Case Study: Junkers 87 'Stuka'

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1 The Case for Dive Bombing

The first attack launched from an airplane was undertaken by Giulio Gavotti in 1911, during the Italo-Turkish war, when Gavotti dropped grenades from his Taube Monoplane (Johnston 2016). A few years later, at the start of World War 1 (WW1), Italy and Russia had developed purpose built bombers, and by the end of WW1 most of the belligerent nations had developed bombing capabilities of their own (citation), using aerodynamically shaped bombs with no thrust or guidance systems ('dumb' bombs). When dropped from a high altitude during horizontal strafes of the target, these bombs had complex trajectories which were affected by drag and gravity, and which were sighted using fixed sights to provide an estimated impact point without accounting for the prevailing atmospheric conditions (citation). Due to these conditions, munition accuracy, expressed in terms of the circular error probable (CEP) (Nelson 1988), the circular region in which 50% of munitions were predicted to land, was poor [more needed], and bombing was limited to mass interdiction strategies requiring air supremacy in order to be successful.

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 before releasing their payload and pulling 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 CEP of the payload. Additionally, the steep angle of dives meant that the target remained in view of the pilot at the point of payload release, further increasing the accuracy that could be achieved.

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.

In the interwar period (WW1 - WW2), purpose built dive bombers were constructed in response to the success of initial dive bombing operations. However, due to post-war treaties, German design of a dive bomber was stymied by restrictions on rearmament and military development, and German production of a dive bomber would not commence until 1932, when the German Reichswehr (defense ministry) ordered development of a dive bomber. Of the four large German aircraft companies, the contract for the military dive bomber was actively pursued by two; Heinkel and Junkers.

2 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 Reichswehr as too expensive, and replaced the Heinkel He 50 as the dive bomber of choice for the Luftwaffe. The Junkers was first flown in combat in 1938, in the Spanish civil war, and was used throughout WW2 to great effect, first in the combined arms 'Blitzkrieg' tactics employed in Czechoslovakia, Poland, and France, as well as in the bombing of shipping in the North, Mediterranean, and Black Seas, and in support of Reich forces in Africa. In the latter stages of the war, as the availablility of experienced pilots and the production capability of the Reich dropped, and the design's weaknesses against fighters showed, the Stuka was deployed only on the Eastern front, where the Luftwaffe still maintained air supremacy, and was also used in nighttime operations in order to reduce the potential risk to valuable pilots and aircraft.

2.1 Payload

3 General Design of the Ju 87

3.1 Structure & Materials

4 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).

4.1 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

4.2 JU 87B

4.3 JU 87D

4.4 JU 87G

5 AERONAUTIC PERFORMANCE

6 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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