Case Study: Junkers 87 'Stuka'

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1 Junkers Ju 87

The Junkers Ju 87 'Stuka' design, the development of which was lead by Hermann Pohlman, began development in 1933. First flown in 1935 (Weal 1997, p. 9), the Stuka succeeded a previous Junkers Ju 47 K dive bombing design, which had been rejected by the German Reichswehr (defense ministry) as too expensive, and replaced the Heinkel He 50 as the dive bomber of choice for the Luftwaffe. Heinkel had also been developing a competing design, the 118, but lost the dive bomber contract when their design could not demonstrate the prequisite ability to dive at a 90° angle, disintegrating during flight (Killen 1967, p. 68-69) and forcing the pilot and judge of the competition, Ernst Udet, to bail out.

The dive-bomber design emerged as a solution to the need for precision bombing of tactical objectives during the later stages of WW1, and was eventually replaced by improvements in bomb sighting, increased bomb payloads, and guided weaponry. Dive bombers would align themselves laterally before engaging in a dive towards a target, descending to a given height to release their payload and then pull out of the dive. Diving aligned the velocity of the aircraft in the direction of the target, and reduced the distance travelled from release to impact; this significantly reduced targeting complexity, and correspondingly shrank the circular error probable (CEP), the region in which 50% of munitions were predicted to land. In comparison, horizontal bombers using unguided bombs had to compensate for a parabolic bomb trajectory where a bomb had horizontal velocity at launch and was acted upon by drag and gravity during flight. Even in calm weather, using tachometric bombsights, horizontal bombers during WW2 had large CEPs and could not accurately hit small targets, being more suited to mass scale interdiction bombing 'area-denial' sorties.

The increased accuracy offered by dive bombing was tactically significant, enabling both close air support of ground forces in combined arms operations without risk to engaged units, as well as accurate attacks against shipping which had been difficult to accomplish with interdiction bombing; however, diving towards targets placed aircraft at increased risk from surface fire, and steep diving maneuvers limited payload weight and placed increased stress on the craft. Dive bombers were also targets of opportunity for enemy fighters, since their diving manoeuvres were predictable and broke from protective formations, and they could not match the manoeuvrability or speed of fighter craft; this, in addition to improvements in sighting technology, lead to the decline of the dive bomber after WW2.

1.1 Payload

2 General Design of the Ju 87

2.1 Structure

The Stuka was a monoplane, with the fuselage acting as an anchor for a single spar which passed through both wings and served to distribute the load caused by lift. This design, pioneered by Hugo Junkers in 1915, provided sufficient strength to support a single fixed wing, and thereby superseded biplane designs by allowing for elimination of drag caused by interference between the two wings, as well as drag caused by adding supporting structures to the wings (such as struts). The fuselage was constructed from two oval sections, which were joined along the longitudinal axis to form the chassis, and which was attached to series of U-shaped longerons running the length of the longitudinal axis. These longerons were also attached by rivets to frames which ran the length of the Stuka, and which were arranged in a z-shaped pattern in order to facilitate easy inspection of the longerons.

The body itself was made principally from duralumin, an aluminum alloy composed from copper, magnesium, and manganese[1], except in cases where parts were required to be more resilient to daily wear, in which case stronger magnesium alloys were used to reduce the need for maintenance (Guardia 1914, p. 15).

3 Testing, Production, Variants

All Stuka variants featured reversed gull wings, a 'broken nose' [reference] hump to the fore of the cockpit, and fixed landing gear with aerodynamic spatting(Curry 1988, p. 4), lending the appearance of [quote, reference].

As a wartime plane, the Stuka had a number of evolutionary variants as Luftwaffe requirements changed during the course of the war. Principal among these were the Ju 87A (pre-war prototype), Ju 87B (early war, Battle of Britain), Ju 87D (late war, improved performace), and Ju 87G (anti tank close support role).

3.1 Ju 87A

The 87A went through a number of iterations in the lead up to WW2, until it was eventually replaced by the Ju 87B production design.

image of Ju 87A

[1] Unfortunately, precise values for the alloy could not be located, but is likely to have been a composition of 95% aluminum, 4% copper, 0.5 - 1.0% manganese, and 0.5 - 1.5% magnesium (Wardlaw 1933, p. 102-103)

3.2 JU 87B

3.3 JU 87D

3.4 JU 87G

4 AERONAUTIC PERFORMANCE

5 ROLE PERFORMANCE

When calculating operational parameters for the Stuka, it is necessary to consider that the Luftwaffe deployed the Stuka in the Western and Eastern fronts, as well as the Desert and Mediterranean theatres. Accordingly, calculations have been done for the most extreme temperatures where the Stuka operated, as well as the more temperate Battle of Britain temperatures, in order to demonstrate the versatility of the Stuka.

Lowest temperature of operation (Moscow): -45C (Raus 2003) European / Battle of Britain temperatures: Highest temperature of operation ():

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