4) Artillery Weapons

a. Light Divisional Artillery (75-105mm Guns, Howitzers, Gun-Howitzers)

Light divisional artillery is usually allocated to an artillery regiment in a division, and is normally used in the direct or indirect fire artillery support role.

i. 75mm Field Guns

In the interwar years the Wehrmacht and the US Army opted for 105mm calibre as the most effective calibre for light divisional artillery. For the Germans this represented a swing away from the 7.7cm calibre used in 1914-18. However in order to hedge their bets and because there were hundreds of 7.7cm calibre weapons still in use, the Germans decided to maintain a significant number of smaller calibre guns in service. Thus in June 1941 the Germans still had two models of 75mm field gun in service (excluding mountain guns and recoilless artillery). These were the 7.5cm FK 16nA and the 7.5cm le FK 18.

The 7.5cm FK 16nA (7.5cm *Feldkanone* 16 *neuer Art*) were revamped 7.7cm FK 16s from WWI. Over 3 000 Rheinmetall FK 16s were manufactured from 1916 to 1918 and they remained the basic divisional gun in the post WWI *Reichsheer*. In the early 1930s the barrel was redesigned to take the new 7.5cm rounds, but little else was updated. The suffix nA for *neuer Art* (new pattern) was added to the designation to indicate this modification. The 7.5cm FK 16nA was a distinct relic from WWI and was a conventional design from that era. It was heavy by WWII standards (at 1 524 kg), but its shell weight and range performance were still very comparable to more modern field guns. By June 1941 the 7.5cm FK 16nA was principally in artillery training units in the Replacement Army. It was also sometimes issued to second line divisions conducting occupation duties. However a few combat units involved in Operation Barbarossa were still equipped with 7.5cm FK 16nAs: specifically the 169th Infantry Division in Northern Finland, the 1st and 2nd SS Cavalry Regiments, and the PZ armoured trains. If we include security and training units, then the 7.5cm FK 16nA remained the most common 75mm gun in the Wehrmacht during 1941. But of these only 56 were committed in total to support Operation Barbarossa in June 1941 (including those mounted on armoured trains).

The 7.5cm le FK 18 (7.5cm *leichte Feldkanone* 18) was the result of attempts to replace the 7.7cm FK 16 with a completely new design. After a very slow development program the Krupp design was accepted as the le FK 18 and issues began in 1938. The 7.5cm le FK 18 was a relatively light field gun (1 120 kg) with a split trail carriage, folding rear spades and a new type of hydro pneumatic recoil system. In this system the hydraulic buffer was contained in the cradle beneath the barrel while the hydro pneumatic recuperator was placed in a cylinder above the barrel. This system was commonly used in later German designs and apparently lowered the centre of gravity of the gun while allowing better heat dissipation from the recuperator. The 7.5cm le FK 18 was only ever produced in small numbers and by 1st April 1941 there were still only 106 in the Wehrmacht's inventory.[1] The le FK 18 was issued to cavalry units, sometimes to light infantry divisions in place of heavier 105mm weapons, and also occasionally to mountain divisions. The only German divisions involved in Operation Barbarossa that appear to have been equipped with le FK 18s were the 97th Light Division and the 1st Cavalry Division. Nevertheless these two divisions had 64 7.5cm le FK 18s between them, making it the most common 75mm field gun used in Barbarossa.[2] Therefore this weapon is selected as representative of the German 75mm guns used in Barbarossa and is shown in table Ger Res Database 1.

ii. 75mm Mountain Guns

In June 1941 the Germans had two models of 75mm mountain gun in service. These were the 7.5cm Geb K 15 and the 7.5cm Geb G 36.

The 7.5cm Geb K 15 (7.5cm *Gebirgskanone* 15) was an elderly Skoda design purchased in the days of the Weimer republic. A small number remained in service after 1939, mainly due to shortages of a better mountain gun (see below). Even in 1941 however the Geb K 15 was still a good mountain gun by contemporary standards. It was reasonably light (630kg), could be broken into seven pack loads for horse transport, and was able to throw a 5.47kg HE round a useful 6 625 metres. On 22nd June 1941 the only mountain divisions still using Geb K 15s were the 2nd and 3rd Mountain Divisions in Northern Finland, each with two batteries of four guns (16 guns total).

[1] H. Boog, et al., Germany and the Second World War: Volume IV, The Attack on the Soviet Union, (German Research Institute for Military History at Potsdam), Oxford University Press, Oxford, 1996, Table I.iii.3, p. 218.
[2] There were also 24 7.5cm Mountain Guns and 16 7.5cm ex-Norwegian guns used in support of Operation Barbarossa. There were a total of 160 7.5cm guns of various types Deployed (D) on the East Front in late June 1941.

The Geb K 15's replacement was the well designed 7.5cm Geb G 36 (7.5cm *Gebirgsgeschutz* 36). The Geb G 36 was designed by Rheinmetall-Borsig and entered service in 1938. It utilized a split trail carriage with the rear trunnions positioned to allow very high barrel elevations. The recoil system was variable in that the recoil was automatically shortened as the barrel elevation increased. The Geb G 36 also incorporated a perforated muzzle brake, lightweight disc wheels, and a breech that could be separated from the gun barrel for transport. The gun could reach targets over 9 100 metres away and yet still weighed only 750kg in action. The whole equipment could be broken down into eight pack loads for horse transport. The only real defect in the Geb G 36 resulted from its light weight. At angles of elevation less than 15 degrees the gun jumped dangerously if the maximum charge (charge 5) was used. This remained enough of a nuisance to the German Army for them to request a redesign in October 1940. This eventually led to the even better Geb G 43, which never went into series production. The 7.5cm Geb G 36 was also good enough to be issued to light infantry divisions (as a light field gun) and airborne divisions (as an air portable field gun). In 1941 the 99th Light Infantry Division and 7th Flieger Division were both equipped with Geb G 36s.

iii. 105mm Howitzers

As mentioned previously, there was considerable debate during the interwar years about what was the 'best' calibre for light divisional artillery. Smaller calibre (75-77mm) guns tended to have higher muzzle velocities, were relatively light, had good range and a high rate of fire. The Red Army opted for this option and it was probably influenced by the Soviet philosophy on combining artillery and AT forces at the tactical level. The Wehrmacht and the US Army opted for a 105mm standard. They felt, based mainly on WWI experience, that the 105mm howitzer delivered a much heavier and more damaging shell despite being heavier and having less range than the guns.[3] The British compromised between both positions with their excellent 25-pdr (87mm) field gun.

On the Soviet-Axis front in WWII, hindsight showed that the 105mm howitzer proved to be a better choice than the 76mm gun in the light divisional artillery role. There were several key reasons for this:

- Although the 76mm field gun was better suited to fighting tanks than a larger howitzer, the tactical concept of using divisional artillery (which was trained and equipped for artillery support operations) in an AT role was fundamentally flawed in many respects. As tank design rapidly improved, larger and more powerful AT guns evolved to deal with this threat whilst still maintaining the prerequisites required for good AT guns. These prerequisites are: high muzzle velocity, low profile, flat trajectory and excellent optics (designed for the job) with crews to match.[4] At the same time the artillery pieces needed to destroy the same tanks became progressively bigger and taller, more expensive in both material and personnel terms, and ever more vulnerable. In addition the optics needed to engage tanks in long range direct fire were deficient in even heavy artillery pieces. This divergence between artillery and AT gun capability and function became progressively wider as the war went on. For example, with the advent of Tiger and Panther tanks in 1942-43 it became suicidal to try and stop them with light or even heavy divisional artillery. This may explain some of the unprecedented kill ratios achieved by these tanks (and German tanks in general) against so called 'AT guns' on the East Front in WWII.[5] The Soviets would have suffered far fewer casualties if the German tanks had been up against specialist 76mm AT guns instead of 'general purpose' 76mm field guns.
- While artillery is fighting with and hiding from tanks it is not able to fulfil its primary role, which is providing artillery support for all other arms.
- Artillery regiments and their support infrastructures represent one of the most valuable military assets on the battlefield. It takes months to train and equip an artillery regiment, particularly in the use of more sophisticated artillery techniques such as firing by map reference etc. These assets are basically squandered if the artillery regiment ends up fighting tanks in direct fire exchanges. This is because tanks

[3] In the US this was the result of the 'Westervelt Board', a War Department board of review. They concluded the 75mm was no longer an effective caliber for this role and made far reaching recommendations, which became the basic guidelines for US artillery development for many years.

[4] Note however that high muzzle velocity, flat trajectory and good optics are attributes of medium to heavy anti- aircraft guns.

[5] Wolfgang Schneider, Tigers in Combat I, J.J. Fedorowicz Publishing Inc, Winnipeg, Canada, 1994, pp. 100, 144 and 145. For example, between 21st September 1942 and 19th April 1945 the 502nd Heavy Tank Battalion destroyed over 1 400 tanks and over 2 000 guns for the loss of only 107 Tiger I tanks. This equates to an incredible 19 guns lost per tank, even if we assume all the Tigers were lost to artillery/AT guns! A large very proportion of these guns were 76mm divisional guns working as AT guns. These figures are particularly relevant because the 502nd Heavy Tank Battalion achieved these figures while mostly defending (or conducting local counterattacks), so almost all the Soviet losses were tactical. I.e. they were the result of direct combat and not the result of capturing large caches of enemy weapons.

(and specialist AT guns) are specifically designed for this type of combat while artillery is comparatively vulnerable and best suited to indirect fire and combat support.[6]

- The superior range of guns over howitzers is only significant if the artillery organisation is capable of effective indirect fire operations, which was a major weakness of the Red Army's artillery arm throughout WWII. The inability of most Red Army artillery units and supporting HQs to carry out flexible and responsive indirect fire operations was particularly acute from 1941-43. Possibly the Red Army artillery units during this period didn't last long enough to become proficient in indirect fire operations because their attrition rate was always too high fighting tanks!
- The range difference between 76mm guns and 105mm gun-howitzers was not large and the gap progressively closed with new designs. In June 1941 the 10.5cm le FH 18M could range out to 12 325 metres while the 76mm M1939 (USV) gun could reach 13 290 metres. In 1942 the 10.5cm le FH 18/42 range extended to 12 700 meters, and the 10.5cm le FH 42 to 13 000 meters.[7]
- The need for a much heavier and more damaging shell was valid. The average 105mm high explosive (HE) round was around 2.4 times heavier than the average 76mm HE round and consequently did far more damage, particularity on fortified or entrenched positions. The 105mm round could destroy strong points that the 76mm round could not penetrate. In addition the superior fragmentation (shrapnel) effect of the 105mm round meant it was considerably better at destroying concentrated enemy infantry attacks.
- The 105mm rate of fire was not significantly less than the 76mm as both rounds were usually 'fixed rounds' and normally carried and loaded by one man.[8]
- On average the weight of the 105mm howitzer was only 1.2-1.4 times more than the 76mm gun. Man handling both types was difficult. In motorised formation with prime movers the weight difference was negligible and even in horse drawn units it was not significant.

For the above reasons the German (and US) Army standardised on 105mm light field howitzers for their light divisional artillery, and subsequently 105mm howitzers formed the backbone of the German field artillery during WWII. In June 1941 the Germans had three models of 105mm howitzer in front line service. These were the 10.5cm le FH 16, the 10.5cm le FH 18 and the 10.5cm le FH 18M.

The 10.5cm le FH 16 (10.5cm *leichte Feldhaubitze* 16) from Rheinmetall was introduced during WWI to provide a partner piece for the 7.7cm FK 16. The two weapons used the same carriage. The le FH 16 originally evolved from the le FH 98/09 L/16 designed by Krupp.[9] During the interwar years the le FH 16 underwent some improvements to the breech mechanism, leading to some sources changing the designation to the le FH 16nA. By 1939 the le FH 16 was bordering on obsolescence, but it still had a very respectable performance. Weighing 1 450 kg in action, it could fire a 14.8kg HE round out to 9 225 metres. Some sources mention how heavy the le FH 16 was, presumably as an indication of its obsolescence by 1939. This is odd when one considers that the latest Soviet 76mm gun (the M1939 (USV)) weighed 1 480 kg in action and is commonly praised for its lightweight design. The 76mm M1939 (USV) gun became the standard Soviet light artillery piece until 1942-43. By June 1941 the le FH 16 had been mainly relegated to second line divisions and training units. However artillery batteries equipped with le FH 16s continued to appear in the odd first line division until the end of the war.

We now come to what were probably the most important German artillery pieces in WWII; the 10.5cm le FH 18 and the 10.5cm le FH 18M. The 10.5cm le FH 18 (10.5cm *leichte Feldhaubitze* 18) was developed by Rheinmetall in 1929-30 and entered service in 1935. The le FH 18 was of orthodox design with a split trail carriage, folding spades, and wood spoked or pressed steel wheels and solid tyres. It used the split recoil system first used on the le FK 18 (see above). The le FH 18 soon established a reputation as a reliable and stable weapon that was easy to handle. As it turned out the le FH 18 was one of the few German weapons able to function relatively normally in the Russian winter of 1941. By September 1939 almost 5 000 were in service and many had been exported to a number of European countries. On 1st June 1941 the Wehrmacht had 7 076 10.5cm le FHs in its inventory and approximately 4 300 of these weapons were committed to Operation

[6] It is noteworthy that on occasion the British army in the Western Desert was forced to use their 25-pdr (87mm) field guns against German tanks. However, whenever and wherever sufficient specialist AT guns became available (such as the 6-pdr AT gun), the artillery unit was withdrawn to fulfil its primary and best suited function.
[7] J. Engelmann, German Light Field Artillery 1933-1945, Schiffer Military History, Atglen, PA, 1995, p. 47.
[8] A 'fixed round' is one where the projectile and cartridge are fixed together and the whole round is manipulated and loaded as a single item. Heavier artillery often used 'separate loading' rounds, 'semi-fixed' rounds, and 'bagged charges'.
[9] For this reason some sources mistakenly credit Krupp for the le FH 16, but the two weapons were quite different.

Barbarossa up to 4th July 1941.[10] The large majority of these howitzers were le FH 18s, which is why this weapon's OCPC is used in table Ger Res Database 1.

While the le FH 18 was satisfactory in most respects, the weapon's maximum range of 10 675 metres was considered inadequate. The Soviet 76mm M1939 (USV)'s maximum range was 13 290 metres (although the Soviet round was 2.4 times lighter). This spurred the Germans to improve the le FH 18 by fitting a muzzle brake and adjusting the recoil system to enable the use of a more powerful charge. The result was the 10.5cm le FH 18M (*Mundungsbremse*), which was outwardly identical to the le FH 18 apart from the muzzle brake, and with a maximum range of 12 325 metres. A significant but unknown number of le FH 18Ms had already been issued by June 1941.

The 10.5cm le FH 18 is another German weapon which commonly comes under criticism for apparently being too heavy at 1 985 kgs.[11] However a comparison with contemporary light divisional artillery is revealing. The British 25-pdr (87mm) field gun weighed 1800 kg in action, fired a 11.3 kg shell out to 12 250 metres, and entered service in 1939/40.[12] The US 105mm M2A1 howitzer weighed 2 259 kg in action, fired a 15 kg shell out to 11 160 metres, and entered service in 1940.[13] Both these weapons are considered classic artillery designs; both were produced in the thousands and are rightly considered to have been excellent designs. This author is yet to find a source that criticises either design for being too heavy for their primary role (light divisional artillery). However we can see from these figures that both artillery pieces are of comparable weight or are heavier than the le FH 18M, have less maximum range, and have comparable or significantly less weight of shot. The only real difference between the German and Allied weapons is that the le FH 18 was fitted spoked or pressed steel wheels and solid tyres, while the 25-pdr and M2A1 only ever had pneumatic tyres for purely motorised traction. It appears that the less modern appearance of le FH 18, and stories of Germans attempting to manhandle it though Russian mud, have distracted commentators from its true capabilities. In actuality, attempting to manhandle any gun weighing close to two tons through mud would be very difficult, regardless of the gun's appearance or the type of wheels fitted.

The German 10.5cm le FH 18 howitzer does however have one truly remarkable claim to fame. This is that it almost certainly inflicted more military casualties than any other singular weapon system in human history! This is because the Soviet-German war from 1941 to 1945 was easily the most costly military campaign in history, with the Soviets suffering considerably more military casualties than the rest of the WWII combatants combined (and far more than all the casualties sustained from WWI).[14] At the same time it has been shown that during WWII the large majority of military casualties were inflicted by artillery, and the most common German howitzer fielded during the conflict was the 10.5cm le FH 18/18M; the backbone of the Wehrmacht's field artillery.[15] Hence without even considering the Western Allied casualties during WWII, the 10.5cm le FH 18 howitzer easily inflicted more military casualties than any other weapon system ever built.

iv. Recoilless (RCL) Guns

The first known recoilless (RCL) gun was the Davis Gun (ca 1910). It used two opposing barrels, one with the projectile and the second with 'counter-shot' consisting of grease and fine lead shot. The Davis gun saw very limited service during WWI with the British Royal Naval Air Service, but obvious problems with the counter-shot's dispersal meant it was never practical as a ground gun.[16] RCL weapons only became practical with the advent of using a high velocity stream of gas as the counter-shot to the projectile. Using this basis,

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[10] J. Engelmann, German Artillery in WWII, Schiffer Military History, Atglen, PA, 1995, p. 109.
[11] E.g., C. Chant, Artillery, Amber Books, Summertime Publishing Ltd, London, 2005, p. 56. Chant states "This was a Rheinmetall design that proved sound but too heavy for the mobile role intended" and "the obvious bulk and weight of the trail legs and spades that combined to make this howitzer much too heavy for the mobile field role".
[12] Purnell's Illustrated Encyclopedia of Modern Weapons and Warfare, Phoebus Publishing Company, London, 1978, part 48, p. 956. Also, I. Hogg, P. Sarson, T. Bryan, Artillery in Colour 1920-1963, Blandford Press Ltd, Poole, UK, 1980, Appendix 1, p. 182.
[13] Purnell's Illustrated Encyclopedia of Modern Weapons and Warfare, Phoebus Publishing Company, London, 1978, part 32, p. 638. Also, I. Hogg, P. Sarson, T. Bryan, Artillery in Colour 1920-1963, Blandford Press Ltd, Poole, UK, 1980, Appendix 1, p. 182.
[14] Modern Russian sources state Red Army and Navy losses in the Great Patriotic War with Germany to have been 29 592 749 killed, wounded and missing. G.F. Krivosheev , et al, Soviet Casualties and Combat Losses in the Twentieth Century, Edited by Colonel General G.F. Krivosheev, Greenhill Books, London, 1997, pp. 96-97, table 69.
[15] In WWII artillery inflicted more casualties than any other weapon type. It was responsible for 50 to 65% of casualties in most WWII engagements. For the US Army in the Mediterranean theatre, artillery and mortars were responsible for 62% of hospitalized and 65% of KIA. In the West European theatre the figures are 59% and 52% respectively. F. A. Reister, Medical Statistics in World War II, Office of The Surgeon General, Department of the Army, Washington, 1973.
[16] The Davis gun was named after its inventor, Commander Cleland Davis of the US Navy. Although built under licence in Britain and although a great deal of development work took place, there is no record of the Davis gun ever being used in action.

Rheinmetall initiated a development programme in the 1930s to develop a RCL weapon for aircraft. By 1937 recoilless field guns were being tested with obvious potential applications in mountain and airborne units.

The world's first operational recoilless field gun was the 7.5cm LG 40 (7.5cm *Leicht Geschutz* 40). The 'light gun' designation was purely a security measure adopted to conceal the fact that these were recoilless guns. Another common designation for this weapon is the LG 1. Both Rheinmetall and Krupp were awarded development contracts but ultimately only the former was accepted for service. It was built in four parts, each capable of parachute descent without the need for special packing. The 7.5cm LG 40 made extensive use of light alloys, had a horizontal sliding breechblock, and was mounted on two small aircraft-type wheels. Its total weight in action was 145 kg and it could fire a 5.83 kg round out to 6 800 metres. The weapon's first deployment in action was on Crete in 1941 with German airborne forces. By June 1941 the Wehrmacht had around 190 7.5cm LG 40s in its inventory, but the only units known to have this weapon were the 7th Flieger Division and the 1st Luftlande Sturm Regiment. These units were transferred to the East Front from September to November 1941 with an authorised strength of 24 7.5cm LG 40s.

A much more important RCL weapon was the 10.5cm LG 40 (10.5cm *Leicht Geschutz* 40), otherwise known as the LG 2. In this instance it was the Krupp design which entered service first as the LG 40 (or LG 2/Kp), while the Rheinmetall design entered service later as the LG 42. The 10.5cm LG 40 used a side-swinging breech, a short box trail, a small gun shield and pneumatic tyres for motorised traction. The LG 2 also had a refinement absent from the LG 1. This consisted of vanes welded to the inside of the jet nozzle and curved in the opposite direction to the rifling in the gun's barrel. This was to balance the torque imparted on the very light weight carriage when the projectile engaged with the rifling in the barrel; a defect in previous RCL weapons. The whole equipment could be dismantled into five parachute containers, or it could be dropped assembled and packed in a special shock-absorbing crate. The 10.5cm LG 40's weight in action was 388 kg and it could fire a 14.8 kg round out to 7 950 metres. This impressive performance remained unmatched by any Allied RCL weapon during WWII and was only surpassed with the advent of the US 105mm M27 (RCL) which entered service in 1953.[17] The 10.5cm LG 40 also first saw action on Crete in 1941 with German airborne forces, and by June 1941 there were 70-80 available in the Wehrmacht's inventory. They were issued to German airborne units in small numbers, and on 22nd June 1941 a motorised recoilless gun battery with four 10.5cm LG 40's was present in the 1st Bicycle Battalion in the 1st Cavalry Division (2nd Panzer Group).

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b. Medium to Heavy Divisional Artillery (122-155mm Howitzers)

Medium to heavy divisional artillery is usually allocated to an artillery regiment in a division, and is normally used in the direct or indirect fire artillery support role.[18]

In June 1941 the German Army had two principal types of 150mm howitzer in service with their divisions: the 15cm sFH 37(t) and the more common 15cm sFH 18. Although designated as 15cm calibre, both howitzers were actually 149.1 mm in calibre.

The 15cm sFH 37(t) was the German designation for the Skoda 149mm Model 37 (K4) Howitzer.[19] The Skoda Model 37 (K4) had been under development since the mid-1930s and was accepted for service in the Czechoslovakian Army in 1937. It was an excellent modern design which was in numerous ways ahead of many of its contemporaries. It was relatively mobile with pneumatic tyres for motorised traction, used a modern split trail carriage enabling a wide 45 degree angle of traverse, weighed only 5 200 kg in action, and could fire a 42 kg shell out to an impressive 15 100 metres. These specifications meant the Skoda Model 37 (K4) was easily one of the best medium to heavy howitzers in the world in 1939. When the Germans marched into Czechoslovakia they captured several examples of this new howitzer for the Czech Army. So impressed were they by its performance that they immediately retained the production lines and pressed the howitzer into service in the German Army with the designation sFH 37(t). By June 1941 the 15cm sFH 37(t) was present in several

[17] The 105mm M27's weight in action was 288 kg and it could fire a 14.5 kg round out to 8 505 metres. Purnell's Illustrated Encyclopedia of Modern Weapons and Warfare, Phoebus Publishing Company, London, 1978, part 40, p. 796.

[18] Depending on the army, 149-155mm howitzers are sometimes also allocated to corps level support units. This was the case in the German Army where the 15cm s FH 18 and 15cm s FH 37(t) were also allocated to motorised Heavy Field Howitzer Battalions and attached directly to Corps HQs. Also (depending on the source) some countries refer to howitzers with calibres up to 155mm as medium artillery as opposed to heavy artillery. In order to ensure there is no confusion, 'medium divisional artillery' is included in this category.

[19] The Germans also commandeered Skoda 149mm Model 25 Howitzers and designated them 15cm s FH 25(t). These old howitzers were largely withdrawn from frontline use by June 1941 and most were relegated to artillery training units. The Model 25 did continue to equip Slovak corps artillery units in the Slovak Army's I Field Corps which supported Operation Barbarossa in 1941.

German divisions, and equipped the I. /77, 154 and 737 Motorised Heavy 150mm Field Howitzer (Corps) Battalions.

The backbone of the German's medium to heavy divisional artillery was provided by the 15cm sFH 18 (15cm *schwere Feldhaubitze* 18). The 15cm sFH 18 was developed in the period 1926 to 1930 and brought into service in 1933-34. The specification was supplied to both Krupp and Rheinmetall-Borsig and the final product was an amalgamation of both designs: the carriage designed by Krupp and the gun by Rheinmetall. The gun was conventional with a horizontal sliding block breech, split trail carriage, pressed steel disc wheels with solid tyres, transverse leaf spring suspension, and two spring balancing presses either side of the barrel to assist rapid elevation and depression. It was designed for either horse or vehicle traction. Horse traction involved two loads: the barrel assembly was withdrawn and placed on a separate four wheeled transport wagon while the carriage formed the second load. Motorised traction was a single load with the barrel disconnected and winched back to the end of the cradle where it was clamped. The 15cm sFH 18 displayed the usual '18' artillery design features with the recoil and recuperator housings being located under and over the barrel respectively. This facilitated easy replacement, lowered the centre of gravity of the howitzer, and allowed better heat dissipation from the recuperator. The sFH 18 was quiet heavy at 5 512 kg in action, and it could fire a 43.5 kg shell out to 13 325 metres.[20] One excellent feature was the exceptionally wide angle of traverse when emplaced. The carriage design enabled the gunners to traverse up to 64 degrees without having to move the carriage spades.

By June 1941 the 15cm sFH 18 was the standard heavy artillery piece in most German divisions as well as the corps assigned motorised heavy 150mm field howitzer battalions. Although heavy, it was of sound design, and proved very sturdy and reliable during periods of prolonged combat. It is reasonable to state the sFH 18 was one of the best weapons in this class in the world from 1933 to 1941-42; until it was surpassed by the US 155mm M1 howitzer and the British 5.5in field gun. Having said this, the 15cm sFH 18 was not an exceptional design and it was at best comparable in overall performance to the latest Soviet howitzers in this class, such as the Red Army's new 152mm M1938 (M-10). Of course it should be remembered that the 15cm sFH 18 entered service six years before any of the aforementioned competitors.[21]

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c. Heavy Corps Artillery (100-152mm Guns-Cannons)

Heavy corps artillery is usually allocated to a corps artillery regiment or battalion, and is normally used in the indirect fire artillery support role. The value of these weapons and crews is such that they should not be used for direct fire unless this is unavoidable. For the purposes of this discussion 'guns' and 'cannon' are the same, and is usually only a result of a particular country's use of the term.

In June 1941 the Germans employed two calibres of weapon in this category: 10cm and 15cm. The 10cm gun was the s 10cm K18 (*schwere* 10cm *Kanone* 18). The 10cm K18 (in fact a 105mm calibre weapon) was developed as a partner weapon to the 15cm sFH 18. Its development and entrance into service paralleled that of the 15cm sFH 18 as described above. The K18 used the same Krupp carriage as the sFH 18 and another gun designed by Rheinmetall. This gun used a one piece 52 calibres (length) barrel inside a jacket compared to the sFH 18's 29.6 calibre barrel. It used the same type of horizontal sliding block breech. Thus apart from the barrel dimensions, the two artillery pieces were practically identical. The K 18 was also designed for either horse or vehicle traction in exactly the same way as the sFH 18. In the event however the K 18 was almost always issued to motorised and panzer divisions (usually only one battery), or to motorised corps heavy artillery battalions. The K 18 has always been criticised as being too much gun for too little shell power, and there is considerable justification for this. It was very heavy for its calibre at 5 642 kg in action and yet only fired a 15.1 kg HE shell. However it was an extremely accurate gun with a muzzle velocity of 835 meters per second, and an impressive maximum range of 19 075 metres. This means the K18 was very suited to counter-battery fire and long range interdiction, and one can only assume this was the army's and designer's intent. On 22nd June 1941 the German Army had 760 10cm *Kanone* in its inventory and of these 428 (including 416 10cm K18s) were initially committed to support Operation Barbarossa.[22]

[20] The s FH 18 was supplied with eight charges for varying ranges. However the last two charges were so erosive they could only be fired under special authorization. The optimal range for the s FH 18 appears to be around 11 400 meters. These erosive level charges also apply to many other types. Caution should therefore be used wherever maximum range is being used to compare detail performance, particularly in heavier artillery weapons. Data from I. V. Hogg, German Artillery of WWII, Greenhill Books, London, 1997, p. 64.

[21] The sFH 18 served for many years after WWII in the Albanian, Bulgarian, Czechoslovakian and Portuguese Armies. Amazingly it was still in service in the 1980s in parts of Central and South America; a service life of almost half a century.

[22] On 22nd June 1941 the German Army had 30 motorised heavy 100mm gun battalions equipped with 360 10cm K18s, and 13 motorised mixed heavy artillery battalions with 52 10cm K 18s. Of these, 28 heavy 100mm gun battalions and 12 mixed

In the 15cm heavy corps artillery category the Germans fielded three artillery pieces for front line operations in 1941. These were the 15cm K 18 (15cm *Kanone* 18), the 15cm K 39 (15cm *Kanone* 39), and the 15cm SK C/28M (15cm *Schiffskanone* C/28 in *Morserlafette*).[23]

The 15cm K 18 was developed by Rheinmetall from 1933 and entered service in 1938. On balance the 15cm K 18 cannot be said to be one of Rheinmetall's better designs. It used a box trail carriage, the usual '18' artillery design features relating to the recoil and recuperator housings, a 55 calibre length barrel, and a horizontal sliding block breech. The 15cm K 18 split into two loads for motorised traction: the barrel assembly on a four wheel trailer and the carriage assembly supported on a small limber. Under the carriage assembly was slung a two-piece firing table. When emplaced the gun's carriage was installed on the firing table enabling 360 degree traverse. Without the firing table the 15cm K 18's traverse (on a fixed carriage) was only 11 degrees. The 15cm K 18 was very heavy at 12 760 kg in action and it was a rather slow and laborious process to emplace the gun. Its main saving grace was its very long reach; it could fire a 43 kg shell out to 24 500 metres. This meant it significantly outranged all but the very heaviest and largest Soviet artillery during WWII. On balance the 15cm K 18 was never popular with the German Army and consequently relatively few were produced. Only 101 had been manufactured by 1943 when production ceased, and only 30 were used on 22nd June 1941 (in four battalions) to support Operation Barbarossa.

In 1938 Krupp developed a commercial 15cm Cannon to meet an order from the Turkish Army. However by September 1939 only two had been delivered and the German Army promptly purchased all outstanding guns and ordered a further batch. This gun became known as the 15cm K 39 (15cm *Kanone* 39). The K 39 was designed as a dual purpose field gun and coast defence gun. For the latter role the entire gun could be mounted on a large special firing platform which enabled 360 degree traverse. In the more common field gun role, the 15cm K 39 used a conventional modern split trail carriage with disc wheels suspended from leaf springs. The gun employed a hydraulic recoil buffer in a cradle beneath the barrel, a hydro pneumatic recuperator in a cylinder above the barrel, and two hydro pneumatic equilibrators on either side of the barrel. Similarly to other German guns of this class, the 15cm K 39 split into two loads for motorised traction: the barrel assembly on a four wheel trailer and the carriage assembly supported on a small limber. On balance the 15cm K 39 was a significantly better design than the 15cm K 18 and one wonders why the German Army persisted with the latter after 1940. The K 39 was lighter than the 15cm K 18 (12 200 kg in action) and fired the same 43 kg shell out to 24 700 metres. Only 24 15cm K 39s were available to support Operation Barbarossa on 22nd June 1941 in four battalions, and ultimately only 64 were produced during WWII (with 13 being produced in 1942).

The last weapon in this class considered here was an extemporary equipment constructed by mounting the 15cm SK C/28 naval gun (15cm *Schiffskanone* C/28) on the carriage of the 21cm *Morser* 18 (described in the next section). The latter carriages were standing idle due to shortages of 21cm barrels, so eight spare SK C/28 guns were used to create the 15cm SK C/28M (15cm *Schiffskanone* C/28 in *Morserlafette*). The SK /28 had a barrel 55 calibres long and on the *Morser* 18 carriage it could fire a 43 kg projectile out to 23 700 meters. All eight 15cm SK C/28Ms were assigned to the 625th Motorised Heavy 150mm Gun Battalion, 16th Army (Army Group North), on 22nd June 1941. The guns were employed in this fashion until sufficient *Morser* 18 barrels became available.

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d. Super Heavy Corps Artillery (200mm Plus; Guns, Howitzers and Mortars)

Super heavy corps artillery is usually allocated to a corps artillery regiment or battalion, and is normally used in the indirect fire artillery support role.

During WWII the Germans produced a plethora of different weapon types in this category, although the total number produced was still relatively low. The calibres used for super heavy corps artillery were 21cm, 24cm, 30.5cm, 35.5cm and even 60cm.

For the Wehrmacht up to 1942/43, by far the most important calibre of super heavy corps artillery was 21cm. This was because of one particular artillery piece, namely the 21cm Mrs 18 (21cm *Morser* 18). The Germans often referred to their heavy howitzers as 'mortars' because of the high angles of elevation used by these weapons when employing plunging fire.[24] The 21cm *Morser* 18 is accordingly also sometimes referred to as the 21cm *Haubitze* 18. If there is a list of the top ten artillery designs ever produced, then the 21cm Mrs 18

artillery battalions (384 10cm K18s in total) were initially committed to support Operation Barbarossa. An additional 32 K18s were distributed amongst selected motorised divisions.

[23] A handful of 15cm K 16s (15cm Kanone 16s) were also still in service in 1941. These guns dated from 1917, and 28 guns were still in service in 1939. A few K 16s remained in service until 1945, principally in reserve and training units.

[24] By strict definition 'mortars' are any piece of ordnance restricted to firing at angles of elevation between 45 and 90 degrees to the horizontal plane.

would definitely be included. This is because of its outstanding carriage design, and because it was the first weapon to enter quantity production that employed what became known as the 'dual recoil system'.

Krupp started developing the 21cm Mrs 18 in 1933 alongside its partner piece, the 17cm *Kanone* 18 which used exactly the same carriage.[25] The 21cm Mrs 18 had a 31 calibre length barrel, employed a horizontal sliding block breech, and could fire a heavy 113kg shell out to 18 900 metres. The carriage was a box trail structure with a dual recoil. This meant the barrel recoiled in its cradle in the usual way, but in addition the top carriage (which carried the gun and the cradle) also recoiled for 1.25 metres along the top of the lower carriage. Both systems were hydro pneumatic, and the effect of this dual system was to damp out recoil stresses so effectively that on firing the lower carriage barely moved at all. In addition, the carriage carried an integral platform slung underneath that could be lowered to the ground. The entire equipment could then be jacked up such that almost the entire weight was held on the platform on three small castor wheels, while the front carriage wheels were held off the ground. The rear of the carriage was then supported by a spade float for small traverses. For large amounts of traverse a rear castor-wheel jack was activated to lift the trail and spade float clear of the ground, after which two men could easily swing the whole weapon through 360 degrees. The system was so stable that the gun could be fired as normal whilst fully jacked up. In addition the entire equipment weighed only 16 700kg in action and could be moved in one load using motorised traction. For long distances the barrel assembly could be removed (for two loads), but the detailed design was such that combining and separating the two loads involved a minimum of time and labour. On 22nd June 1941 the Germans had 388 21cm Mrs 18s in their inventory, of which 291 were deployed to support Operation Barbarossa. Out of a total of 29 motorised heavy 210mm howitzer battalions and three motorised heavy 210mm howitzer batteries in the German Army on 22nd June 1941, all but one battalion was committed to attack the USSR. Only the II./115 Heavy 210mm Howitzer Battalion was missing: it was attached to the Afrika Corps (D.A.K). There is little doubt that the excellent design of the 21cm Mrs 18 contributed significantly to the ability of these heavy 210mm howitzer battalions to almost keep pace with the rapidly moving panzer corps in the first months of the campaign in the East.

The second 21cm super heavy corps artillery piece fielded by the Wehrmacht in 1941 was the 21cm K 39 (21cm *Kanone* 39). This weapon was originally designed and built by the Czechoslovakian Skoda works (designated 210mm K52) to meet an order from the Turkish Army. Apparently two guns were delivered to Turkey before the war intervened and the German Army took over the balance of the contract as well as the production facilities. In German use the guns were modified with a muzzle brake; the largest German artillery piece to be fitted with such a device. In addition the gun was unusual in German service in that it used bagged charges as opposed to cased cartridges. The 21cm K 39 was conventional in design with a box trail structure that revolved on a fixed ground platform. The equipment was extremely heavy at 39 800 kg in action, and had to be split into three loads for transport: the barrel, the carriage and the ground platform with turntable. Apparently it took six to eight hours to emplace the gun, a large part of which was devoted to digging in and anchoring the gun platform. Once emplaced the gun was effective: it could fire a 135 kg shell out to a massive 34 000 metres. This outranged anything in the Soviet artillery arsenal and was the longest range artillery piece used in WWII with a calibre of 21cm or less.[26] On 22nd June 1941 there were only 12 21cm K 39s deployed to support Operation Barbarossa in the 767 and 768 Motorised Heavy 210mm Gun Battalions.

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In June 1941 the Germans also deployed a few 24cm super heavy corps artillery pieces. The first of these was the 24cm H 39 (24cm *Haubitze* 39). This was yet another heavy artillery piece ordered by Turkey before the war and which the German Army took over. The 24cm H 39 was another Skoda design (designated 166/600), a companion piece to the 21cm K 39. The 24cm H 39 used a similar a box trail structure to the 21cm K 39, also used bagged charges and was separated into three loads for motorised towing. The howitzer weighed 27 000 kg in action and could fire a 166 kg shell out to 18 000 meters. On 22nd June 1941, only eight 24cm H 39s were deployed to support Operation Barbarossa in the I./814 and II./814 Motorised Heavy 240mm Howitzer Battalions.

Another 24cm Skoda design to equip the German Army was the Skoda 240mm Model 16 Gun. Six of these guns were purchased from the Czech War Ministry, presumably before the Germans marched into Czechoslovakia. They were designated 24cm K (t) (24cm *Kanone* (t)) in the German Army. The 24cm K (t) design dated back to WWI, and by WWII they were bordering on obsolescence. These guns split into four heavy loads for motorised traction and originally special mobile 'artillery generator autos' were used for towing. By

[25] The 17cm K 18 in Mrs Laf was introduced in to service in 1941/42. In 1942 production of the 21cm Mrs 18 ceased to concentrate on production of the much longer range 17cm K 18.
[26] The closest Allied weapon was the US 8 inch (203mm) M1 gun with a maximum range of 32 585 metres, but this weapon fired a lighter shell, only entered service in 1944 and only 109 were manufactured.

1941 however these were all replaced by Sd Kfz 9 (18t) halftracks. The 24cm K (t) was extremely heavy and cumbersome, weighing 86 000 kg in action. Installation was very laborious and involved digging a large ditch into which the gun's two firing platforms were placed. Once emplaced the 24cm K (t)'s performance was respectable: it could fire a heavy 161 kg shell out to 29 875 meters.[27] The 24cm K (t) was definitely not suited to modern mobile warfare, but it still gave sterling service as a siege weapon pounding Leningrad and Kronstadt for long periods from 1941 to 1944. On 22nd June 1941 only six 24cm K (t)s were deployed to support Operation Barbarossa; all in the II./84 Motorised Heavy 240mm Gun Battalion.

The last significant 24cm super heavy corps artillery piece (in the Wehrmacht in 1941) was a quiet outstanding German design. This was the 24cm K 3 (24cm *Kanone* 3). Rheinmetall-Borsig started designing a very long range gun in 1934 with the first examples appearing in 1938. The gun had an exceptionally long barrel at 54.6 calibres, used a box trail carriage with a four wheel bogie at the front, and employed a similar type of dual recoil system as that found in the 21cm Mrs 18. This combination enabled the 24cm K 3 to fire a 151.4 kg shell out to the staggering range of 37 500 metres. This performance means the 24cm K 3 completely outranged any comparable (in calibre) artillery piece in WWII which was not either a long range railway gun or mounted on a large warship. The price paid for this performance was naturally size and weight, with the 24cm K 3 weighing 54 866 kg in action and splitting into six loads for motorised transport. However the designers had made every effort to render the gunners' work easier. Assembly was done without any cranes or gins using an ingenious system of inclined ramps, guide rails and runways. Power for assembly winches, integral to the gun's equipment, was provided by a generator, also integral with the equipment. The result was that 25 men could assemble the complete equipment from transport mode to firing mode in 90 minutes. This may seem a long time to bring a gun into action from transport, but it is an order of magnitude faster than any other gun of this size and weight during WWII. Only ten 24cm K 3s were ever manufactured by Krupp (who interestingly were not the gun's designers), with four delivered in 1942 and the last two delivered in 1944. Thus on 22nd June 1941 there were only four 24cm K 3s deployed to support Operation Barbarossa; all in two batteries of the I./84 Motorised Heavy 240mm Gun Battalion.[28]

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In addition to the motorised heavy howitzer-gun battalions, the Germans also fielded a handful of motorised super heavy howitzer battalions. These battalions were equipped with 30.5cm, 35.5cm and 60cm calibre artillery pieces.

The 30.5cm weapon used was the Skoda 305mm Model 16 Howitzer, a partner piece to the Skoda 240mm Model 16 Gun (above). It shared the same prefabricated firing platform and carriage, although the Model 16 Howitzer was far lighter than the Model 16 Gun. In 1939 the Germans seized 17 Skoda 305mm Model 16 Howitzers still in Czechoslovakian service. Despite their bulk, weight and being a WWI design, the Germans decided to use them in super heavy howitzer batteries under the designation 30.5cm Mrs (t) (30.5cm *Morser* (t)). A further six Skoda 305mm Model 16s were seized in Yugoslavia in 1941. The 30.5cm Mrs (t) had a stubby 12 calibres long barrel, so its maximum range was only 12 300 metres. On the plus side the standard 289 kg shell was very effective at destroying large fortified structures. The 30.5cm Mrs (t) was not suited to modern mobile warfare with the result that their service was mainly limited to siege warfare: mainly against Leningrad and later Sevastopol. On 22nd June 1941 there were 16 30.5cm Mrs (t) deployed in support of Operation Barbarossa; all in the 624, 641 and 815 Motorised Super Heavy Howitzer Battalions.

In response to a 1935 German Army request for a modern super heavy howitzer, Rheinmetall-Borsig started designing the 35.5cm H M1 (35.5cm *Haubitze Morser* 1) in 1936. This was essentially the howitzer counterpart to the 24cm K 3 (above). The 35.5cm H M1 entered service in 1939 and was a thoroughly up to date piece of equipment. It used the same dual recoil system and two part carriage as the 24cm K 3, which enabled 360 degrees of traverse. Its performance was also impressive: it could fire a standard 575kg HE shell out to 20 850 metres, or it could fire the extremely destructive *Rochling-Granate* 42 concrete penetrating projectile which weighed no less than 926 kg. The 35.5cm H M1 was naturally very heavy and large, weighing 78 000 kg in action. However the ingenious design meant the six transport loads could be assembled in two hours using the same mechanisms used to assemble the 24cm K 3. This used a generator on an additional halftrack (a seventh load) to generate power for the winches etc, but no additional cranes or gins were required. The generator also provided power for the gun's elevating gear, traverse and ammunition hoist during operations, although the gun could be manually loaded and operated if required. Only eight 35.5cm H M1 were ever manufactured, with five

[27] W. Fleischer, German Heavy 24 cm Cannon, Schiffer Military/Aviation History, Atglen, PA, 1998, p. 21.
[28] The last battery of the I./84 Battalion was equipped with two 24cm *Kanone* L/46s. These were semi-experimental weapons made by Krupp and introduced in 1937. They resembled a scaled up version of the 15cm K 39 with a box trail as opposed to a split trail. Details of this weapon are scarce, but available sources indicate a weight in action (with firing platform) of 45 200 kg, a HE shell weight of 180 kg, and a maximum range of 32 000 metres.

delivered in 1942, one delivered in 1943, and the last one delivered in 1944. Thus during 1941 there was only one 35.5cm H M1 deployed in the East, and it was in the 1st Battery/ 641 Motorised Super Heavy Howitzer Battalion.

We now come to the heaviest field artillery used by the Wehrmacht in WWII, excluding railway guns. These were the monster 60cm *Gerat* self-propelled howitzers. Although these weapons constituted the heaviest artillery pieces ever to be placed on tracked chassis and could therefore be considered AFVs, the term 'self-propelled' would be stretching the point in this case. This is because their bulk and weight made anything but the shortest moves under their own power very difficult. Additionally, in June 1941 all four available 60cm *Gerat* were assigned to the 833 Motorised Super Heavy Howitzer Battalion, and are thus classified as super heavy corps artillery in this discussion.

The 60cm *Gerat* stemmed from a mid-1930s army request for an artillery system capable of destroying any of the French Maginot Line forts. Studies by Rheinmetall-Borsig soon showed that this would require super heavy calibres, and conventional platform type carriages would be much too heavy to be mobile or practical. It was therefore decided to mount short howitzer barrels on enormous self-propelled tracked chassis. This self-propelled version was ordered in June 1937, under the auspices of General Karl Becker of the Artillery, who was also involved in the development. For this reason the 60cm *Gerat* is also commonly known as the 60cm *Morser* '*Karl'* and the 60cm *Karlgerat*. Delivery of the six production vehicles took place between November 1940 and August 1941. These all had 60cm L/8.44 barrels and were designated 60cm *Gerat* 040. They were capable of firing a 2 170 kg concrete piercing shell 4 500 metres. This was considered too short a range tactically, so lighter 1 700 kg rounds were produced which could be fired out to 6 700 meters. All the 60cm *Gerat* available until 1943 used L/8.44 barrels and were 040s.[29] Unfortunately the 60cm *Gerat* 040 weighed 124 000 kgs in action so for strategic or operational moves it had to move by rail or road. For rail transport, two specially constructed railway wagons were used which suspended the 60cm *Gerat* 040 between them on large cantilever beams. For road transport the 60cm *Gerat* 040 was partially dismantled into four parts and transported on multi-axle, multi wheeled 'Culemeyer' trailers. For loading, erecting and dismantling the *Gerat* a separate 35 ton folding crane was needed in addition to four smaller cranes. Ammunition was also transported using Culemeyer trailers (ten rounds each) on roads, and using special *Munitionsschlepper fur Karlgerat* (armoured ammunition carriers based on Pz IV chassis) during cross country moves. Two of the latter vehicles were included for each 60cm *Gerat* 040 in the artillery battery.

So the question is, was the 60cm *Gerat* worth all the effort? Well there is no doubt the 60cm *Gerat* 040 was a weapon for siege warfare and was even classified as a 'self-propelled heavy siege mortar on tracked carriage' by the German Army. In this role its fire was indeed devastating: ground detonations caused craters 15 meters in diameter and 5 meters deep, whilst generating clouds of debris 300 metres wide and 170 meters high. In addition reports indicate that fortifications with 3.5 meters of reinforced concrete were easily smashed. For the German infantry and *pionier* troops who would otherwise have to overcome such obstacles under enemy fire, the 60cm *Gerat* was almost certainly worth the effort.

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e. Railway Artillery

The German Army had a penchant for heavy railway guns going back to WWI, and when the Wehrmacht began to rearm, railway guns were reasonably high on the list of priorities. The German railway guns of WWII generally fall into two groups: those built as part of a long term programme, largely very long range super guns, and those built in a crash programme (*Sofort-Programm)* begun in 1936. The object of the crash programme was to provide the army with a reasonable selection of heavy railway guns by 1939. It was successful because at the start of WWII the Germans had the most diverse, most modern and hence most powerful railroad artillery force in the world.[30] As the Germans continued to produce modern very long range railway guns until 1945 (particularly the excellent 28cm K 5 (E)), and the Allies had long since abandoned any serious development of these weapons, this status did not change much until the end of WWII. Table Ger RR Art shows the types of railway guns produced in the pre-war and war period, some key performance data, the total number produced,

[29] There is often confusion over the 60cm *Gerat* 040 and 041. In February 1941 discussions commenced in regard to increasing the range. In May 1942, 54cm L/11.5 barrels were ordered which would enable a 1 250 kg shell to be fired out to 10 400 metres. These new barrels were first installed in the existing *Gerats* in mid-1943, and these were then designated 60cm *Gerat* 041. However the barrels were interchanged as required until war's end. Additionally a total of six *Gerats* were manufactured during WWII and all were delivered by 1941: additional *Gerat* 041s were not manufactured after August 1941.

[30] Interestingly all the German pre-war and WWII railway guns were built by Krupp. By 1939 Krupp was unmatched anywhere in the world in the design and building of long range heavy railroad guns.

the number in service in June 1941, and the railroad gun deployment status on the East Front on 22nd June 1941.[31]

Table Ger RR Art								
German Railway Artillery, June 1941								
Weapon designation and name	**In 1936 crash prog**	**Weight in action, kg**	**Weight HE shell, kg**	**Max range, m**	**Number prod to 1945**	**Number avail, June 41**	**Year entered service**	**Deployed in the East, 22/6/41**
15cm K (E), (15cm Kanone in Eisenbahnlafette)		74000	43.0	22500	18	18	1937	3
17cm K (E), (17cm Kanone in Eisenbahnlafette)	yes	80000	62.8	27200	6	6	1938	
20cm K (E), (20cm Kanone in Eisenbahnlafette)		86100	122.0	37000	8	8	1940	
21cm K 12 (E), (21cm Kanone 12 in Eisenbahnlafette)		302000	107.5	115000	2	2	1939	2
24cm Th Br K (E), (24cm Kanone in Eisenbahnlafette 'Theodor Bruno')	yes	94000	148.5	20200	6	6	1939	
24cm Theodor K (E), (24cm Kanone in Eisenbahnlafette 'Theodor')	yes	95000	148.5	26750	3	3	1937	
28cm Kz Br K (E), (28cm Kanone in Eisenbahnlafette 'kurz Bruno')	yes	129000	240.0	29500	8	8	1937/38	4
28cm lg Br K (E), (28cm Kanone in Eisenbahnlafette 'lange Bruno')	yes	123000	284.0	36100	3	3	1937/38	3
28cm s Br K (E), (28cm Kanone in Eisenbahnlafette 'schwere Bruno')	yes	118000	284.0	35700	2	2	1938	
28cm Br N K (E), (28cm Kanone in Eisenbahnlafette 'Bruno neue')		150000	265.0	36600	3	2	1940	2
28cm K 5 (E), (28cm Kanone 5 in Eisenbahnlafette)		218000	255.5	62180	28	12	1936	10
38cm Siegfried K (E) (38cm Kanone in Eisenbahnlafette 'Siegfried').		294000	495.0	55700	4	4	1940	
40.6cm Adolf K (E), (40.6cm Kanone in Eisenbahnlafette 'Adolf').		323000	1030.0	42800	1		1942	
80cm K (E) (80cm Kanone in Eisenbahnlafette 'Gustav Gerat')		1350000	4800.0	38000	2		1942	

For the German FILARM model (database) there are three categories of railway artillery considered. These are 150-200mm calibre weapons, 200-280mm calibre weapons, and 380mm plus calibre weapons.

At the lower end were the 150-200mm calibre weapons. The problem with railway artillery in this calibre range is that the guns are arguably too small to be worth the trouble of a railway mounting. For example, the smallest railway gun produced by the Germans was the 15 cm K (E) and although it was an efficient design the gun's performance was slightly inferior to the 15cm heavy corps artillery being fielded by the German Army at this time. However the 15 cm K (E) weighed around six times as much as the 15cm K 18 and the 15cm K 39. As the 15 cm K (E) could only operate near an operational rail network and could only fire out to 22 500 metres, its tactical usefulness was very limited, especially in offensive operations. The 17cm K (E) was built as the15cm K (E)'s replacement, but only six were built and its maximum range was only 4 700 metres more, so the limitations on its tactical employment remained. The 20cm K (E) came about because the German Navy had eight surplus 20.3cm gun barrels which were originally destined for the Blucher class heavy cruisers. At the army's request, Krupp reworked an old WWI design and in record time produced the 20cm K (E) which entered service in 1940. However the army belatedly realised that they had introduced a new and unique calibre of artillery into their inventory (with all the associated logistical nightmares) and asked for the guns to be rebored to 21cm. This proved impossible so new barrels were ordered, but production priorities meant these would not be ready until mid-1944. It is possible that this was the main reason why none of the eight available 20cm K (E)s were committed to support Operation Barbarossa in 1941. Subsequently, in the 150-200mm calibre railway artillery category, only three 15 cm K (E) were used in the East in 1941, and these were deployed in the Norway Army (*Befehlsstelle Finnland*). The remaining 29 150-200mm calibre railway guns were mostly deployed in coast defence roles during WWII.[32]

For the Germans during WWII, railway artillery in the 200-280mm calibre was by far the most important and most effective of these weapons. There were three main reasons for this. Firstly, long range field artillery with calibres over 200mm are very heavy, and consequently it becomes a major logistical operation to move and supply them. Guns on railway mounts are relatively quickly and easily moved even if they weigh several hundred tons. Secondly, 200-280mm guns are large enough to be capable of very long range, so the limitations on their tactical employment are vastly reduced (i.e. even staying on railways they can often reach the enemy). Thirdly, the shells in this calibre range are heavy enough to be effective against the heaviest fortifications, and destroying enemy fortifications is one of the primary missions of heavy and super heavy artillery.

The first railway gun considered in this category is the massive 21cm K 12 (E). This gun has the distinction of being the longest range gun ever built: it was capable of firing 107.5 kg (non-rocket assisted) shell out to a staggering 115km (71.46 miles).[33] However the 21cm K 12 (E) was more a technical exercise in long

[31] Excludes captured French railroad artillery, most of which went into German coastal artillery units.
[32] This is somewhat ironic because the 15cm K (E), 17cm K (E) and 20 cm K (E) were the 15cm SK (*Schiffskanone*) C/30, the 17cm SK L/40, and the 20.3cm SK, respectively, i.e. they were all naval guns mounted on railway mounts.
[33] Several sources indicate a maximum range of 120km. The closest to this record was the famous Krupp 'Paris Guns' of WWI. The Paris Gun or Kaiser Wilhelm Geschutz hit Paris with 367 shells in 1918 from a distance of around 110km.

range ballistics than an operational artillery piece. The small shell size and slow rate of fire could never justify the resources required to build and operate this weapon. Nevertheless the first gun became operational in March 1939 and was kept under wraps as a form of 'secret weapon'. A second improved gun designated 21cm K 12 N (it did not require jacking up to fire) was issued in 1940. Both weapons were available to support Operation Barbarossa in the 701 Railroad Artillery Battery.

From table Ger RR Art we can see that the next five railroad artillery pieces were all products of the German 1936 crash programme. The 24cm Th Br K (E) *Theodor Bruno* used the 24cm SK L/35 naval gun mounted on a box-girder structure. It had the shortest range of any of the German WWII railway guns and was not used in the East in 1941. The 24cm Theodor K (E) used the 24cm SK L/40 naval gun and was a better design, but its useful range was still limited. All nine available 24cm railway guns remained in the west during 1941, primarily in coast defence roles. The 1936 crash programme produced three 280mm railroad artillery models: the short *kurz Bruno*, the long *lange Bruno*, and the heavy *schwere Bruno*. These were based on the 28cm SK L/40, the 28cm SK L/45 and the 28cm *Kusten Kanone* L/42 naval and coastal guns. Although these guns were to some extent improvisations, they proved to be sound designs which were operationally successful. Four *kurz Bruno* guns and three *lange Bruno* guns were in position to support Operation Barbarossa on 22nd June 1941. The last Bruno gun was not a product of the 1936 programme. Whereas the earlier Bruno series were all converted naval guns, the *Bruno neue* was a completely new piece. The gun's barrel was 58 calibres long, and the mounting was a clean and modern design. Two guns were available in June 1941 and were both deployed in the 1./725 Railroad Artillery Battalion supporting 17th Army.

The last 28cm railway artillery gun to support Operation Barbarossa was also the most significant. This was the famous 28cm K 5 (E); arguably the finest long range railway gun ever built, and easily the most successful. Work on the K 5 began as far back as 1934, with the first gun being tested in 1936/37. From then until the end of WWII the K 5 remained in production with 28 being built. The K 5 and K 12 development overlapped to some extent as both were intended as super long range weapons employing deep grooved barrels and splined projectiles. The K 5 appears deceptively simple in design: the mounting was a straightforward box-girder assembly on two twelve wheel bogies. The very long 76 calibre barrel did not require any bracing and enabled the K 5 to fire a heavy 256kg HE shell out to over 62kms. In addition the K 5 was capable of firing an impressive 8-15 rounds per hour. In service the 28cm K 5 (E) proved to be a formidable weapon and demands for more were made on all fronts. By 1940 eight K 5s were operational and by June 1941 this number had risen to twelve. Of these, ten were available to support the initial phase of Operation Barbarossa.

In the 380mm plus category, the only German railway artillery that was operational in June 1941 were four 38cm Siegfried K(E)s. These were used for a short time on the Hel Peninsula in Poland protecting Danzig. In early 1942 they were withdrawn. The guns were then removed from their rail mountings before being redeployed as coast defence guns.

The only railway guns with calibres greater than 380mm involved on the East Front in 1941 were three captured French 400mm guns in the 693rd Railroad Artillery Battery, which went east in September 1941.[34] Three more of these guns went into the 696th Railroad Artillery Battery (which remained in the West). These were French *Materiel de* 400 *modele* 15 and 16 guns, and were designated 40cm *Haubitze* (*Eisenbahn*) 752(f) in German service. They were well designed rail-howitzers which were capable of lobbing a useful 641kg shell to the relatively short range of 16 000 metres.

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f. Coastal Artillery (East Front)

On 1st June 1941 the Wehrmacht had 171 coastal artillery batteries, of which 73 were outside of Norway. This equates to around 57 coastal artillery battalions guarding a coastline stretching from the Spanish border to the Arctic Circle, which by any standard is a large force requiring a lot of artillery pieces. Unsurprisingly the Germans struggled to find artillery pieces to meet this demand and ended up using every weapon they could; whether constructed, commandeered or captured. Of this force, 13 coastal artillery battalions were involved on the East Front in 1941. They were assigned to Armies involved in operations encompassing coastlines and ports. For Operation Barbarossa these were the 18th Army (Army Group North), the 11th Army (Army Group South), and the Norway Army (*Befehlsstelle Finnland* only).

The large majority of coastal artillery was mounted in turrets or casemates. Obviously these were immobile units with their barrels pointing seaward. For Operation Barbarossa however, ten of the coastal

[34] T. Gander, P. Chamberlain, Weapons of the Third Reich; an Encyclopedic Survey of all Small Arms, Artillery and Special Weapons of the German Land Forces 1939-1945, Doubleday and Company Inc, New York, 1979, p. 246.

artillery battalions involved were mobile units, which were also capable of using their guns as field artillery.[35] These units were well equipped by German 1941 coastal artillery standards and all had 105-155mm guns which were mostly German made.

In the 10.5cm category the Germans most commonly used the 10.5cm SK (*Schiffskanone*) C/32s (15 231kg using a marine pivot mounting) or 10.5cm SK L/60s (11 750kg in action). In addition old 10.5cm le FH 16 howitzers were sometimes used to fill in. Both the 10.5cm SK C/32 and 10.5cm SK L/60s were ex-naval antiaircraft guns and were often mounted so they could engage both air and sea targets. The 10.5cm SK C/32 and 10.5cm SK L/60s could fire a 15kg shell out to 9 500 and 17 500 metres respectively.

The most common (and useful) 15cm coastal artillery piece involved in the East was the 15cm SK C/28 in Kust MPL C/36 (15cm *Schiffskanone* C/28 *in Kusten Marine Pivotlafette* C/36). This was no ordinary coastal gun however, because its designers (Rheinmetall-Borsig) had far-sightedly intended the end result to be an all-purpose weapon. The fully mobile version was designated the 15cm SK C/28M, and involved fitting the 149.1mm *Schiffskanone* C/28 with a long L/55 barrel on a very advanced mobile mounting. In transport mode the four side outriggers were folded up and the entire equipment was jacked up onto two four-wheel bogies. The identical bogies had independent suspension on all wheels and Ackerman steering, so the equipment could be towed from either end. The entire gun was towed by a single heavy halftrack and although it weighed 19 761 kg in action its design enabled it to be rapidly brought into action. In action the gun rested on a platform stabilised by six outriggers. The gun also had twin loading trays to aid rapidity of fire: one was in use while the other was being replenished, as well as a centralised fire control system. The only real drawback of the 15cm SK C/28M as a field artillery piece was that its ammunition was not compatible with other field artillery munitions of the same calibre. However, the ammunition types available included concrete or armour piercing, high explosive, and impact or delayed action fused. As the mobile coastal artillery units were integrated into the German Army's field artillery system (even though these units retained their original German Navy personnel), and as the 15cm SK C/28M could fire a 45.5 kg shell out to 23 500 metres, the mobile coastal artillery battalions proved to be a very useful addition to the army's field artillery.

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g. Rocket Artillery

Rocket artillery was usually allocated to a corps rocket artillery regiment or battalion, and normally used in the direct and indirect fire bombardment role. The provisions of the Versailles Treaty forbade the Germans from developing heavy artillery. However a loophole in the provisions allowed the German general staff to set up a rocket research station at the Kummersdorf artillery proving ground in the early 1930s. The most famous weapon stemming from this was the A-4 Missile (also known as the V2 Rocket). However a weapon that ultimately did far more damage to the Allied war effort was also developed there; namely the *Nebelwerfer* ('fog-thrower' or smoke mortar) rocket system. It is ironic that it would probably have been better for the Allies in WWII if they had allowed further development of heavy artillery.

The first *Nebelwerfer* became operational in 1934 and was the Nbl.W. 35 (10.5cm *Nebelwerfer* 35). The Nbl.W. 35 was basically a large mortar: it consisted of a single smooth tube loaded via the front, and had a high elevation and trajectory. The equipment could be dismantled into three man-packed loads and carried by its crew of seven, including three ammunition handlers. The Nbl.W. 35 rocket weighed 7.38kg (2.2kg HE or smoke payload) and had a range of 3 025 metres. In June 1941 the Nbl.W. 35 was still in service, mainly with the army's seven separate motorised rocket launcher battalions. The Nbl.W. 35 remained in service until 1942, partly because the launcher was able to fire the longer Nbl.W. 40 rocket (below).

In 1940 the Nbl.W. 35 was complemented in service by the Nbl.W. 40 (10.5cm *Nebelwerfer* 40), a weapon with over twice the range. The Nbl.W. 40 was also a large single tube system, but was a much heavier and more complex weapon. It was loaded via a breech block, fired by percussion, and had a recoil mechanism. However the high elevation trajectory and smooth barrel of a mortar were retained. The Nbl.W. 40 was too heavy to be man-portable and was towed on a small two wheeled trailer. The Nbl.W. 40 rocket weighed 8.9kg (1.2kg HE or smoke payload) and had a range of 6 350 metres. Like all non-spin stabilised and unguided rockets of WWII, the Nbl.W. 40 was relatively inaccurate: at maximum range the fall of shot was spread over a radius of around 140 metres. The Nbl.W. 40 was allocated principally to the separate motorised rocket launcher battalions, but a few batteries were also present in selected motorised units.

[35] Fixed emplacements included the 'Tirpitz' and 'Breslau' Batteries, which were part of the German Coastal Artillery Group attached to the Rumanian Coast Defence Forces defending Constanta harbour. Also the 498 and 504 Battalions in Army Norway were semi-static units requiring additional transport to move.

In July 1940 the first motorised rocket launcher regiments were formed, equipped with the new 15cm Nbl.W. 41 (15cm *Nebelwerfer* 41), an altogether more powerful and sophisticated weapon compared to previous *Nebelwerfers*. The Nbl.W. 41 used the 15cm *Wurfgranate Spreng* (HE) or *Wurfgranate wKH Nebel* (smoke) rockets. These rockets weighed 34.15kg with a 10kg warhead, and had a range of 6 700 meters. The 15cm *Wurfgranate* were spin stabilised as opposed to using the more traditional fins. The spinning in flight was achieved by means of a rocket motor in front of the explosive payload with 26 venturi outlets arranged around the rocket body. These outlets were canted at fourteen degrees so that as well as achieving the forward thrust they also spun the rocket. The combination of front drive and spin produced a bombardment rocket of unparalleled payload efficiency and accuracy for its day.[36] This combination also ensured that the rocket motor and casing were added to the blast and fragmentation of the warhead, and did not simply fly off when it exploded. The Nbl.W. 41 used a six tube launcher mounted on a two wheeled trailer with spit trail legs (derived from the carriage of the 3.7cm Pak 36). Electric ignition was employed so that the rockets were fired in a sequence lasting about ten seconds. In addition, multiple launchers could be fired simultaneously. On 22nd June 1941 the Nbl.W. 41 equipped the German Army's five motorised rocket launcher regiments, all of which were deployed on the East Front.[37]

In addition to the *Nebelwerfers*, the Germans also developed larger rockets in separate disposable launchers for heavier payloads. These were the 32cm *Wurfkorper Flamm* (Flame Mortar) and the 28cm *Wurfkorper Spreng* (HE Mortar). These rockets were one shot bombardment rockets which shared the same type of motor but with different warheads: either an incendiary mixture, an early sort of napalm, or high explosive (HE). These rockets were relatively short range weapons and were not very accurate, but they were still devastating on certain target types due to their large payloads. The *Wurfkorper Flamm* employed a bulbous 55.8kg warhead with incendiary mixture. It was supplied in a carrying crate and launcher which was laid on the ground, elevated by a pair of folding legs, and then fired electrically. Its range was only 2 200 metres. The *Wurfkorper Spreng* was used in the same way, but it had a devastating 61kg amatol warhead and a range of only 1 925 metres. Although the 28/32cm rockets were primarily 'one shot' systems with integrated rocket and launcher, frame launchers were also sometimes used. These were designated *schweres Wurfgerat* 40 (wood) and 41 (metal). These launchers had the capacity to launch four rockets each and there were normally ten launchers per battery. In 1940 approximately 10 000 *Wurfkorper Spreng* and 12 000 *Wurfkorper Flamm* rockets were produced. In 1941 77 150 *Wurfkorper Spreng* and 62 550 *Wurfkorper Flamm* rockets were produced. They were issued to *pionier* troops, selected infantry units and motorised decontamination battalions (*Entgiftungs-Abteilung (motorisiert)*).[38] There were eight motorised decontamination battalions (including three 'road' battalions) in the German Army on 22nd June 1941, all of which were deployed on the East Front.

On 22nd June 1941 the German Army's rocket forces comprised: four motorised special rocket launcher HQs, five motorised rocket launcher regiments (*Nebelwerfer*-regiments), seven motorised rocket launcher battalions and a separate battery, and eight motorised decontamination battalions. All these units were initially committed to support Operation Barbarossa.[39]

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[36] Payload efficiency is weight of payload (HE or chemical) compared to the rocket's overall weight. The Payload efficiency for the Nbl.W. 41's 15cm *Wurfgranate Spreng* was 29% compared to the Soviet BM-8 and BM-13 with 6% and 12% respectively. The BM-8 had less range while the BM-13 had 1 770 metres more range.

[37] As an aside it is interesting to note that the Germans managed to keep the Nbl.W. 41 details secret for a considerable time. It was not until 1943 that the Soviets captured a specimen.

[38] In late 1941/42 these battalions were redesignated *schw. Werfer Abteilung* (heavy Rocket Battalions).

[39] Also refer to Volume V - 3. 9). vi. - 'Relative Overall Combat Proficiency (ROCP): the ROCP of Soviet and Axis Forces in 1941-Axis and Soviet Relative Overall Combat Proficiency (ROCP) in 1941 - Weapon Effects on the 1941 German-Soviet ROCP - Artillery: Weapon Effects on the 1941 German-Soviet ROCP - Rocket Artillery' for a review of the strengths and weaknesses of WWII rocket artillery. In particular why rocket artillery could not be used like conventional artillery.