STEEL RAIN

Donald Nijboer examines the use of flak in World War Two – the greatest combat hazard to bombers operating in European skies

One of the few colour photographs showing German flak. Taken from the tail gunner's position, this shot shows B-17Gs of the 385th BG ploughing through heavy flak en route to their target in late 1944. The white target indicators immediately above the central Flying Fortress denote a 'blind bombing' mission using H2S radar ALL PHOTOS VIA DONALD NIJBOER

The combat that raged over European skies during World War Two has often been described as a battle between fighters and fighters vs bombers. Historians frequently dismiss the impact of German anti-aircraft defenses (flak) as ineffective and a waste of valuable material and personnel. The official histories after the war downplayed the impact of the Flakwaffe. According to *The Strategic Air War Against Germany 1939-45 British Bombing Survey*: "Anti-aircraft guns were plentiful, but relatively speaking, provided with poor radar control. They did not prove a very lethal weapon – even when they were most numerous." In fact, the German Flakwaffe made a major contribution to the defence of Germany and one for which the US Eighth Air Force was unprepared.

At least half of the American aircraft shot down over Germany was due to flak (5,380 lost to flak, 4,274 to fighters and 2,033 due to other causes). The numbers speak for themselves, but they also hide other important facts.

Anti-aircraft fire had two important roles to play. One was to bring down enemy aircraft, while the more important one was to force bombers to drop their bombs sooner or from a higher altitude, thus reducing accuracy. More hot flak up, meant less accurate cold steel coming down. Flak also damaged thousands of B-17s and B-24s, causing them to break formation and lose altitude, making them easy pickings for German fighters. One Luftwaffe pilot recalled: "That was the old fighter pilot's trick. The successful ones built up their scores in this way."

Lt Harry Crosby of the 100th BG wrote: "Ahead of us, a lone B-17 was limping along. A flight of three Messerschmitts were harassing it, darting in and out but not attacking it. Finally, all three swooped in and fired for a long time at the bomber. And those three small planes kept attacking that plane, receiving no damage to themselves, till finally the B-17 caught fire. It was with a hapless feeling that we saw our last ally turn over, spin slightly and then burst into a huge fireball."

As the British and Americans grappled with the technical problems of building and fielding an effective bombing force, Germany was preparing for war on the ground and in the air. The Germans saw their air force as an instrument of attack and defence; *Luftwaffe Regulation 16, The Conduct of Aerial Warfare 1935* states: "From the start of the conflict, the air forces bring the war to the enemy… The anti-aircraft artillery directly protects the homeland. Its primary mission is the defence of the homeland in co-operation with the fighter force."

From the beginning of the war the Germans had in place some of the most effective anti-aircraft guns in the world. The most infamous was the 88mm Flak 18-41. Next in line was the 105mm Flak 38 – heavier and more complex to produce than the 88mm, its performance was only slightly better. The most effective heavy flak gun of the war was the massive 128mm Flak 40. Despite its size and power, it averaged just 3,000 rounds per aircraft shot down – half as many as the 105mm and less than one-fifth of the older 88 models.

The arrival of the Eighth Air Force in the spring of 1942 did not immediately tip the balance in favour of the Allies. Instead of having to engage the RAF at night and relying on gun laying radar, the Flakwaffe would soon have a large number of targets with which they could engage using optical sights. The USAAF held strong in their belief that daylight precision bombardment held the key to victory. While the Americans focused on bombing individual factories and other important targets during the day, the RAF stuck to their night bombing strategy.

Eighth Air Force commanders quickly realised that cloud cover over Europe shortened their list of available targets. In order to keep their mission numbers up, they were forced adopt British bombing techniques using H2X ground-mapping radar. By the autumn of 1943, the first H2X radar-equipped B-17Gs entered service. The 'blind' or non-visual method met with mixed results. During the winter of 1944-1945, 42% of bombs dropped fell more than five miles from their target.

Unfortunately for Eighth Air Force crews, the USAAF focused their resources on the idea of self-defending bombers. Little or no thought was given to the dangers of flak. Equipped with sophisticated powered turrets and flexible guns, the B-24 and B-17 were thought to be more than capable of defending themselves against fighter attack, bombing the target and returning home. The possibility of being shot down or damaged by flak wasn't considered.

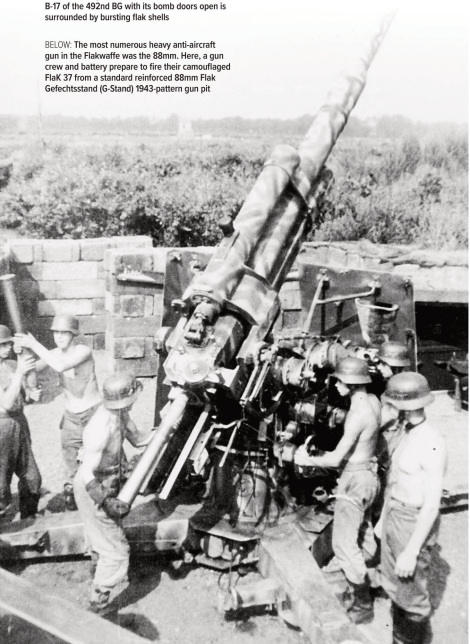
On August 17, 1942, the US Eighth Air Force launched Mission #1. Escorted by RAF Spitfires, twelve B-17s attacked the railway marshalling yards at Rouen in France. Bombing from 23,000ft, the mission was a success, with no losses. By the second half of 1942, the Eighth had grown to six bomb groups. By the end of

1942, 30 daylight missions had been flown with limited results. Losses were light and optimism was high. Most USAAF commanders downplayed the threat of flak, but not everyone was in agreement.

These raids only reinforced the concept of the self-defending bomber. According to the US Army Air Force's official history, the bombers were "more than able to hold their own against fighter attack, even with a minimum of aid from the escorting fighters." These early raids led air commanders to downplay the dangers of flak, but bomber crews knew differently. When Curtiss LeMay, commander of the 3rd Air Division, arrived in England in the autumn of 1942, he asked Colonel Frank Armstrong of the 97th BG his opinion about German flak. Armstrong replied: "The flak was really terrific... If you fly straight and level for as much as 10 seconds, the enemy are bound to shoot you down."

ABOVE RIGHT: **From the initial point (IP) to bomb release, bombers had to fly straight and level, which was when they became most vulnerable to flak. This B-17 of the 492nd BG with its bomb doors open is surrounded by bursting flak shells**

BELOW: **The most numerous heavy anti-aircraft gun in the Flakwaffe was the 88mm. Here, a gun crew and battery prepare to fire their camouflaged FlaK 37 from a standard reinforced 88mm Flak Gefechtsstand (G-Stand) 1943-pattern gun pit**



The pivotal year in the European war was 1943, with the first major German defeats altering the strategic balance. The German surrender at Stalingrad in February and in North Africa in May, along with the first notable victory against the U-boats in the Atlantic, finally gave the Allies the initiative.

Hitler continued to champion the Flakwaffe and wanted more guns to defend the Third Reich. Because of the loss of personnel in Africa and the Soviet Union, the Germans were forced to use women and young men in the flak arm. In 1943, 116,000 young women replaced regular Flakwaffe men. Training programmes were shortened and flak schools were stripped of much of their equipment. The scales were beginning to tip, but the flak arm continued to grow. By the end of June 1943, there were 1,089 heavy flak batteries compared to 659 in January. Flak gun production had almost tripled between 1941 and 1943.

The Germans also proved adept at modifying captured enemy flak guns. Between 1939 and 1944, the Luftwaffe managed to use 9,504 captured flak guns of all calibres and almost 14 million rounds of ammunition.

German flak tactics

The Flakwaffe's first line of defence was the numerous gun batteries located on the coast of the Netherlands and the Low Countries. Flying directly over the Netherlands was known as the 'bomber autobahn'. The Flakwaffe was augmented by numerous Kreigsmarine batteries, covering harbours and U-boat pens.

“German flak gun batteries employed three methods of fire control against high flying heavy bombers: continuously pointed fire, predicted concentration fire and barrage fire”

Like the Allies, German flak gun batteries employed three different methods of fire control against high flying heavy bombers: continuously pointed fire, predicted concentration fire and barrage fire.

Continuously pointed or predicted fire relied on both good visual or gun-laying radar acquisition of the target formation. This type of fire was designed to place shells directly in front of the lead aircraft in the formation. The guns would fire a continuous pattern of bursts along the aircraft’s course and each battery would maintain fire until the formation was no longer in range. New batteries would then join in, once in range.

Predicted concentration fire was less effective. Used at night, through cloud cover or when radar information was of minimal quality, it needed the incoming formation to fly straight and level for about 90 seconds in order to come into effect. A master command post directed the fire of several batteries at once. With the target sighted, the direction, angular height and altitude readings were taken at several points along the formation’s incoming course. Based on these readings an actual prediction was made as to where the formation would be in the sky prior to firing. Each battery was informed and adjustments made so that the concentrated fire would strike the point of prediction at the given time.

The least effective tactic was barrage fire. This was primarily used at night or when cloud cover prevented good visual aiming and it was designed to put as much flak into a certain volume of sky, or ‘box’. The box was usually placed just outside the expected bomb release line of the incoming formation.

Flak trains

With US daylight raids focusing on industrial centres, the Luftwaffe knew it could not protect every important target in Germany. One response was to increase the number of heavy and light railroad flak battalions. These mobile units became the flak elite, with the best equipment and crews. Able to move quickly, they provided areas that had few or no guns with a robust defence. By the end of 1943, there were 100 heavy and 20 light railroad flak batteries in operation.

ABOVE: **A waist gunner’s view of heavy flak exploding around 457th BG B-17s over Schweinfurt on February 24, 1944. Bombing was under way despite the heavily overcast conditions. Eleven Flying Fortresses were lost during the mission**

For US bomber crews, flak was one of the things they feared the most. Arriving unannounced, it was impersonal, dirty and, once on the bomb run by up to two minutes, it was unavoidable.

Aircrews of the Eighth Air Force relied on speed and altitude through the target zone to avoid the worst of the flak, but it wasn’t enough. Bombing accuracy began to decline and evasive manoeuvring was to blame. Colonel Curtis E LeMay of the 3rd Air Division castigated his commanders for using evasive action on their bomb runs.

For new crews on their first missions, the introduction to flak was both

BELOW: **Ammunition fuse-setters carry out their critically important task on 88mm shells moments before they are loaded into the breech and fired. With each of these shells weighing 31lb 11oz, being an ammunition handler for an 88mm battery was physically taxing work. By the autumn of 1944, the ranks of the Flakwaffe had been bolstered by 98,000 volunteer and PoW ammunition handlers**

ABOVE: **A direct hit by a heavy flak shell was almost always lethal, although B-17G 42-98004 of the 508th BS/351st BG had a lucky escape. During a raid on Cologne on September 27, 1944, an 88mm shell entered the fuselage near the rear entrance to the radio room and blasted away the ball turret. It made it back to the 351st BG's base at Polebrook, Northamptonshire, where its pilot, Capt Jerome Geiger, was photographed surveying the damage**

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fascinating and frightening. John Commer, a B-17 flight engineer with the 533rd Sq, 381st BG, wrote: "Suddenly the bombardier called out: 'Flak nine o'clock low!' Huge puffs of black smoke began to burst around the formation. Because we were on the bomb run it meant we had to fly straight and steady for several minutes to provide a stable platform for the bombardier and the Norden bomb sight. BAM!! The ship rocked and I saw a nearby burst of orange followed by boiling, black smoke. I had been told that the crew would not hear the shell bursts. Well, I heard that one! Mostly I saw only black smoke explode into large globs and heard pieces of shrapnel striking the aircraft."

By late 1943, the USAAF began to take the science of 'flak analysis' seriously. The number of heavy bombers shot down and damaged was increasing, forcing a change in tactics and the use of electronic countermeasures. In November 1944, the Eighth Air Force Operational Analysis Section produced an in-depth study titled *An Evaluation Taken to Protect Bombers from Loss and Damage*. The results were sobering: "During the past year enemy flak defences have been concentrated and our bombers faced many more guns. The percentage of bombers lost to or damaged by enemy fighters has declined sharply while the percentage lost to flak has declined only moderately, and the percentage damaged by flak had remained almost constant. As a result, there had been a steady increase in the relative importance of flak until in June, July and August 1944, flak accounted for about 2/3 of the 700 bombers lost and 98% of the 13,000 bombers damaged.

"In number the current rate is startling. From 3,360 to 4,453 bombers have returned with flak damage in each of the six months ending September 1944 – a monthly average just about double the total number damaged by flak in the entire first year of operations. All our efforts to reduce flak damage have apparently been offset by the fact that we have increasingly flown over targets defended by more and more guns. Further, enemy equipment, gunnery and ammunition have probably improved. The 60-gun target of a year ago is likely to be defended by 300 guns today. This makes it essential that we increase our efforts to decrease flak risks by re-examining the tactics we have been using and such new tactics as offer real possibilities."

An Evaluation Taken to Protect Bombers from Loss and Damage went on to outline the principal tactics to reduce flak risks:

- Avoid flying over flak defences en route to and from the target.
- Enter and leave the target area on course, which cross over the weakest flak defences in the shortest time possible, i.e. with allowances for wind vector.
- Fly at the highest altitude consistent with other defensive and offensive considerations.
- Plan the spacing and axes of attack of bombing units to make the fullest use of the radio countermeasures Window and Carpet.
- Minimise the number of bombers flying together as a bombing unit.
- Increase the spread of the entire formation in altitude and breadth to reduce the risk from barrage fire.
- Close up in trail so as to reduce the time between attacks of successive

bombing units and thus saturate the enemy flak defences when they are employing continuously pointed or predicted concentration firing tactics.

• Plan evasive action when flying over know anti-aircraft positions (except on bomb runs) to make it difficult or impossible for the enemy to get accurate data for continuously pointed or predicted concentration firing tactics.

February 1944 saw the Flakwaffe swell to a wartime high of 13,500 heavy flak guns, 21,000 light flak guns, 7,000 search lights and 2,400 barrage balloons. The highest concentration of weapons was in Germany. The increase in the numbers did not necessarily translate directly to more aircraft being shot down. Part of the reason for this was the increased use by the Eighth Air Force of electronic countermeasures such as Window or chaff and active radar jamming using a device codenamed Carpet. The Germans were also beginning to suffer shortages of anti-aircraft ammunition and well-trained personnel.

In December 1943, the introduction of the P-51 Mustang and larger drop tanks for the P-38 and P-47 provided the Eighth Air Force with the means to strike deep into Germany without heavy losses. It proved to be the death knell for the Luftwaffe fighter force.

The burden of defending the Reich now fell to the Flakwaffe. In response, the number of super batteries was increased, consisting of at least 24 heavy guns. Most were situated around vital targets. Around Berlin alone, there were 24 super batteries, including formidable two-barrelled 128mm flak guns mounted on three massive flak towers. The massed firepower of these batteries greatly improved the effectiveness of the flak arm in the spring of 1944. During January to April, the Eighth and Fifteenth Air Forces lost 315 bombers to flak and 10,563 were damaged.

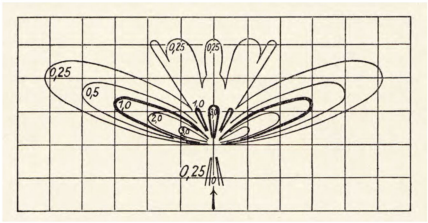
It wasn't just the bombers that were suffering. In January 1944, the Eighth Fighter Command abandoned the 'close escort support' of the bombers in favour of 'ultimate pursuit.' Fighters could now attack enemy aircraft wherever they could be found, in the air or on the ground. Most of the pilots did not realise how well protected the Luftwaffe airfields were and, as the war progressed, the Germans created numerous flak traps – airfields packed with useless aircraft and numerous flak guns. Many pilots took the bait and lost their lives in the process. Before this controversial policy was put into place, fighters lost due to flak before January 1944 stood at just one. After that, 2,449 were shot down by German flak compared to 1,691 shot down by Luftwaffe fighters.

The D-Day invasion in June 1944 and the subsequent liberation of France signalled the end of the Reich's air defence network. Following the invasion

BELOW: **For protection against low-level air attacks, German airfields were equipped with numerous 20mm and 37mm weapons. One of the most effective was the 20mm Flakvierling 38 automatic cannon shown below. Four such weapons were grouped onto a single gun mounting**

of Normandy, the Eighth Air Force turned its attention to German oil facilities. In response, the Luftwaffe was forced to move their flak guns to defend those sites. Guns were relocated from Berlin and the Ruhr, unfortunately leaving some towns and cities defenceless.

The attacks on German oil plants led to a sharp increase in the number of USAAF casualties. During attacks against the Leuna oil facility alone, 82 US bombers were shot down, with flak accounting for 59 of them. Clearly, firing concentrated flak within a small area could inflict heavy damage and prevent accurate bombing. The attacks also crippled the Luftwaffe, but at a price. Between June and August 1944, the USAAF lost 654 heavy bombers, with 14,329 damaged. At this time, flak was inflicting ten times as much damage as fighters.



ABOVE RIGHT: **The splinter distribution of an 88mm flak shell. Taken from a German 88mm flak manual, the figures in the diagram indicate the number of effective fragments per square metre. In order to be effective a flak shell had to explode within 30-80ft of its target**

BELOW: **The Kommandogerät 40 was the brains of the flak battery, the one-and-a-half-tonne director requiring 13 personnel to operate it. Normally attached to a four-gun battery, the KodoG 40 combined an optical range finder with a ballistic computer, a combination that afforded precise firing at visible targets**

By January 1945 the end of the war was in sight. However, even in its diminished state, the Flakwaffe could still deal a deadly blow to the Allied air forces. On April 25, 1945, the Eighth Air Force launched its final raid of the war, with 307 B-17s and 288 B-24s. While flak failed to shoot down any of them, 200 aircraft were damaged.

In the end, the Flakwaffe proved its worth. Between July 1942 and April 1945, the Eighth lost 1,798 heavy bombers to flak, with the Fifteenth losing a further 1,046 between November 1943 and May 1945. Flak also damaged an astonishing 54,539 Eighth bombers between December 1942 and April 1945, with casualties numbering more than 47,000, with 26,000 dead.

By themselves, German flak defences could not successfully defend German airspace. However, without the thousands of heavy and light flak guns defending the Reich, German cities and factories would have been quickly blasted into ruin. While the Eighth Air Force contributed a great deal to final victory in Europe, USAAF General Henry 'Hap' Arnold noted ruefully: "We never conquered the German flak artillery."