane. On the figure 2 above, the right wing spoiler is activated while the left one is not deployed. Since the flow of air above the right wing is changed by the spoiler, the drag on the right wing is increased, causing a decrease in lift compared to the left wing. This causes the plane to rotate.

Conclusions

Airplane spoilers are installed on the wings to alter the flow of air above them. They are used for several functions such as in-flight braking, dumping, braking while landing and in banking. Spoilers are more effective than flaps because they are more effective and precise than flaps. For example, in a rejected landing, lowering the spoiler increases the lift on the airplane

rapidly, causing it to gain altitude quickly. Overall, spoilers are crucial to the smooth and effective control of airplanes.

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