

Flak – from a modeller's viewpoint

by Dan Mouritzsen

'Flak' stands for **F**lieger **A**bwehr **K**anonen: no word was more dreaded among Allied bomber crews than this during the air war between 1939–45.

In this two-part article I will take a close look at some of the fieldworks employed for the single towed guns and their crews by the German forces in WWII, as well as the ammunition used for these weapons.

Note that in this article centimetres are used instead of millimetres – so the 2cm is the same calibre as a 20mm. The only exception to this is the 7.92mm calibre rifle.



(Left) Figure 1. 'Flak so thick that you could walk on it' – a common remark by American aircrews late in the war

Tactical use of anti-aircraft guns

Anti-aircraft guns are deployed around an area vulnerable to aerial attack. Such an area could be static (a factory), or moving (a truck convoy). The area around a vulnerable point is divided into three circles – from outwards:

1. Preparatory zone.
2. Line of bomb release.
3. Vulnerable point (the target).

It is important that the anti-aircraft battery commander places his guns in such a way that he can prevent the attacking aircraft from crossing the line of gun/bomb release. Alternatively, if that is not possible, he must ensure they disrupt the attacking aircraft so that it misses its target.

An anti-aircraft gun can be used tactically in two ways, either against ground targets as a ground support weapon or against aerial targets as an anti-aircraft weapon.

Against ground targets, it can be brought into action using direct fire or indirect fire. Direct fire means that the target is within visual range of the gun. Indirect fire means that the gun is firing in an arc into a non-visible zone calculated by the commander (for example, over a hilltop or a forest). Indirect fire can only be done with non self-destruct ammunition.

Against aerial targets, it can be brought into action as a barrage weapon or by using direct fire.

Barrage fire means that the gun/guns are firing into a specific area or 'box' of airspace. The box is predicted by the gun/battery commander to be at the same height as and within the plane's flight path. Direct fire means that the gun is aimed directly at the enemy aircraft (or in its flight path depending on the angle and speed of the enemy aircraft).

Flak units

The basic German Flak unit was divided into four main types: **Schwere** (heavy 8.8cm–12.8cm), **Leichte** (light 2cm-5cm), **Gemischte** (mixed with both heavy and light guns) and **Scheinwerfer** (searchlight) units. These were further sub-divided into fully motorised, semi-motorised or static units.

A standard heavy Flak unit (**Zug**) consisted in 1939 of four guns, a power unit, rangefinder, sound locator (not always) and a searchlight unit. The guns were laid out in the corners of a square, with the power unit and the rangefinder in the centre. There was at least 50m between the guns and the rangefinders to protect the operators and their delicate instruments against the muzzle flash and blast. In 1941, the number of guns was changed to six guns, which were laid out in a circle, or a circle of five with the sixth gun in the centre. The power units and rangefinders were still placed in the centre or as in the latter layout slightly to the side of the guns. From 1944 onwards, two units often worked together with a single power/rangefinder unit in the middle of the group (see Fig.2 below).

In 1942 radars were introduced, and in 1943-44 8 guns became normal. Batteries using both radar and searchlights together were to be found often with the searchlights linked to the radars. The searchlights were always placed quite a distance from the guns, as they were an attractive target for Allied turret gunners. From 1944 until the end of the war, several heavy Flak units were bought together to form the so called **Grossbatterien** of 16 to 24 guns. Sometimes up to 32 guns were seen.



(Left) Figure 2. Two power, two predictor units (1.) and two six gun batteries (2.) situated in a heavy Flak battery at Fliiegerhorst Grove (today Karup Air Station) Denmark April 7, 1945. Note that the top positions are empty while the lower ones are occupied. However, they could easily be dummy guns. Also, note the three parked fighter aircraft in the lower left corner.

A standard light Flak unit (**Zug**) consisted of three guns. In 1940, these were usually laid out in a triangle about 50-75m apart and each gun had its own commander. In 1944 this was reduced to 30m apart, with a single battery commander situated in a small dugout in the middle of the triangle. The triangle was laid out with the apex towards the vulnerable point.



(Left) Figure 3. Light Flak battery at Einsatzhafen Rye, Gl. Ry Airfield Denmark November 6, 1941. The small dugout 'horseshoe' is the gun position, while the larger square one is the crew hut. The squares in the fields surrounding the positions mark the boundaries for the barbed wire fences

Self-propelled Flak

Mobile Flak like the tracked Wirbelwind or other wheeled Flak vehicles were primarily used to protect moving vulnerable points like truck convoys or larger travelling units like Panzer divisions or infantry divisions. Again the purpose was for the battery/gun commander to place his gun(s) in such a way as to prevent the attacking aircraft from crossing the line of bomb release or from strafing (engaging ground targets with its guns); or alternatively, if this was not possible, to distract the attacking aircraft so that it missed the vulnerable point (target).

If a self-propelled Flak gun was intended to stay for a longer period in the same position and if it was soft-skinned like a truck, the entire vehicle was often dug in so only the gun and the top of the truck's cab was above ground, or a small wall of earth, wood, stones or other suitable materials were erected instead.

Preparing the Flak gun for action followed the below order:

1. Remove the tarpaulin and the muzzle cover.
2. Dismount the gun from its carriage*.
3. Level the gun.
4. Unlock the travel locks.
5. Install the sighting mechanism.
6. Prepare the ammunition.
7. Load the weapon.

[*Most of the towed German Flak guns could be fired from their carriage in emergencies. However, it affected their accuracy considerably.]

After engaging the enemy, the following order was observed:

1. Unload the weapon.
2. If necessary, clean the gun and the bore.
3. Repack the sighting mechanism.
4. Repack unused ammunition.
5. Lock the travel locks.
6. Remount the gun on its carriage.
7. Remount the tarpaulin and muzzle cover.

If a heavy Flak unit worked its guns in cooperation against aerial targets, it was also necessary to synchronise/aim the guns before they could be brought into action. Depending on the situation, all the expended cartridge cases were recollected for later reuse.

A battery's war diary

One of the daily duties of the battery commander, amongst other paperwork, was to keep and maintain the battery's war diary. Below is a page from the war diary of one of the German 416 Inf. Division's 3.7cm Flak 36/37 positions. This particular position was one of three that guarded the airspace around their divisional HQ at Silkeborg Bad in Denmark in 1943.

Datum Und Uhrzeit	Angabe des Ortes, Wind, Wetter, Beleuchtung, Seichtigkeit der Luft, Mondschein usw	Vorkommnisse
16.5.43		Keine besonderen Vorkommnisse.
17.5.43 1524- 1532	Bedeckung:10/10 Wolkenhöhe:200 m Sicht a.b.:10 km Wind.WSW 4	Eine von Süden nach Norden fliegende Mosquito kam nicht in den Bereich unsere Kampfmittel. Bereitschaftsgrade: bef. v. Ugruko 1524 Uhr Flakalarm 1532 Uhr Kriegswache Ruhe.
18.5.43		Keine besonderen Vorkommnisse.
19.5.43 1300- 1320 1415- 1442	Bedeckung:6/10 Wolkenhöhe:3000 m Sicht a.b.:15 km Wind.N 3	Um 1300 Uhr überflog eine Feindmaschine den Flakbereich in 8000 m Höhe. Kurs Ost. Keine Kampfhandlungen. Eine von Norden nach Süden fliegende Feind-Maschine über Silkeborg (1415) kam nicht in den Bereich unserer Kampfmittel. Bereitschaftsgrade: bef. v. Ugruko 1300 Uhr Flakalarm 1320 Uhr Kriegswache Ruhe. 1415 Uhr Flakalarm 1442 Uhr Kriegswache Ruhe.
20.5.43		Keine besonderen Vorkommnisse
21.5.43		Keine besonderen Vorkommnisse.
22.5.43		Keine besonderen Vorkommnisse

Field fortifications

If a Flak unit was intended to stay in a certain position for several days or longer, the crews usually started the construction of fieldworks for protection of both the gun and the crew. Naturally, the longer the crew stayed in one position the better it was constructed.

The Germans used four different terms to describe the deployment of their Flak guns:

1. **Feldmässig.** The gun is deployed on an open road or in a field without any construction around it, if the situation requires it to stay on its carriage.
2. **Feldmässiger Ausbau.** The gun is taken off the carriage and a berm of earth, sand, snow, stones, sandbags, logs or similar is erected around the guns position.
3. **Verstärkter Feldmässiger Ausbau.** A parapet of wood, timber, light concrete or bricks is erected around the gun's position. Extensive work is also put into sheltering both the gun and the crew against attack and the elements.
4. **Ständiger Ausbau.** The gun is placed in a fully fortified position either on a heavy concrete gun platform or in a bunker.

How the gun was deployed depended heavily on materials available, which could be affected by shortages or distances to available material.



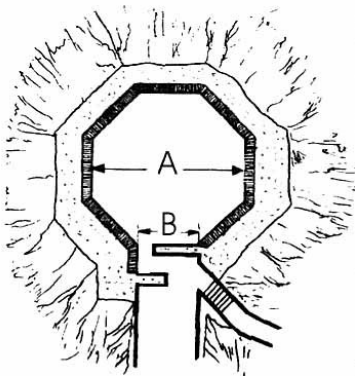
Figure 4. 3.7cm Flak 36/37 gun in a 'Feldmässig' position

Figure 5. 3.7cm Flak 36/37 in a 'Feldmässiger Ausbau' position



Figure 6. 2cm Flak 30 gun in a 'Verstärkter Feldmässiger Ausbau' position

Figure 7. A 'Ständiger Ausbau' position for 2cm Flak 30/38, Hanstholm Denmark, 2002



The design of a Flak field position

(Left) Figure 8.

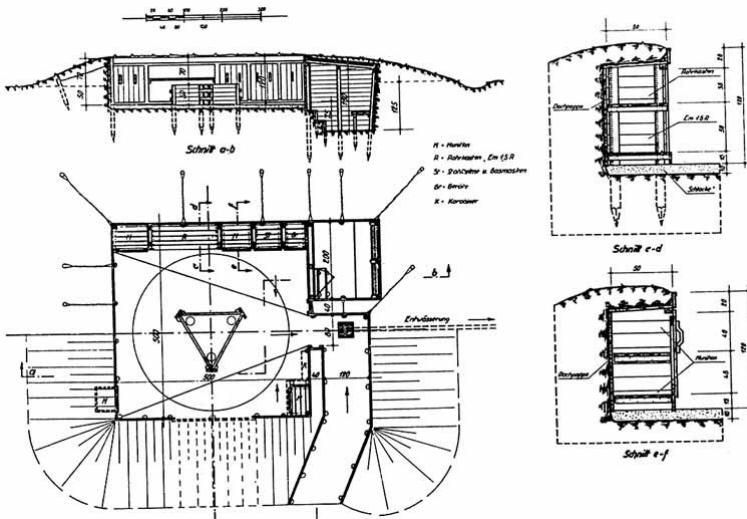
The inner diameter of the Flak position was:
 for 2cm–2.5cm A = 5m x 5m, B = 2m
 for 2cm (Vier)–4cm A = 6m x 6m, B = 2.5m
 for 5cm–10.5cm A = 7m x 7m, B = 3m
 for 12.8cm A = 8m x 8m, B = 4m

Note that in the centre of the 2cm–3.7cm Flak gun positions, including the 2cm Vierling, there was a raised centre platform. The platform could be made of wood, bricks or concrete and the height was 30–50cm. For 4cm guns upwards, the floor was flat. The purpose of the platform was to bring the gun a little higher up so the high walls could be maintained, giving added protection to the gun crew and at the same time allowing the gun to engage targets coming in at low level or ground targets.

In some of the larger Atlantic Wall Flak bunkers, you can see a large raised circular gun platform in the middle of the position. This was a standard constructed platform to accommodate all types of Flak guns, searchlights and sound locators.



(Left) Figure 9. The raised centre platform for a 2cm Flak 30.



(Left) Figure 11. Verstärkter Feldmässiger Ausbau Flak position for 2cm Flak 30/38.

What was placed in the position beside the gun?

The ammunition for the gun was often stored in recesses built into the parapets (Fig.7) or in closets placed in the corners of the position. For single round guns, the recesses had shelves in them like the ones used to store wine bottles. For automatic guns, they contained either preloaded clips, magazines or new ammunition boxes. Hinged doors or a removable wooden board covered the front of the recesses to protect the ammunition against the elements.

On or above the doors, there were often written in chalk or paint the type of fuses that the ammunition within had – e.g. Zt.Z (Zeitzündler) or A.Z. (Aufschlagszündler) - time fuses and percussion fuses (percussion fused means that it has to hit something to detonate, time fused that it detonates after a specific amount of flight time). The reason was to prevent any shells falling to earth and harming friendly forces or civilians. Often the projectiles had both types of fuses.



(Left) Figure 12. Automatic fuse setting before loading it into the chamber on a 12.8cm Flak. Note the stored ammunition in the back.

(Left) Figure 13. It could also be done manually with a fuse setting key. Two men are holding the 47.7kg cartridge, while a third is setting the fuse. In positions for the automatic guns, there were also metal containers marked “Rohrkasten” or “2 cm Flak 38 Rohr-Waffe Nr 8461” (for example) on the lid in white or black letters for the spare barrels. Other wooden or metal boxes/containers might contain extra parts, spares or tools for the guns.



(Left) Figure 14. The metal container for the 2cm spare barrels (Rohrkasten): two of the tool/spares boxes can be seen above.

A wooden crate to store the gun's tarpaulins when they were not covering the gun might also be found. Often the tarpaulins were just thrown on the parapet. There were also wooden racks for gun cleaning equipment like oil, grease and cleaning rags, and a field telephone. On top of the rack, the gun crew's helmets could be stored when they were not in use. This rack also contained the metal container for the stereo rangefinder until the winter of 1944/45, when the automatic guns started to use tracer ammunition to establish the range to the target instead. There could also sometimes be a rifle stand for the crew's personal weapons in the position.

There could also be a protective deflection bar in wood or iron placed on the top of the parapet. The purpose of this was to prevent the gun crew from hitting other Flak positions or other friendly installations nearby in the heat of the battle.

As an aid to the gunner and the commander the numbers 1-12 (in clock fashion) were often painted on the inside of the parapet. Number 12 was set at North to help locate the target. The targetting command was given like in an aircraft – 'enemy aircraft 12 o' clock high' – thus no one had any doubt where they should start looking for the enemy. (Fig.6).

Often there was also painted profiles of prominent landmarks on the walls with the exact range to those landmarks painted beside them. This helped both the gunner and the commander to calculate the exact range to the target. Boards on the walls with aircraft silhouettes or technical data about the gun's ballistics were also common.

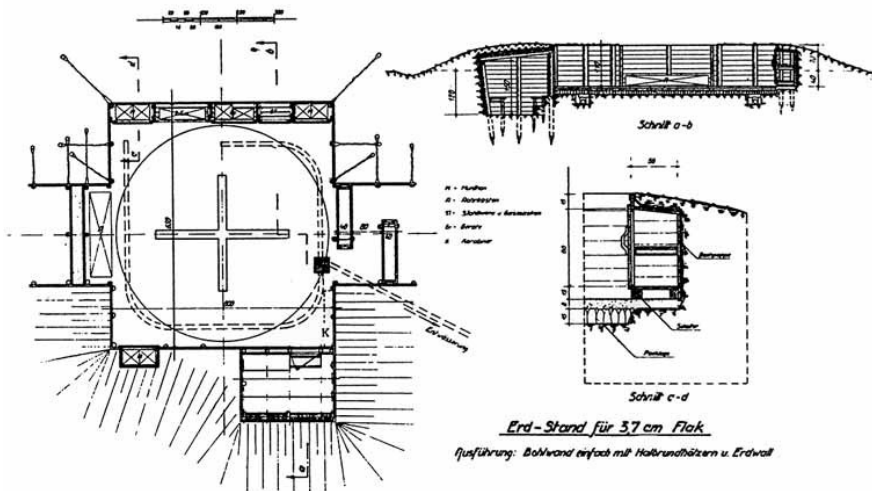


(Left) Figure 15. Note the deflection bars on both sides of this position

During daylight hours there was usually one watch guard with binoculars on duty in one or more of the positions. In the event of an attack, he would first sound the alarm; then he ripped off the tarpaulins and unlocked the gun. By that time, the rest of the gun crew should 'hopefully' have arrived.

The alarm (Flak alarm) for specific areas in the predicted flight path of enemy intruders was often raised in advance by telephone or radio from command and control headquarters.

If the Flak position was placed in an occupied area or areas at risk of enemy ground action (including partisan/freedom fighter actions) a perimeter defence was also constructed. Often this consisted of an extensive trench system with large amounts of barbed wire or even landmines.

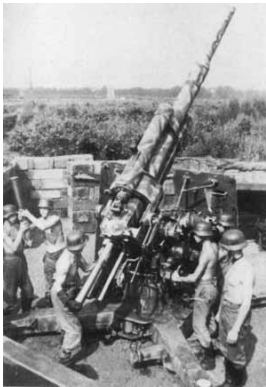


(Left) Figure 16. Verstärkter Feldmässiger Ausbau position for 3.7cm Flak.

What else to take into consideration?

1. The gun had to have a free and unobstructed field of fire. I have read on several occasions, that if a large tree or an entire tree line was in the way, a round or two from an automatic cannon quickly took care of it.
2. The ammunition, the clips and magazines were always to be kept in pristine condition, and not lying around in the sand or mud. Quite often, it was unpacked, cleaned with oiled rags and then repacked/reloaded. New ammunition for the automatic guns did not arrive ready to use in clips or magazines. A certain amount of clips or magazines belonged to the gun and they were refilled after use.
3. Spent cartridges were removed as soon as possible by the crews operating gun areas. Often they was just shovelled up or thrown out of the position as soon as there was a lull in the fighting. After combat was over, they were collected for reuse.
4. When the gun was not in use it was protected against the elements with tarpaulins, muzzle covers etc. Depending on the situation, the whole position could also be covered with camouflage netting/material, but this was not to hinder the operation of the gun.
5. In battle, all personnel had to wear their steel helmets. When they were not in use, they were placed in a row on top of the parapet or in a special place close to the crew's entrance to the position.
6. There was always a gun blast/muzzle flash safety area around larger guns. This was 30m from the centre of the gun for guns calibre 8.8cm and upwards. Everything unprotected outside the parapet up to a range of 30m could sustain serious damage if the gun fired below +5. The crew shelters for the larger guns were therefore always placed some distance from the guns.
7. The opposite applied for automatic guns. The 'Gruppen Unterkunft/unterstand' crew shelter was always placed only a few meters from the guns to reduce reaction time. If it was placed outside of the parapet, it was often shielded with an earth wall reaching up to or just above the windows. (Fig.3)
8. There was always an opening in one or both sides of the position (depending of the size of the gun's carriage), making it possible for the gun's carriage to deliver or remove the gun. The opening

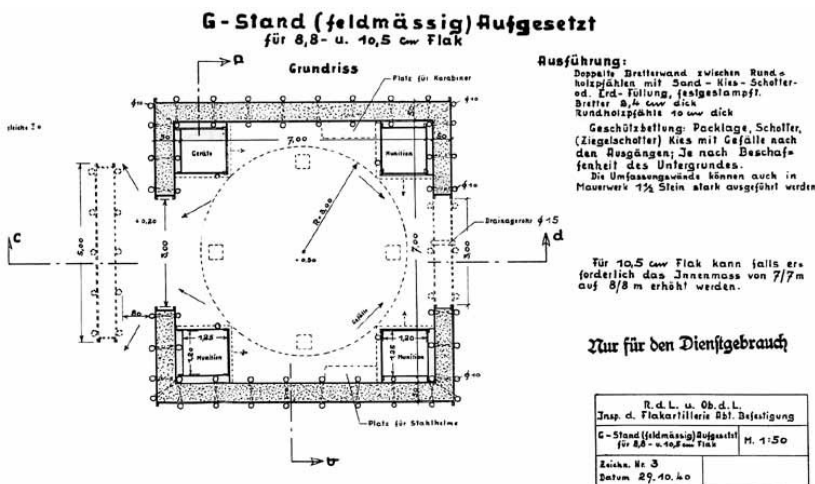
was closed with removable walls in zig-zag pattern, so the position could still be entered but at the same time preventing someone from shooting down the length of the position. (Fig 8 and 17).



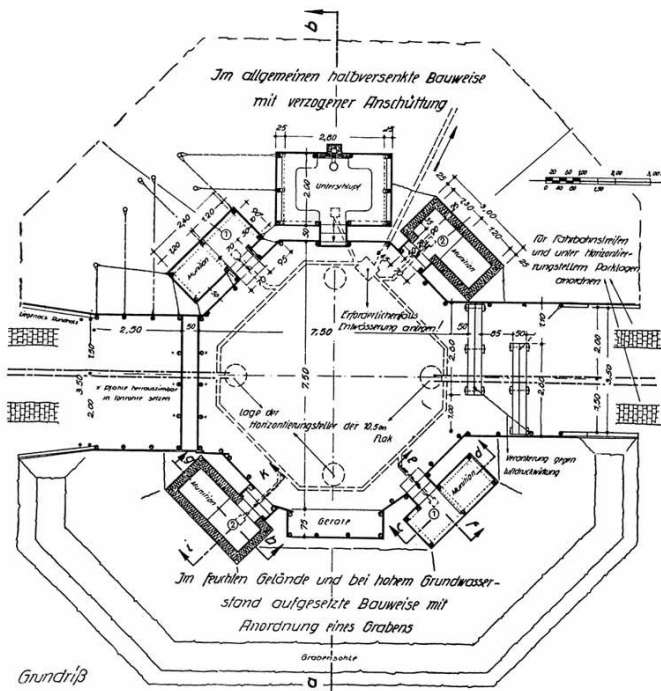
(Left) Figure 17. Note how the entrance behind this 8.8cm Flak gun has been closed with removable walls

9. The position was very seldom dug into the ground. The walls/parapet were erected around the gun position.

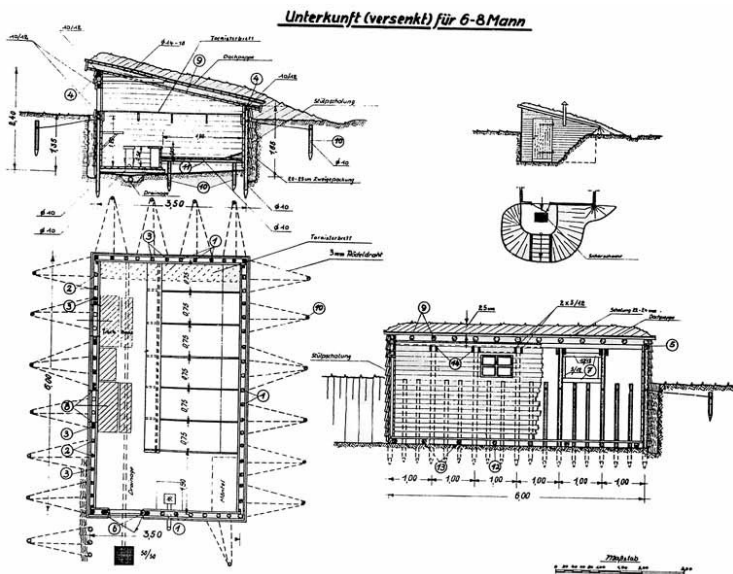
10. The whole position was camouflaged so it could blend in as much as possible with the surrounding terrain. If paint was used the colours also reflected the surrounding terrain.



(Left) Figure 18. Feldmässiger 'Ausbau' position for 8.8cm–10.5cm Flak guns.



(Left) Figure 19. Verstärkter Feldmässiger Ausbau position for 8.8cm–10.5cm Flak. The position for the 12.8cm Flak guns were similar, just a bit larger.



(Left) Figure 20. Basic layout of a crew shelter.

Ammunition details

There were 14 main types of Flak guns used by the Germans during WWII. In addition, several captured so-called *Beutewaffen* were also used. However, they will not be covered in this article.

	Gun feed by	Weight of round/ mag.	Ammunition storage*
2cm Flak 28 (Oerlikon)	15 round magazine	6.3kg	Airtight amm. Box. 130 cartridges 49kg
2cm Flak 30 2cm Flak 38 2cm Geb. Flak 38 2cm Flak Vierling 38	20 round magazine	9.5kg	Airtight amm. Box. 100 cartridges 45.5 kg
3.7cm Flak 18 3.7cm Flak 36/37	6 round clip Single shot – (Stiel-Gr. 41)	12.5kg 8.60kg	Airtight amm. Box. 18 12 cartridges 25 kg - Airtight amm. Box. 16 cartridges 31 kg - Airtight amm. Con. 1 grenade 10.4kg
3.7cm Flak 43	8 round clip	16.5kg	Airtight amm. Box. 16 cartridges 31kg
4cm Flak 28	4 round clip	2.10kg	Amm. Box 8 cartridges 22kg - 20 cartridges 61kg
5cm Flak 41	5 round clip	30kg	Airtight amm. Box. 41 3 cartridges 19kg
8.8cm Flak 18/36/37	Single shot	HE 14.7kg AP 15.3kg	Amm. wicker basket 3 cartridges 56kg - Amm. Box 3 cartridges 60kg - Airtight amm. Con.

			1 cartridge 20kg
8.8cm Flak 41	Single shot	HE 19.2kg AP 19.8kg	Airtight amm. Con. 1 cartridge 25kg - Amm. box 2 cartridges 50kg
10.5cm Flak 38/39	Single shot	HE 26kg AP 26.1kg	Amm. Con. 38 1 cartridge 32kg - Amm. box 2 cartridges 62kg
12.8cm Flak 40	Single shot	HE 47.7kg AP 46.5kg	Amm. Box 40 1 cartridge 72kg

* New ammunition boxes (factory fresh).

Abbreviations/ explanations:

1. Airtight = The wooden box had an airtight sheet metal lining.
2. Amm. = Ammunition.
3. AP = Armour piercing.
4. Con. = Container (tube container).
5. Geb. = Gebirge (Mountain (Gun for mountain troops)).
6. Gr. = Granate (grenade)
7. HE = High Explosive
8. kg = Kilogram
9. Mag. = Magazine
10. Stiel = (stick)

Samples of text on ammunition boxes and containers		
	Ammunition	Boxes and containers
2cm Flak 28	2cm Sprgr. Patr. L/Spur 2cm Pzgr. Patr. 2cm Pl. Patr.	Luftdichter Patronenkasten 18.
2cm Flak 30 2cm Flak 38 2cm Geb. Flak 38 2cm Flak Vierling 38	2cm Sprgr. Patr. L/Spur 2cm Sprgr. Patr. Db. 2cm Br. Sprgr. Patr. vk L/Spur W. 2cm Br. Sprgr. Patr. L/Spur 2cm Pzgr. Patr. 2cm Pzgr. Patr. L/Spur	Luftdichter Patronenkasten. HEERES Munition ¹ Gesamtgewkg
3.7cm Flak 18 3.7cm Flak 36/37	3.7cm Sprgr. Patr. 18 3.7cm Br. Sprgr. Patr. L/Spur 3.7cm Pzgr. Patr. 18 3.7cm H. Pzgr. Patr. L/Spur o. Zerl. 3.7cm H. Pzgr. Patr. L/Spur m. Zerl.	Luftdichter Patronenkasten 18. Luftdichter Patronenkasten d. 3.7cm Flak 18.

	3.7cm Stielgranate 41 ²	Mun. 3.7 Flak (Stiel-Gr.)
3.7cm Flak 43	3.7cm Sprgr. Patr. 18 3.7cm Br. Sprgr. Patr. L/Spur 3.7cm Pzgr. Patr. 18 3.7cm H. Pzgr. Patr. L/Spur o. Zerl.	Luftdichter Patronenkasten 18. Luftdichter Patronenkasten d. 3.7cm Flak 18.
4cm Flak 28	4cm Sprgr. Patr. L/Spur 4cm Br. Sprgr. Patr. L/Spur	Patronenkasten 4cm Flak 28.
5cm Flak 41	5cm Sprgr. Patr. 41 L/Spur 5cm Br. Sprgr. Patr. 41 L/Spur 5cm Pzgr. Patr. 42	Luftdichter Patronenkasten 41 d. 5cm Flak 41.
8.8cm Flak 18/36/37	8.8cm Sprgr. Patr. L/4,5 8.8cm Pzgr. Patr. 8.8cm Pzgr. Patr. 39 8.8cm Hl.G. Patr. 39 Flak 8.8cm Pzgr. Patr. 40 8.8cm Leucht-geschoss L/4,4	Patronenkasten 8.8cm Flak 18. Luftdichter Patronenbeh"lter 8.8cm Flak 18.
8.8cm Flak 41	8.8cm Sprgr. Patr. Flak 41 8.8cm Sprgr. Patr. Flak 41 Gerillt 8.8cm Pzgr. Patr. 39 Flak 41 8.8cm Pzgr. Patr. 40 Flak 41	Patronenkastend. 8.8cm Flak 41. Luftdichter Patronenbeh"lter 8.8cm Flak 41.
10.5cm Flak 38/39	10.5cm Sprgr. Patr. L/4,4 10.5cm Sprgr. L/4.4 Gerillt 10.5cm Pzgr. Patr. Flak 10.5cm Pz. Sprgr. Patr. Flak	Patronenkastend. 10.5cm Flak 38. Luftdichter Patronenbeh"lter 10.5cm Flak 38.
12.8cm Flak 40	12.8cm Sprgr. Patr. L/4.5 Flak 40 12.8cm Br. Schr. Flak 40 12.8cm Pzgr. Patr. Flak 40	Patronenkasten 40.

Notes:

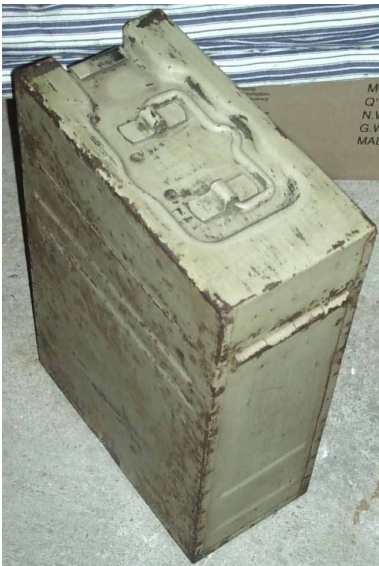
1. Also Luftwaffe and Kriegsmarine.

2. The fin-stabilised muzzle-loaded hollow charge stick grenade, fired by a special blank cartridge. The 3.7cm Pak L/45, also used this grenade.

Abbreviations/ translations:

1. **8.8cm Br. Sprgr. Patr. (Grün) L/Spur** = 8.8cm high explosive incendiary grenade cartridge with a green tracer.
2. **Br.** = Brand (incendiary).
3. **d.** = Der (For). (Patronkasten d. 8.8cm Flak 41 = Ammunition box for 8.8cm Flak 41).
4. **Gerillt** = Grooved: (a shell engraved with 15 longitudinal grooves to improve fragmentation.)
5. **Gesamtgew** = total weight (in kilos).
6. **Gr.** = Granate (grenade).
7. **H** = Haube (ballistic capped grenade).
8. **HEERES Munition** = Army ammunition (LUFTWAFFE Munition – KRIEGSMARINE Munition).

9. **Hl.G.** = Hohlladungs-Granate (hollow charge grenade).
10. **L/4,5 or 18** = (type).
11. **L/Spur** = Leuchtspur (tracer).
12. **Leuchtgeschoss** = illuminating shot (parachute-suspended illuminating unit, or star shell).
13. **Luftdichter** = Airtight.
14. **m.** = Mit. (with)
15. **Mun.** = Munition (ammunition).
16. **o.** = Ohne (without).
17. **Patr.** = Patrone (Cartridge).
18. **Patronenbehälter** = Cartridge container (tube container).
19. **Patronenkasten** = Cartridge box.
20. **Pl.** = Platzpatrone (blank cartridge; a cartridge with a hollow wooden bullet for blank firing).
21. **Pzgr.** = Panzergranate (armour piercing grenade).
22. **Schr.** = schrapnel (shrapnel).
23. **Sprgr.** = Sprenggranate (high explosive grenade).
24. **Stiel** = Stick.
25. **Üb.** = Übung (exercise, practice inert).
26. **vk.** = Verkürzt (shortened i.e with a short-burning tracer).
27. **W.** = Warme Übertragung (heat transmitted, i.e. tracer initiated self-destruction).
28. **Zerl.** = Zerlegung (self-destructing).



(Left) Figure 22: 2cm Flak 30/38 magazine container. Containers for the Flak 18/36/37 and 43 had the same design, but were accordingly larger, so they could contain the 6- and 8-round clips. Note the colour.



<p>8,8cm Sprgr. Patr. L/4,5 (Kz) Zt. Z. S 30 Gewichtsklasse IV</p>
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<p>8,8cm Sprgr. Patr. L/4,5 (Kz) Az. 23 28 Gewichtsklasse II</p>
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Left) Figure 25: A sample of two paper labels to be found on both the side and the end of the ammunition boxes and ammunition containers. All ammunition boxes and containers, no matter what calibre, had these paper labels attached on the outside to identify the contents. The paper labels normally measured

7x10cm Some of them could have a green, blue, yellow or red 3cm-wide bar running across them or in the middle of the label from top to bottom to identify what colour of tracer/fuse there was within. In addition, triangles in the corners of the label in the colours of the tracers are also visible (see Fig.27)



(Left) Figure 26: Paper label from a 2cm ammunition box.



(Left) Figure 27: Luftdichter Patronenkasten d. 3.7cm Flak 18. Note the colour, text and paper label. It is exactly the same container type as used for the German stick hand grenade.



Shells/ basic body colours - all calibres:

Olive green, olive drab or field grey: High explosive (only non anti-aircraft), anti-concrete, smoke, chemical or hollow charge shells, and case shots.

Black: Armour piercing shot or shell.

Yellow: Anti-aircraft high explosive shell.

Red and blue: Anti-aircraft incendiary shrapnel shell.

Pale green: Star shell.

Cartridge cases/basic body colours - all calibres:



(Left) Figure 31: These 7.92mm cartridge case colours are the same as their bigger sisters. From left - Brass with copper shine, two different brass colours (unpolished-polished), Steel with a shiny light field grey lacquer layer, Steel with a shiny greenish lacquer layer. Here you should note that the 2cm guns were the only ones that used steel cartridges with the grey/greenish lacquer layer.



(Left) Figure 32: Steel 3.7cm Flak cartridges in matt light field grey colour, the brown stuff is not rust but weapon grease.

Brass cartridges: Brass – some brass cartridges could also have a copper shine. 2cm–12.8cm.

Steel cartridges: Shiny greenish lacquer layer. 2cm only.

Steel cartridges: Shiny light field grey lacquer layer. 2cm only.

Steel cartridges: Matt light field grey. 2cm–12.8cm

Steel cartridges: Shiny green. Only produced from February 1945 until end of war. 2cm–3.7cm.

Steel/brass cartridges: Steel cartridge with a very thin brass skin covering the steel. This brass skin had a slight copper shine. (This was an attempt to reduce the wear and tear on the gun chambers caused by ordinary steel cartridges). 2cm–12.8cm

Fuse/basic colours - all calibres:

Nose fuse: Silver coloured Aluminium (in case of two fuse types AZ. Zt.Z. in the same shell, the other one was placed in the bottom of the shell “Bodenzünder”).

Tracer markings/ Basic colours - all calibres:



(Left) Figure 33: 2cm Flak 30/38 HE shell with a red tracer.

A 5mm-wide red, green, yellow or white band on or just above the shell's driving band on the calibres from 2cm to 4cm. The rest had a 1cm-wide band. The band reflected the shell's tracer colour. Red was the most common.

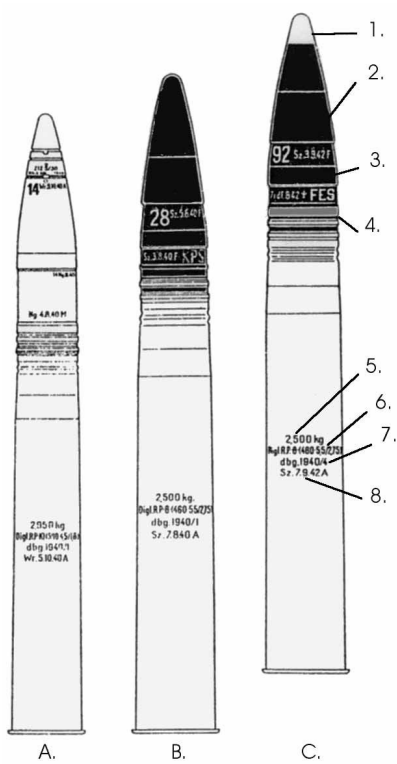
Incendiary markings/basic colours - all calibres:



(Left) Figure 34: 2cm Flak 30/38 shells. "Edq" is the manufacturer's code. In this case Deutsche Waffen und Munitionsfabriken A.-G Lübeck-Schlutup.

A 5mm-wide blue band just below the nose fuse and or a 12mm high white or black Ph (phosphorus) stamped on the side of shell.

Text stamped on shells and cartridge cases - all calibres:

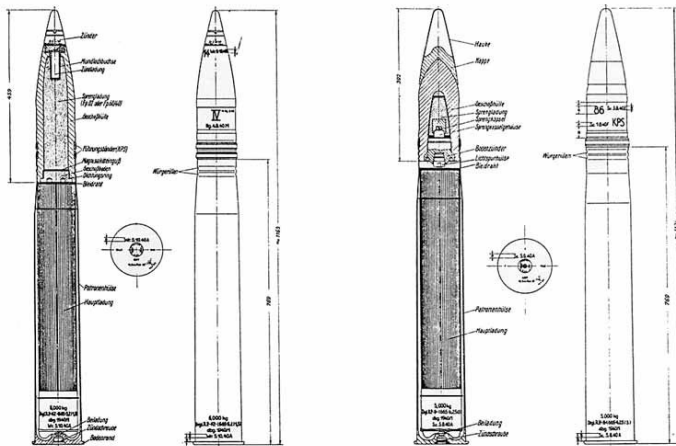


(Left) Figure 36: 10.5cm cartridges:

- A. HE shell.
 - B. 1941 AP ballistic capped.
 - C. 1943 AP ballistic capped.
1. From early-1943, the noses of the 8.8cm–12.8cm AP shells were painted white to help loading them in the dark. The HE shells already had a silver coloured aluminium tip so it was not necessary to paint them.
 2. 14, 28, 86, 92 are bursting charge numbers. Place, day, month, year of fusing with work mark.
 3. Place, day, month, year of shell filling with work mark. KPS, FES or KES is the type of driving band.
 4. Colour of tracer band.
 5. Weight of propelling charge.
 6. Type of propellant.
 7. Location, year, delivery number of propellant.
 8. Place, day, month, year of manufacture with work mark.
- Text was stamped on in either black or white paint depending on the colour of the cartridge.



(Left) Figure 37: Work mark placed in a square on a 3.7cm shell. Note that a protective layer of weapon grease has been smeared on the entire shell/cartridge to protect it against moisture but at the same time making the colour look a bit darker. (The vk. on the shell before the L'spur (tracer) means Verkürzt – "shortened". It has a short burning tracer).



(Left) Figure 35: 10.5cm cartridges. He and AP ballistic capped. The large II, III, IV are the weight classes. KPS, FES or KES stands for the bimetallic type of driving band.

Normal combat load for a 2cm and a 8.8cm gun in 1940

In 1940 the normal combat load of ammunition for one gun for a normal Flak Zug was:

8.8cm

- 200 - Sprgr. Patr. Percussion fused.
- 200 - Sprgr. Patr. Time fused.
- 100 - Pzgr. Patr.

2cm

- 4800 - Sprgr. Patr. Percussion fused.
- 200 - Sprgr. Patr. Time fused.
- 100 - Pzgr. Patr.

During the war this changed slightly due to shortages and new types of ammunition coming into use.

Sources:

- Die Flak Stellungen ein Typen heft* (1944, German handbook, WWII origin)
- Recognition handbook for German ammunition* (1945, Allied forces handbook, WWII origin)
- The Luftwaffe data book* (ISBN 1-85367-293-9)
- German Flak in WWII* (ISBN 0-7643-0399-6)
- Die leichte und mittlere Flak 1906 – 1945* (ISBN 3-7909-0395-7)
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- Der geschichte der deutschen Flakartillerie 1939-1945* (ISBN 3-7909-0166-00)

Versions of the 8.8cm gun

- **Geschütze 8.8 Kw FlaK** Entered service in 1916. Produced by Krupp.
- **8.8 cm FlaK 18** New semi automatic breech, high velocity gun. Entered production in Germany in 1933. Produced by Krupp.
 - **Mod 1938 I** - many upgraded to **Sonderanhänger 201** trailer. Weight 7 tons. Rate of fire 15-20 rounds per minute.
 - **Mod 1940** - Fitted with a gun shield to protect the crew when engaging ground targets. Produced by Krupp.
 - **Mod 1938 II** - approx 50 guns modified so a single man can adjust elevation and traverse.
- **8.8 cm FlaK 36** Entered service 1936-37. Redesigned trailer **Sonderanhänger 201** enabling faster time to action from the move. Could engage ground targets from its travelling position. Weight 7 tones. Rate of fire 15-20 rounds per minute. Produced by Krupp.
 - **Mod 1940** - Fitted with a shield to protect the crew when engaging ground targets.
- **Late model** Fitted with an improved trailer the **Sonderanhänger 202** with twin wheels.
- **8.8 cm FlaK 37** An Anti-aircraft only gun, fitted with **Übertragungser 37** (a data transmission system). Produced by Krupp. Last of the versions with the shorter 571 mm cartridge case.
- **8.8 cm FlaK 41** Entered service 1943. Improved development, longer barrel and cartridge case. Fitted to the **Sonderanhänger 202** as standard. Produced by Rheinmetall-Borsig.
- **8.8 cm Gerät 42** Krupp design to fill the same role as the **FlaK 41** did not enter service as anti-aircraft gun. Further development of the weapon led to the Pak 43 anti-tank gun.
- **8.8 cm PaK 43** Anti-Tank model developed from Krupp's 8.8 cm Gerät 42 . New gun carriage similar to the **Sonderanhänger 201**. Developed by Krupp and manufactured in its different versions, including KwK 43, by at least Dortmund Hoerder-Hüttenverein, Henschel, Weserhütte and Fr. Garmy. A 71 caliber barrel and a 822 mm cartridge case.
 - **8.8 cm PaK 43/41** Pak 43 mounted on single axle split-trail field gun carriage produced as a stop-gap measure due to scarcity of materials. Weight 4.9 tonnes.
- **8.8 cm PaK 43/1** Pak 43 as mounted in the 'Nashorn' tank destroyer.
- **8.8 cm PaK 43/2** Pak 43 as mounted in the 'Ferdinand'/'Elefant' tank destroyer. On occasion referred to as 'StuK 43/1'.
- **8.8 cm PaK 43/3 and 43/4** Pak 43 as mounted in the 'Jagdpanther' tank destroyer. Falling wedge breech block.
- **8.8 cm KwK 43** Pak 43 modified as a tank gun. Main gun of the Tiger II heavy tank. Falling wedge breech block.

Reference Photographs

