ARMORED UNITS IN THE 1940 WESTERN CAMPAIGN

by David Lehmann

1. GERMAN ARMORED UNITS

On 1st September 1939, the German Army is still immature, it lacks some equipment and is far from being organized around the Blitzkrieg concept. The chain of command is still very classical and the armored units have not the importance they will gain later in 1940. 5 Korps include motorized units but there is no specific group dedicated to large mechanized operations beyond the tactical level.
The Panzerwaffe formed in 1934 includes in 1939 7 Panzerdivisionen and 4 Leichten-Divisionen (light armored divisions) beside 4 ID (mot). It is the most powerful element of the Heer but only 16% of the tanks are armed with a 3.7cm or a 7.5cm gun, 84% of the tanks are Panzer I, Panzer II or command tanks. At the tactical, mobility and flexibility level the German mechanized units were superior to their Polish opponents in 1939 but the inter-arms cooperation (tank/infantry/artillery/air support) was not yet mature even if already tested on the very basic level in Spain with the Panzer I and several crews.
The size of the Panzerwaffe is too limited in 1939 and its practical use is not yet well defined, the old school favoring the classical warfare is still powerful in the German high command. All the Panzerdivisionen and Leichten-Divisionen are completely dispersed ; only the 10th Armee has in some extend some concentrated mechanized troops. The Panzerwaffe of September 1939 is not mature and not directed towards a specific point (Schwehrpunkt) of the front. Fall Weiss allowed testing some tactical principles that the German HQ wanted to upscale. The Germans did more than replace losses between the Polish and French Campaigns. They created new divisions and improved their army in terms of equipments, chain of command and doctrine.

The German forces had been reorganized after the campaign in Poland (Fall Weiss) :

- At the eve of Fall Gelb there are 155 German divisions available (136 engaged), including 2 Waffen-SS motorized divisions instead of 105 divisions (63 engaged) in September 1939. The Leichten-Divisionen have been transformed into Panzerdivisionen. The Leichten-Divisionen have been transformed into Panzerdivisionen. Created in 1936, these Leichten-Divisionen were based on the model of the French DLM. In Germany like in France, the cavalry wanted its own tanks because it was frightened to loose influence. After Fall Weiss the 1., 2., 3. and 4. Leichten-Divisionen became the 6., 7., 3. and 4. Panzerdivisionen and the 5. PzD had been created. The German army in May 1940 had therefore 10 Panzer Divisionen, 6 ID (mot) and 1 newly created Kavalerie division.
- The 3. and 4. Wellen Infanterie Divisionen from the Polish campaign were largely improved, younger men were enlisted and the equipment was modernized. In 1940, 15 of these divisions were frontline units.
- The chain of command is less centralized and more flexible whereas in Poland the command structures were very traditional. Add to that the important communication means (many radio sets), a well organized logistics and you have a powerful army.
- The German tactics with good inter-arms cooperation (tank / aircraft couple, close air support provided by the Ju87s and Hs123s, omnipresent tactical air reconnaissance) were not mature in Poland but they are ready for Fall Gelb. The first trials with air-ground cooperation were to be held in Grafenwöhr training area 21st - 25th August 1939, but cancelled due to the oncoming war. Therefore, in September 1939 the Germans had no new Blitzkrieg tactics to use.

A complete new HQ and ad-hoc structure is created with Gruppe Kleist for the initial phase of Fall Gelb. It includes 3 motorized army corps, regrouping 5 armored divisions and 3 motorized infantry divisions, directed towards the Ardennes. Unlike in Poland, the mechanized elements are well **concentrated** and have a real **strategic role**. They are well supported by the VIII.Fliegerkorps concentrating all the 300 Ju87 dive bombers and 42 Hs123 assault biplanes. The 5.PzD and 7.PzD of the XV.Armee Korps (mot.) are only several kilometers north of Gruppe Kleist. Therefore 7 Panzerdivisonen are concentrated against the weak area of the Ardennes. In the area of Sedan, 1500 aircrafts are concentrated on a small area to support the German attack. It is the very first time in History that such armored and air support forces are concentrated on such a small area.

During the initial phase of Fall Gelb, the Germans used also extensively airborne troops (paratroopers and glider troops) and commandos (in German uniforms, in allied uniforms or in civilian clothes – Brandenburger commandos, assault engineers or elite infantry of the "Grossdeutschland" regiment etc.). Such a concentration of commandos and airborne troops having a real strategic role is probably also a first time in History.

Compared to the Polish campaign, in France the armored units were better armed (more tanks were armed with 3.7cm and 7.5cm guns (16% - 452 tanks - in Poland and 36% - 955 tanks - in France) and also better armored. There were Panzer IV Ausf.A/Bs in Poland but more Panzer IV Ausf.C/Ds in France. There were lightly armored early Panzer III in Poland but more Panzer III E/F in France. The Panzer II was built with 14.5mm armor and up-armored after the Polish campaign for the invasion of France. Also the early Panzer IIs had no vision cupola for the commander, which reduced probably the tactical awarness. The cupolas were retrofitted to the existing tanks over

a period of time. The first Panzer III armed with a 5.0cm gun left the production line in July 1940. During that month 21 were built and 17 of these accepted by Army (according to Blatt G112, 15th December 1940 "Überblick über den Rüstungstand des Heeres"). Apparently if 5.0cm shells were already in production in June 1940 it was because the 5.0cm PaK38 were slowly being produced at this time, not because of Panzer III with 5.0cm guns used in France in 1940.

→ For all these reasons, the 1940 western campaign can be seen as the best example of the so-called *Blitzkrieg*. It worked also later against Greece and Yugoslavia but it couldn't work anymore in Russia which was too big.

The Panzerwaffe had **2636 German tanks** on 10th May 1940 :

Unit	Light tanks			Medium tanks				TOTAL
	PzI	PzII	PzBef	PzIII	Pz35(t)	Pz38(t)	PzIV	
1.PzD	52	98	8	58	-	-	40	256
2.PzD	45	115	16	58	-	-	32	266
3.PzD	117	129	27	42	-	-	26	341
4.PzD	135	107	10	40	-	-	24	316
5.PzD	97	120	16	52	-	-	30	315
6.PzD	60	-	14	-	118	-	31	223
7.PzD	34	68	8	-	-	91	24	225
8.PzD	-	58	15	-	-	116	23	212
9.PzD	30	54	12	41	-	-	16	153
10.PzD	44	113	18	58	-	-	32	265
AA Totenkopf	-	-	-	-	10	-	-	10
40.Panzerabteilung	29	18	4				3 *	54
TOTAL in the field	643	880	148	349	128	207	281	2636
TOTAL available	1077	1092	244	381	143	238	290	3465

* Neubau Fahrzeuge

NOTE : other sources indicate a different composition for the 3.PzD and 4.PzD with 19 extra tanks :

Unit	Light tanks			Medium tanks				TOTAL
	PzI	PzII	PzBef	PzIII	Pz35(t)	Pz38(t)	PzIV	
3.PzD	117	129	29	42	-	-	26	343
4.PzD	141	111	15	40	-	-	24	331

These 2636 tanks include 965 ones (37%) armed with a 3.7cm or 7.5cm gun. Not counting here the additional 99 Panzerjäger I and 24 StuG A. Which leads to 2759 AFVs and 1088 ones (39%) armed with a 3.7cm, 4.7cm or 7.5cm gun. All the German tanks were concentrated in the 10 Panzerdivisionen. The German Panzerdivisionen might be very different in composition from one to an other and during the campaign itself because of various attachments at different times. The type 1 Panzerdivisionen (Guderian model) like the 1., 2. and 10.PzD and the type 1 bis like the 3.,4. and 5.PzD had 2 tank regiments with 2 battalions each. The type 2 Panzerdivisionen, originating from the transformation of the Leichten-Divisionen, are the 6., 7. and 8.PzD. They had a single tank regiment but with 3 battalions. Finally the 9.PzD was a "reduced" type 2 Panzerdivision with only one tank regiment of 2 battalions. Except the atypical 9.PzD which is engaged in the Netherlands, a Panzerdivision had a mean of 270 tanks including 170 light tanks and 100 medium tanks. The Panzer 35(t)s are concentrated in the 6.PzD and the Panzer 38(t)s are all in the 7.PzD and 8.PzD.

2. FRENCH ARMORED UNITS

During World War 1, the French tanks were part of the artillery and called AS for "artillerie d'assaut" (assault artillery … and not special artillery as it is often written). General Estienne, father of the French tanks, was indeed from the artillery. He worked since 1915 to use mobile and armored guns. The main task of the tanks was nevertheless to support the advance of the infantry.
In 1920, the tanks became part of the infantry with more than 3,000 FT17 tanks available. In 1940, 1297 FT17 tanks were still in service : 1062 tanks in France and 235 in the colonies. From the 1062 FT17 tanks in France, 462 were in combat units and many others were in airfield protection platoons, anti-paratroops tank companies, regional platoon of protection tanks, important buildings protection platoons etc.
During the inter-wars period, the infantry and the cavalry developed their tanks separately. The infantry had tanks long before the cavalry but created big armored/mechanized units (divisions) later. The cavalry first used only armored cars.

The development of the French tanks was hampered by several factors :
- The disarmament conference at Geneva and the League of Nations with the post-WW1 pacifism. Germany left the League of Nations and developed its own tanks despite the interdiction of the Versailles treaty.
- Financial and political issues from 1919 to 1930 leading to the main effort on light tanks instead of medium main battle tanks. They appeared less offensive and therefore in adequacy with the international pacifist context. From 1928 to 1934, only 2.4% of the budget for armament production was dedicated to the tanks.
- Too many dispersed efforts and projects
- Not one single arm (independent or not) regrouping all the AFVs. There were infantry and cavalry tanks whereas in Germany the Panzerwaffe became an independent arm concentrating all the tanks.

In 1936, the French army had still some 700,000 horses. Nevertheless, in 1940 it had 400,000 motorized vehicles including motorcycles, cars, trucks, tanks, armored cars etc. (more or less equivalent to the German army, the small US army for example had 12,000 vehicles at the same time which shows how quickly it increased its size afterwards).

In the cavalry the DLC = Division Légere de Cavalerie = Light Cavalry Division included some tanks and armored cars but the main armored unit was the DLM = Division Légere Mécanique = Light Mechanized Division. The term "light" referred to its speed and mobility not its strength since it was more powerful than the armored division of the infantry.

In the infantry the armored division was the DCR = Division Cuirassée de Réserve = Reserve Armored Division (cuirassée means armored). The acronym DCR was chosen in order to differentiate it from the already existing DC (= Division de Cavalerie = Cavalry Division). But it was indeed originally meant as "Division Cuirassée de Réserve", the word "reserve" being a political choice. These new units would not be ready until 1940 and were initially assigned to the HQ reserve, thus their name. But once in the field they were simply known as "Divisions Cuirassées", which was technically abbreviated as DCu, yet DCR was often retained (leading to the use of DCr). The BCC (bataillon de char de combat) were the tank battalions included in the DCR but on 10th May there were still about 35 BCC available for the armies beside several companies (CACC = Compagnie Autonome de Chars de Combat = independent tank company). They were dispersed in all the armies and all over the territory to support the infantry. During peacetime the BCC were depending from RCC = Régiment de Chars de Combat = tank regiments.

In 1940 the main tanks were :

Infantry tanks :
- Renault FT-17BS (light)
- FT-17c (light)
- FT-17m (light)
- FCM36 (light)
- Renault R35/39/40 (light)
- Hotchkiss H39 (light)
- Renault D1 (medium)
- Renault D2 (medium)
- Renault B1 (heavy)
- Renault B1bis (heavy)
- FCM-2C (very heavy)

Cavalry tanks :
- Hotchkiss H35/39 (light)
- Somua S35 (medium)

2.1 The French cavalry tanks

General Flavigny was the director of the cavalry from 1931 to 1936. In 1931, with general Weygand, he started big efforts to modernize the French cavalry and introduced motorized/mechanized elements, despite a low budget and many oppositions originating from pro-horse lobbies.

The development of the cavalry AFVs begun in 1930/1931 and three types of vehicles were studied :

- **AMD** = Auto-Mitrailleuse de Découverte = distant reconnaissance wheeled vehicles : Panhard P165/175, Laffly 80AM, Laffly 50AM, Laffly S15TOE were used at first but the main AMD in 1940 was the excellent Panhard P178. The Panhard 178, nicknamed "pan-pan", was a very good and reliable armored car. It has proven a superior designed armored car in 1940. It had a 2-men APX3 turret (hand-cranked) and its 25mm SA35 gun had good anti-tank capacities. The Panhard 178 was capable of relative high speed (72.6 km/h) and had two drivers (one forward and one backward) to change direction very quickly, increasing the overall maneuverability.
- **AMR** = Auto-Mitrailleuse de Reconnaissance = cross-country reconnaissance, tracked armored car / light tank : AMR-33 and AMR-35 ZT1, ZT2 and ZT3.
- **AMC** = Auto-Mitrailleuse de Combat = tracked (or half-tracked) vehicle that has better armament and armor, capable of heavy combat : at first the Panhard-Schneider P16 M^{le}1929 (used as AMR in 1940), Renault AMC-34 (YR), Renault AMC-35 (ACG1), Hotchkiss H35/39 and the most important, the very good Somua S35. The Somua S35 was fast, well armed and well protected. It was very liked by its crews who pulled away the embossed "SOMUA" plates and welded them on their new Sherman tanks in North Africa.

In 1932, 3 hybrid cavalry divisions (horses / armoured cars) are created but it remained a "oil and oats" solution, mainly because of the horse traditions and also because the modern armored cars and tanks were at first only slowly available. These DC = Division de Cavalerie = Cavalry Division were made up of half conventional horse mounted cavalry and half armored cars. The trainings revealed the issues of such units : if the armored cars moved at 25-45 km/h they were too fast for the horses and could not hold alone the area they just took, if the unit moved at 8 km/h, the rhythm of the horses, the armored cars' engine was overheating.
On 10th February 1940, there were 50% less horses in these units, 1 cavalry brigade instead of 2. This enabled to create more such units thanks to all the newly available tanks and armored cars. From the 3 hybrid units 5 DLC were created.

Each DLC includes about 7,800 men, 2,000 horses and 2,100 vehicles :

- 1 divisional HQ
- 1 cavalry brigade (BC = Brigade de Cavalerie) of 2 cavalry regiments (horse mounted)
- 1 light motorized brigade (BLM = Brigade Légère Motorisée) with :
  - a RAM (Régiment d'Auto-Mitrailleuses = armored cars regiment) including 13 Hotchkiss H35 tanks and 12 Panhard 178 (+1 radio car + 2 reserve armored car)
  - a RDP (Régiment de Dragons Portés = mechanized cavalry regiment) of 2 battalions including 23 AMR33 / AMR35 ZT1 and 5 motorcycle platoons
- 1 divisional AT squadron (EDAC = Escadron Divisionnaire Anti-Char)
- 1 divisional repair and recovery squadron
- 1 motorized artillery regiment (75mm Mle1897 and 105mm C with all-terrain tractors)
- 1 motorized AT battery (BDAC = Batterie Divisionnaire Anti-Char)
- 1 motorized engineer company (sapeurs-mineurs company)
- 1 mixed signals company
- 1 HQ horse-drawn transport company
- 1 HQ motor transport company
- 1 divisional quartermaster group
- 1 divisional medical group

Therefore each DLC had only an AFV strength of 13 tanks and 35-37 armored cars = 48-50 AFVs. A DLC could in no way compete with a German Panzerdivision but they will nevertheless face them.

During combats, the 2 components (horse vs motorized) are often separated, the armored cars joining other motorized/mechanized elements. These hybrid characteristics could also be found in the motorized reconnaissance "battalions" of infantry divisions or army corps : 7 GRDI (= Groupe de Reconnaissance de Division d'Infanterie), 5 of them including armored cars, and 3 GRCA (=Groupe de Reconnaissance de Corps d'Armée).

In 1932-1935, the first fully motorized unit, the 1^{e} DLM, was born and developed. The 2^{e} DLM was born in 1937 and the 3^{e} DLM in February 1940. There will be 3 DLMs on 10th May 1940 (1^{e} DLM, 2^{e} DLM and 3^{e} DLM) forming the French cavalry corps under command of general Prioux. The DLM is more powerful than the DCR, faster and more mobile. It is a unit fully adapted to modern mobile warfare.

The 1e DLM and 2e DLM became very well trained divisions (even at the divisional an corps level) with efficient crews and specialists. Manoeuvres and trainings were organized at large scale in 1935, 1936, 1937 1938, 1939 and the last divisional training in 1940.. They included deep penetration behind fortifications, cooperation with close air support and close inter-arms cooperation. The crew knew their tanks and how to operate them. The gunners were skilled and trained. The 3e DLM formed in 1940 had only reservists who did their military service on horse and some of them discovered their tank a short time before being engaged, except some officers and specialists originating from the other DLMs.

The cavalry corps and the corresponding HQ are created at the mobilization beginning September 1939. It is under the command of general Prioux until 25th May 1940 when he took command of the 1st army and general Langlois replaced him at the head of the cavalry corps. The cavalry corps contains initially only the 1e DLM and 2e DLM. The 1e DLM is then attached to the 7th army to operate in the Netherlands on 10th May 1940. It is replaced in the cavalry corps by the 3e DLM on 26th March 1940. During the 1940 western campaign the cavalry corps will regroup 1, 2 or the 3 DLMs. During the battle of Hannut, general Prioux had the actual command of a real French tank corps facing a German tank corps. They inflicted heavy losses to the Germans. The use of such a French tank corps is unique during the 1940 campaign except perhaps the formation of the "groupement Buisson" beginning June for the battles on the Aisne and Retourne Rivers south of Rethel which grouped the 3e DCR and the 7e DLM.

Each DLM included about 10,400 men and 3,400 vehicles :

- 1 divisional HQ
- 1 light motorized brigade (BLM = Brigade Légère Motorisée) with 2 armored cavalry regiments (RC = Régiment de Cuirassiers or RD = Régiment de Dragons).

1e DLM : 174 tanks (+ 16 reserve tanks) in the **1e BLM**
- **4e RC** (43+4 Hotchkiss H35 and 44+4 Somua S35)
- **18e RD** (43+4 Hotchkiss H35 and 44+4 Somua S35)

2e DLM : 174 tanks (+ 16 reserve tanks) in the **3e BLM**
- **13e RD** (43+4 Hotchkiss H35 and 44+4 Somua S35)
- **29e RD** (43+4 Hotchkiss H35 and 44+4 Somua S35)

3e DLM : 174 tanks (+ 16 reserve tanks) in the **5e BLM**
- **1e RC** (43+4 Hotchkiss H39 and 44+4 Somua S35)
- **2e RC** (43+4 Hotchkiss H39 and 44+4 Somua S35)

- 1 light motorized brigade (BLM = Brigade Légère Motorisée) with 1 armored reconnaissance regiment (regiment de découverte) and 1 RDP (Régiment de Dragons Portés = mechanized cavalry regiment)

1e DLM : 107 armored cars in the **2e BLM**
- **6e RC** : 40 Panhard 178 (+1 radio car + 2 reserve armored car)
- **4e RDP** : 67 AMR33 / AMR35 ZT1 (+2 reserve armored cars)

2e DLM : 107 armored cars in the **4e BLM**
- **8e RC** : 40 Panhard 178 (+1 radio car + 2 reserve armored car)
- **1e RDP** : 67 AMR33 / AMR35 ZT1 (+2 reserve armored cars)

3e DLM : 107 tanks / armored cars in the **6e BLM**
- **12e RC** : 40 Panhard 178 (+1 radio car + 2 reserve armored car)
- **11e RDP** : 22 Hotchkiss H35 and 47 Hotchkiss H39

- 1 divisional AT squadron (EDAC = Escadron Divisionnaire Anti-Char)
- 1 divisional repair and recovery squadron
- 1 motorized artillery regiment (with all-terrain tractors)
- 1 motorized AT battery (BDAC = Batterie Divisionnaire Anti-Char)
- 1 motorized AA battery (BDAA = Batterie Divisionnaire Anti-Aérienne)
- 1 engineer battalion (3 motorized companies plus a bridging company)
- 1 telegraph company
- 1 radio company
- 1 carrier-pigeon detachment
- 1 HQ motor transport company
- 1 divisional quartermaster group
- 1 divisional medical group

On 10th May 1940 the cavalry consisted in :

- 5 Divisions Légères de Cavalerie (DLC)
- 3 Divisions Légères Mécaniques (DLM)
- 1 Brigade de Cavalerie (BC)
- 3 Brigades de Spahis (BS)
- 23 Groupes de Reconnaissance de Corps d'Armée (GRCA)
  - 20 normal (horses)
  - 3 motorized
- 105 Groupes de Reconnaissance de Division d'Infanterie (GRDI)
  - 52 normal (horses)
  - 7 motorized (5 with armored cars)
  - 46 reduced (in the colonies or late created units)
- A few corps francs de cavalerie (including armored cars) during the campaign
- 3 regiments in the 4e DCR of the infantry

During early June 1940, the remains of the 5 DLCs were to be converted to a DLM "type réduit", a reduced DLM :

- 1e DLC as 4e DLM
- 2e DLC as 5e DLM
- 3e DLC as 6e DLM
- 4e DLC as 7e DLM
- 5e DLC as 8e DLM

The deteriorating military situation meant only 4e DLM and 7e DLM were actually formed.

The 1e DLM, 2e DLM and 3e DLM are also reconstituted beginning June, as reduced DLMs, with men evacuated from Dunkirk and who returned to France after a transit in Great Britain. These 5 DLMs fought until 25th June 1940.

The cavalry tanks are organized in "escadrons" (1 escadron = 1 squadron) and in "pelotons" (1 peloton = 1 platoon). For example in a cavalry unit like the 4e Régiment de Cuirassiers there are : 44 Somua S35 and 43 Hotchkiss H35 (+4 reserve tanks of each model) :

- 1 regiment command tank (1 Somua S35)
- 1 Somua S35 squadrons group = 43 Somua S35 :
  - 1 Somua S35 squadrons group command tank (1 Somua S35)
  - 1st squadron (21 Somua S35) (one "escadron" with 4 "pelotons")
    - 1 squadron commander tank
    - 4 platoons of 5 tanks
  - 3rd squadron (21 Somua S35s) (one "escadron" with 4 "pelotons")
    - 1 squadron commander tank
    - 4 platoons of 5 tanks
- 1 Hotchkiss squadrons group = 43 Hotchkiss H35 :
  - 1 squadrons group command tank (1 Hotchkiss H35)
  - 2nd squadron (21 Hotchkiss H35) (one "escadron" with 4 "pelotons")
    - 1 squadron commander tank
    - 4 platoons of 5 tanks
  - 4th squadron (21 Hotchkiss H35) (one "escadron" with 4 "pelotons")
    - 1 squadron commander tank
    - 4 platoons of 5 tanks

1e DLM
General Picard (27.08.39)
General De Beauchesne (23.05.40)

2e DLM
General Altmayer (23.08.39)
General Bougrain (13.01.40)

3e DLM
General Langlois (01.02.40)
General De La Font (26.05.40)
General Testard (06.06.40)

2.2 The French infantry tanks

After World War 1, the Schneider CA-1 and Saint-Chamond tanks were retired and only Renault FT17 tanks were available. The Renault FT17 light tanks were replaced by the Renault D1, Renault R35 (later R39 and R40), Hotchkiss H39 and FCM36. In 1935, The Renault R35 and the Hotchkiss H35 tanks were produced but already in 1937 they appeared insufficient. The Renault R35 was adopted by the infantry and the Hotchkiss H35 by the cavalry only. It was rejected by the infantry which accepted only the later Hotchkiss H39, better armored (40mm instead of 35mm for the hull) and with a more powerful engine (120 hp on 2800 rpm for 36.5 km/h onroad and 16km/h in medium difficult offroad). The 37mm SA38 L/33 gun was nevertheless rare and only introduced in March/April 1940. In 1940, most of the tanks had only the 37mm SA18 L/21 gun. The heavier Renault D2 was produced in 1937.

The Renault B1bis tank was developed between 1921 and 1938. During this time it became heavier (increased armor to 60mm) and more intricate and despite an always more powerful engine (307 hp) it had lost in autonomy compared to the initial project. The B1bis was before all conceived in the 20's and 30's as infantry support tank, transported by railway behind the frontline, used to pierce the frontline by neutralizing the MG nests and fortifications, moving at the speed of the infantry, opening the way to the infantry and the cavalry which were in charge of exploiting the breakthrough. Destroying a strongpoint and moving then to the next position to neutralize. The B1bis tank's autonomy (about 150 km) was therefore totally sufficient according to this doctrine and was in fact not bad at all compared to the other tanks of 1940. Nevertheless this heavy tank used a lot of fuel, especially during combats because the tank had to turn on the spot to aim the 75mm hull gun. The practical autonomy was of about 6 hours. The Renault B1bis tank is able to cross ditches 2.75m wide, to climb slopes at 41° (90%) (on hard ground) and to cross obstacles 1.33m high. In 1940, these heavy tanks are used at the rhythm of a medium tank and they proved able to play this role. The Renault B1bis was used as infantry support tank like in Abbeville but it was also successfully in tank vs tank warfare. The Renault B1bis was nonetheless not able to follow the fast and mobile strategic warfare imposed by the German Panzerwaffe. The infantry high command refused to equip the DCR with the Somua S35 tanks of the cavalry, despite being better adapted to mobile tank vs tank combats.

Both the Hotchkiss H39 and the heavy B1bis were better tanks than the Renault R35 in terms of speed and mobility. Beside all the infantry and cavalry AFVs that were mentioned, some 30 others AFVs were studied and tested.

All the BCCs which were used to from the DCRs were already available, they were not new units but the creation of an armored division was a new project. The first half DCR was born on 2nd September 1939 and a second one on 5th September 1939. The 1e DCR and 2e DCR were created on 16th January 1940 and the 3e DCR on 20th March 1940. Since at least 4 months training were required to make of these DCRs operational units, the 3e DCR was not completely ready on 10th May 1940. A 4e DCR will be created on the field during May 1940.
On 10th May 1940, beside the French cavalry units, the 10 Panzerdivisionen concentrating all the German tanks encountered the 3 new DCRs and about 30 BCCs dispersed in the armies from Switzerland to the North Sea / Channel.

Each DCR included about 6,400 men and 1,700 vehicles :

- 1 divisional HQ
- 1 heavy tank half-brigade of two heavy tank battalions

1e DCR : 62 + 1 command tank = 63 Renault B1bis (+6 reserve tanks)
- **28e BCC** : 31+3 Renault B1bis
- **37e BCC** : 31+3 Renault B1bis

2e DCR : 62 + 1 command tank = 63 Renault B1bis (+6 reserve tanks)
- **8e BCC** : 31+3 Renault B1bis
- **15e BCC** : 31+3 Renault B1bis

3e DCR : 62 Renault B1bis (+6 reserve tanks)
- **41e BCC** : 31+3 Renault B1bis
- **49e BCC** : 31+3 Renault B1bis

4e DCR : 49 Renault B1bis (+3 reserve tanks) and 19 Renault D2
- **46e BCC** : 31+3 Renault B1bis
- **47e BCC** : 18 Renault B1bis

Attachements :
- **19e BCC** : 40+5 Renault D2

- 1 light tank half-brigade of two light tank battalions

1e DCR : 80 Hotchkiss H39 (+10 reserve tanks)
- **25e BCC** : 40+5 Hotchkiss H39
- **26e BCC** : 40+5 Hotchkiss H39

2e DCR : 80 Hotchkiss H39 (+10 reserve tanks)
- **14e BCC** : 40+5 Hotchkiss H39
- **27e BCC** : 40+5 Hotchkiss H39

3e DCR : 80 Hotchkiss H39 (+10 reserve tanks)
- **42e BCC** : 40+5 Hotchkiss H39
- **45e BCC** : 40+5 Hotchkiss H39

4e DCR : 80 Renault R35 (+10 reserve tanks), 39 Somua S35, 40 Hotchkiss H39
- **2e BCC** : 40+5 Renault R35/39
- **24e BCC** : 40+5 Renault R35/39

Attachements :
- **3e RC** : 39 Somua S35 + 40 Hotchkiss H39

- 1 mechanized infantry battalion (BCP = Bataillon de Chasseurs Portés)
- 1 motorized artillery regiment (with all-terrain tractors)
- 1 motorized AT battery added to the two first DCR in February 1940
- 1 motorized engineer company
- 1 mixed signals company
- 1 HQ motor transport company
- 1 motor transport company
- 1 divisional quartermaster group
- 1 divisional medical group

The above composition was not final, there were to be further changes. It soon became apparent in training that the division had too few infantry. An extra battalion was planned to be added but the Germans attacked before anything was done. The lack of reconnaissance troops was also noted and something was planned to remedy this : a 131e, 132e and 133e GRDI each of a motorcycle squadron and an AMR squadron began to form in early June 1940. The 3 motorcycle squadrons were to come from the 7e RDP, a unit of the projected 4e DLM. Fall Rot, the

second stage of the German offensive on the Somme and Aisne Rivers, beginning June, forced to cancel the formation of these units.

The 4e DCR was exception to the above organization as it was effectively an emergency formation initially used to block the German advance towards Paris. The division is engaged in battles like Montcornet, Crécy-sur-Serre and later to eliminate the German bridgehead at Abbeville on the Somme River. Formed on 15th May 1940, with only a few units ready when ordered to the front, it was nearly two weeks before it reached its peak strength beginning June. The units were not trained to act together and at the beginning even the engineers were used as supporting infantry. The 4e DCR seems strong but the units were at first engaged one by one as they arrived and had often not their theoretical strength.

The tanks from the infantry are organized in "compagnies" (1 compagnie = 1 company) and sections (1 section = 1 platoon) :

→ **Renault B1bis company – heavy tanks :**
company commander : 1x B1bis
1st platoon (section) : 3x B1bis
2nd platoon (section) : 3x B1bis
3rd platoon (section) : 3x B1bis = 10 tanks

For the whole battalion :
3 companies = 30 tanks
+ 1 battalion command tank = 31 tanks
+ 3 reserve tanks in the "compagnie d'échelon" = 34 tanks in a B1bis battalion.

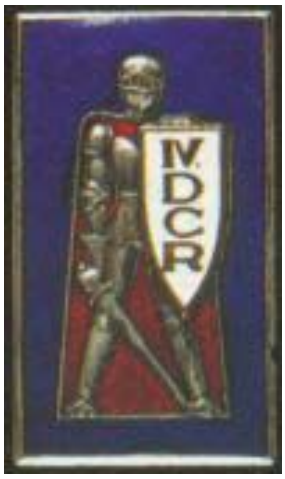
→ **Renault R35 company – light tanks :**
company commander : 1x R35
1st platoon (section) : 3x R35
2nd platoon (section) : 3x R35
3rd platoon (section) : 3x R35
4th platoon (section) : 3x R35 = 13 tanks

For the whole battalion :
3 company = 39 tanks
+ 1 battalion command tank = 40 tanks
+ 5 reserve tanks in the "compagnie d'échelon" = 45 tanks

1e DCR
General Bruneau (15.01.40.)
Colonel Sandrier (19.05.40)
General Welvert (01.06.40)

2e DCR
General Bruché (16.01.40)
General Perré (20.05.40)

3e DCR
General Brochard (20.03.40)
General Buisson (16.05.40)
Colonel Le Brigant (07.06.40)
General Buisson (11.06.40)



4e DCR
General De Gaulle (15.05.40)
Colonel Chaudessole (06.06.40)
General De La Font (07.06.40)

NUMBER OF FRENCH TANKS IN FRANCE ON 10th MAY 1940, IN COMBAT UNITS : 2307 (2777)

- Hotchkiss H35 : 328
- Hotchkiss H39 : 474
- Renault R35/39 : 900
- FCM36 : 90
- Somua S35 : 264
- Renault D2 : 45
- Renault B1bis : 206

→ Modern tanks : 2307

- Renault FT17 : 462 (obsolete)
- FCM-2C : 8 (obsolete)

→ Obsolete tanks : 470

If the AMR tracked armored cars are counted as light tanks :

- AMR33 / AMR35 ZT1 : 259 (including about 150 AMR35 ZT1)
- AMR35 ZT2 : 10
- AMR35 ZT3 : 10

→ TOTAL : 3056 French tanks

3. BRITISH ARMORED UNITS

On May 1940, 23 years after the first tank attack led by 49 British tanks, Great Britain has only achieved one exemplar of a kind of basic armored unit but roughly without supporting infantry, artillery, engineers or services.

In 1927, an experimental armored unit is tested by the British with 65 tanks, 16 tankettes, one motorized infantry battalion, supporting artillery and engineers. It is disbanded 2 years later and judged without interest.
In 1931, other trials are made with the 1st brigade, Royal Tank Corps (RTC), but the unit is only created for summer trainings.
In 1934, 4 battalions of the RTC are permanently regrouped : 150 obsolete tanks. One training of this mobile force proved to be a complete failure : bad coordination, the tanks were completely dispersed, isolated and "neutralized" one by one. This led the armored unit project to be completely neglected.
In 1934, Great Britain tested 1 tank brigade while the German had 1 operational battalion. In 1935, they had still 1 experimental tank brigade but the Germans had already 3 armored divisions. In 1937, there was a project for a possible armored division and the Germans had 4 armored divisions. The reluctance of the British high command delayed the development of an armored arm.

In 1934, the British high command had a project of reorganization of the army, implying the motorization of the cavalry but it faced the opposition of the pro-horse lobbies, which were even stronger than in France or Germany. At first Dragoons, Lancers, Hussars and Horse Guards didn't want to change their traditions.
Between the cavalry and the new and tiny RTC the relations were often very bad, the first one seeing the new one as being devoid of elegance and traditions.
Nevertheless, major general Blakiston-Houston, general inspector of the cavalry, announced that there was no future for the horse mounted cavalry. The regiments would have to be transformed in mechanized/motorized units, beginning with 3rd Hussars, Queen's Bays, 4th Hussars and 9th Lancers. The lack of equipments delayed the operation, which happened only on the paper.

The first modern tanks appeared only in the 3rd Hussars during 1937. The first operational unit is the 4th Hussars in November 1937. The last horse unit disappeared in 1941.

The RTC, whose expansion was strongly slowed down in 1934, continued its development during May 1937. 9 battalions were formed in 1938 and 5 others in 1939. This development created tensions between the cavalry and the RTC. The Royal Armored Corps (RAC) was therefore created, concentrating all the AFVs. Great Britain avoided therefore the cavalry/infantry tanks rivalry that can be found in France, but developed its mechanized units years later.

Germany was creating an independent and powerful Panzerwaffe. In France the industrial effort was similar to the German one but less efficient due to the inability to choose a unique doctrine and to unify all the AFVs in one arm (independent or not). United Kingdom had lost considerable time and was the last one to choose to have powerful armored units. The first modern British tanks, the A9 and A13 cruisers, are only available in December 1938.

In October 1939, the new born 1st armored division (AD) had in charge the defense the south British coast and is completely dispersed, all trainings being cancelled. In January 1940, the 1st AD was again grouped and went on with the training. On 16th/17th May 1940, 1 week after the German attack, the 1st AD (general Evans) was sent to France, without artillery, infantry or engineers. The AA and AT units are incomplete. The British AT units received French 25mm AT guns (a total of 220 25mm SA34/37 for the BEF). Several tanks had no guns, no episcopes or no radio set and there are roughly no spare parts. Part of the 1st AD remained to defend Calais and was quickly destroyed without any result in one day.

NUMBER OF BRITISH TANKS IN FRANCE ON 10th MAY 1940 : 308

- 4th battalion Royal Tank Regiment : 50 Matilda I and 5 Vickers MkVIb
- 7th battalion Royal Tank Regiment : 23 Matilda II, 27 Matilda I and 7 Vickers MkVIb
- 13th / 18th Hussars (1st Division) : 28 Vickers MkVIb
- 4th / 7th Dragoon guards (2nd Division) : 28 Vickers MkVIb
- Lothian & Border Horse (48th Division) : 28 Vickers MkVIb
- 15th / 19th Hussars (3rd Division) : 28 Vickers MkVIb
- Innskilling Dragoon guards (4th Division) : 28 Vickers MkVIb
- East Riding Yeomanry (3rd Corps) : 28 Vickers MkVIb
- Fife & Forfar Yeomanry (51st Highland division) : 28 Vickers MkVIb

TOTAL :

- Matilda I : 77
- Matilda II : 23
- Vickers MkVIb : 208

Only the 23 Matilda II are armed to fight against tanks, the other tanks have only MGs.

The 1st Armoured Division is arriving on 17th May 1940 only :

2nd Armoured Brigade
- *2nd Dragoon Guards (Queen's Bays)*
- *9th Queen's Royal Lancers*
- *10th Prince of Wales Lancers*

3rd Armoured Brigade
- *2nd battalion Royal Tank Regiment (not present in France)*
- *3rd battalion Royal Tank Regiment*
- *5th battalion Royal Tank Regiment*

Tank strength :

- Vickers MkVIb : 134
- Cruiser MkI (A9) : 24
- Cruiser MkII (A10) : 31
- Cruiser MkIII (A13) : 95

→ 284 extra tanks but only 150 cruisers able to fight against tanks.

The British tanks except the Matilda II were all too lightly armored and the crew inexperienced. All the British light tanks could be easily penetrated even by the German 2.0cm guns which were not efficient against the French tanks. Some of these British tanks were fast but they did not use this potential advantage to hit and run. As described by German testimonies in Abbeville for example : while fired on, the British tanks generally just stopped to fire or to regroup, allowing the German AT gunners to concentrate easily on sitting ducks. The French tanks at least, even the lighter ones, had the luck to have a 40mm thick armor.

In Abbeville and Arras alone the British lost 167 of their 588 tanks (28% losses) in hours. The first attack on Abbeville for example was led by the 1st AD which lost 120 tanks out of 165 (73% losses), the attack failed in only 2 hours. The counter-attack in Arras involved 60 Matilda I and 16 Matilda II but also 60 French tanks (45 Hotchkiss H35 of the 13e BCC and 15 Hotchkiss H39 + Somua S35 of the 3e DLM). It cannot be called a success with the heavy losses that were sustained by the British troops before retreating : 62% of the British tanks (47 tanks), about 50% in the infantry and 75% of the reconnaissance vehicles (16 armored cars). The French troops covering the right flank were soon confronted to direct 10.5cm artillery and Flak fire as well as Pak and tanks. They were even fired at by British AT guns. They destroyed at least 3 Panzer IV and 6 Pz38(t) from the Pz.Rgt.25 when covering the retreat of the British troops. The French lost about 20 tanks and the Germans about 20 tanks during the battle of Arras.

Several other British tanks were lost around Boulogne and Rouen but most of the remaining tanks simply abandoned or lost due to mechanical breakdowns and could not be recovered and repaired in front of the advancing German troops. The 1940 British army shared the same weaknesses as the bulk of the contemporary French one like the inability to wage mobile battles, slow-thinking command, and what we would today call poor C3I, and did no better job in May/June 1940 than the French army. They were beaten the same way and led their battles more or less according to the same tactics of infantry support.

4. COMPARISON OF FRENCH AND GERMAN ARMORED UNITS

4.1 Organization of armored units

	DLM	DCR	Panzerdivision
Strength	~10,400 men ~3,400 vehicles 174 tanks	~6,400 men ~1,700 vehicles 142 tanks	~12,500 men ~2,400 vehicles 220-340 tanks
Tanks	2 regiments	2 half-brigades (4 battalions)	2 regiments (4 battalions) like in the 1.,2.,3.,4.,5. and 10.PzD
heavy	-	62/63 Renault B1bis (+6 replacement tanks)	-
medium	88 Somua S35 (+8 replacement tanks)	-	65-160 PzIII, Pz38(t), Pz35(t) and PzIV
light	86 Hotchkiss H35/39 (+8 replacement tanks)	80 Hotchkiss H39 or Renault R35 (+10 replacement tanks)	60-260 PzI, PzII and PzBef
Infantry	1 regiment of dragons portés = RDP (3 battalions)	1 battalion of chasseurs portés = BCP	2 regiments (4 battalions of Panzergrenadiers)
Motorcyclists	5 squadrons of dragons portés	-	1 battalion
Armored cars	40 Panhard 178 (+1 radio car + 2 reserve armored car) in a reconnaissance regiment 67 AMR33 / AMR35 ZT1 (+2 reserve armored cars) in the RDP (107 armored cars)	-	Aufklärung Abteilung with 56 armored cars (+ armored halftracks like the SdKfz-251/10)
Artillery	24x 75mm guns 12x 105mm guns	24x 105mm guns	24x 105mm guns 12x 150mm guns 24x 7.5cm leIG 8x 15cm sIG sometimes self-propelled sIG
AA guns	6x 25mm AA guns	-	1 battalion : 9x 8.8cm FlaK 24x 3.7cm and 2.0cm FlaK
AT guns	8x 47mm AT guns 12x 25mm AT guns	8x 47mm AT guns 9x 25mm AT guns	51x 3.7cm PaK 8.8cm FlaK and 10.5cm leFH in direct fire and sometimes self-propelled AT guns
Engineers	3 engineer companies 1 bridging company	1 engineer company	1 battalion
Signals	1 radio company 1 telephone company	1 radio/telephone company	1 battalion

This table gives just roughly a comparison ; specific units may vary from this composition on both sides.

Unlike the French units, the German Panzerdivision is a real little army, able to fight completely independently. It contains numerous tanks and a powerful infantry support. There are important supports : numerous AA guns and good artillery support, more engineers including assault engineers and an efficient supply system.

The French units have several imperfections in their organization and available equipments. There is a lack of modern signals, AA guns, infantry, modern fuel supply organization and river crossing elements compared to the German Panzerdivision. The DLM has a reconnaissance regiment but not the DCR. Each Panzerdivision has an Aufklärung Abteilung and a Kradschützen (motorcycle) battalion. In the DLM the motorized infantry was very well integrated like in the Panzerdivision. The French engineers lacked crossing equipments whereas the German engineers were better integrated in fast and mobile units. The signals are more modern on the German side. The French logistics is originally very efficient but it was shattered by the new fast warfare imposed by the Germans and showed its limits in 1940. Ammunition, food and fuel had therefore often to be transported by requisitioned civilian trucks/lorries. The towing/recovery units were also better organized in the Panzerdivision.

4.2 Concept of use of the armored units

The DLM has to provide intelligence and to make deep reconnaissance, to cover the deployments of the French armies and to fight the enemy AFVs. Once engaged, the DLM will fight like the Panzerdivision but without the massive air support and the numerous spotter aircrafts of the Germans. In Hannut for example each DLM had only 3 modern spotter aircrafts available.

The DCR has by far not the power or the mobility of a Panzerdivision. A DCR remains subordinated to an infantry army which leads the manoeuvre at his own rhythm. The DCR is used for local counter-attacks, heavy charges like an armored fist, but not deeper than 15-25 km. It is rather a "defensive war hammer", powerful but slow, compared to the "offensive and fine sword" constituted by a Panzerdivision.

The French armored units were not a separate arm ; they were depending from the infantry or the cavalry in 1940. The French tanks were intended to work closely with the infantry, allowing it to advance from one specific target to an other. French armored units are meant to fill a gap in a front, to counter-attack against an enemy offensive, to delay the enemy long enough to enable the deployment of infantry division on a rear frontline or to piece the enemy lines but only 15-25 km deep. A German Panzerdivision is able to penetrate 100 km in the rear of the enemy lines before having to be supplied.
The German Panzerwaffe was organized for the kind of war it wanted to fight in 1940. It was independent and in the center of the operational chain unlike the French armored units. Everything around was subordinated to it or thought to support it.

One must add that the German doctrine for the Panzerwaffe was very often to avoid combat against the French tanks. The Luftwaffe and/or AT guns had to neutralize the enemy tanks. They engaged AT guns, 8.8cm FlaK and 10.5cm field guns in direct fire against the tanks while the German tanks went deeper in the French lines, spreading like water and disorganizing the rear lines.

4.3 Number of tanks and common mistaken conclusion

On 10th May 1940, there are 2636 German tanks, 99 Panzerjäger I, 24 Sturmgeschütze, 38 15cm s.I.G.33 auf Pz.Kpfw.I, 6 8.8cm FlaK (Sfl) auf Sd.Kfz. 8 and 917 armored cars for a total of 3720 AFVs. 965 tanks are armed with a 3.7cm or 7.5cm gun, 99 Panzerjäger I with a 4.7cm gun and 24 StuG III with a 7.5cm gun. That leads to **1088 German AFVs armed with a good AT capacity** (not counting the 6 8.8cm self-propelled AT guns).

There are 2307 modern French tanks (2777 tanks with the obsolete FT17 and FCM-2C tanks) and about 575 armored cars or light reconnaissance tanks. That makes 3056 French tanks (if the AMR33/35s are counted as tanks) :

- only about 480 French tanks armed with a 47mm SA35 (including the B1bis tanks with their 75mm hull gun)
- about 300-350 which have a 37mm SA38 gun.
- from the 279 AMR33/35s, 259 are only armed with a single 7.5mm or 13.2mm MG and 20 AMR35 have a 25mm SA35 gun, which is also better than the German 3.7cm gun.

That makes **800-850 French tanks (26-28%) with an excellent to good anti-tank capacity**.

The huge majority of the French tanks (2206-2256 tanks) are light tanks armed with the 37mm SA18 gun or only MGs. The 37mm SA18 gun can be used at 300-400m against the Panzer I and Panzer II but to knock out a Panzer III Ausf.E/F (the previous models are less armored and easier to destroy) or a Panzer IV Ausf.C/D, they have to get as close as < 25-100m, whereas the enemy can destroy them at about 300m (3.7cm KwK) to 500m (7.5cm KwK) and even from longer range if you consider the obsolete Renault FT17.

On 10th May 1940, the British armored units add only 23 tanks (Matilda II) with a good AT capacity and the Belgian armored units add 236 tanks and self-propelled AT guns for a total of **1059-1109 allied AFVs with a good to very good AT capacity.**

But note that the German AFVs have an armor of 13-30mm whereas the French tanks (except the obsolete ones) have generally a 40-60mm armor (35mm for the hull of the Hotchkiss H35).

There are comparable numbers of allied and German tanks with about 2800-2900 tanks. If all the AFVs are counted there are 4033 allied vs 3720 German AFVs, with the obsolete French FT17 and FCM-2C tanks being counted (3563 allied vs 3720 German AFVs without them). This apparent "equality" in the number of tanks is purely mathematical and just taken as such by many people. In the facts it is completely false.

All the about 3000 German tanks are concentrated in the 10 Panzerdivisionen unlike only about 960 French tanks in the DCR/DLM. Each DCR/DLM has less tanks than a Panzerdivision : there are roughly 10x300 German tanks against 6x160 French tanks and many dispersed battalions. That was the reality on the battlefield. The British 1st AD, which arrives during May 1940, concentrated the cruiser tanks but did not really change the balance and was quickly neutralized. All the Belgian tanks were dispersed in small numbers in their infantry divisions, the higher number of Belgian tanks could be found in the 1e division de chasseurs ardennais with about 50 AFVs. During the battle the Belgian AFvs were generally dispersed in groups of 2-4 AFVs.

In the DLM/DCR 80-90 tanks are only light tanks unlike what was initially planned (only medium/heavy tanks). 80% of these light tanks are armed with the 37mm SA18 L/21 gun and only 20% with the 37mm SA38 L/33 gun. The 37mm SA18 is only adapted to infantry support. A tank armed with the 37mm SA18 gun can actually destroy armored cars, Panzer I and Panzer II tanks at 300-400m but has to go closer than 25-100m to have a chance to destroy a Panzer III or Panzer IV, whereas it can itself be destroyed at 300-400m by them.

The DLMs were led by the cavalry corps HQ and the different DCRs were commanded by an armored group HQ. Nevertheless, these HQs had insufficient means unlike the Panzerkorps which had fully operational HQs.

Thanks to more radio sets the German tanks were able to better coordinate and concentrate their attack, changing more easily the attack axis. The French tanks favored better armor (and armament if we exclude the 37mm SA18 gun) rather than communications and speed. This better tactical regulation resulted in much more concentrated German armor against allied tanks, usually 4 vs 1, sometimes even 8-10 vs 1 odds.

4.4 Fuel supply

In the French army there were 5-10 liters fuels cans but most of the fuel supply relied on fuel tank trucks or lorries carrying 50 liters fuel cans. For example each B1bis tank company had the fuel required for "4 days" of operations without being supplied by units higher than the battalion level.

- "1 day" in the tanks of the company themselves (10x 400l for the 10 B1bis tanks)
- "1 day" thanks to the Lorraine 37L TRC (fuel supply tractors) of the company (6x565l = 3390l)
- "1 day" thanks to the fuel tank truck of the company (3600l)
- "1 day" for each combat company thanks to the 50l fuel barrels provided by the battalion's supply company

Various fuel trucks where used by the French army for the strategic transport of fuel :

- Unic SU55 (5000 l) : 23
- Panhard K125 (5000 l) : 4
- Berliet VDCN (5000 l) : 80
- Renault AGR (5000 l) : 16
- Renault AGK (5000 l) : 340
- Berliet GDR7 (5000 l) : 400
- Matford F917-WS (5000 l) : 150
- Willeme (18000 l) : 0-50
- Renault AIB1 (9500 l) : ?
- Also a few White 920 (8000 l and 18000 l), Mack EXBX (18000l) and several Chevrolet conversions. + civilian requisitioned trucks.

For the cross-country/tactical supply on the battlefield other vehicles were used :

- Lorraine 37L TRC as mentioned (565 l fuel + ammunitions + oil + water) : 482

The Lorraine 37L TRC was very liked because of its armor + good cross country capacity, he could supply the first line troops.

- Renault 36R tractor with a 450 l trailer : 260
- Laffly/Hotchkiss S20 TL (1450 - 1900 l) : 39
- Lorraine 28 (2000 l) : a dozen
- Citroën-Kégresse P17 (2000 l) : 50

- + special dedicated trailers (450 l, 600 l and 800 l models) that could be towed by the tanks themselves, by tractors or tankettes.

In the German army nevertheless the use of the jerricans was more generalized and supply was quicker and easier on the frontline.

4.5 Tank carriers and towing / recovery elements

Until 1935/1937 most of the tank carriers were simply trucks with an embarkation ramp allowing the truck to carry the tank. This solution had been adopted in the 20's for strategic movements.

For the new light tanks (R35, FCM36, H35, H39 ...) special lifting-carrier trucks (camions "leveurs-porteurs") were also developed : Berliet GPE2 (1 produced), Berliet GPE3 (2 produced), Berliet GPE4 (32 produced) and Willeme DW12A truck (5 produced).

The theoretical strength was at first 3 lifting-carrier trucks for a battalion of 45 light tanks and later only 1 lifting-carrier truck complemented by 2 simple tank carrier trucks with no special device except a winch and an embarkation / disembarkation ramp. Of these tank carriers, 430 Bernard trucks had been ordered for example, but only 73 were delivered. 300 White-Ruxtall 922 US tank carriers had also been ordered but only one vehicle could be delivered. 5 ex-Spanish Autocar (US trucks) were also used.

Medium (D2, Somua S35 ...) or heavy (B1 and B1bis) tanks needed a dedicated trailer towed by a tractor (Somua MCL5, Somua MCL6, Laffly S35T, Laffly S45T or Latil M4T). There were two types of trailers : 20t and 30t. These trailers were produced by Titan, Coder, Lagache & Glazmann ... Theoretically there should be one trailer for a company of 10 Renault B1bis and two trailers for a squadron of 20 Somua S35 cavalry tanks. Only 60 20t trailers and 40 30t trailers had been delivered to the French army.

From 1935 on, the typical tow truck was the Somua MCL5, but this vehicle reached its limits with the B series heavy tanks because of its only 90 hp engine. Therefore the Laffly S45T had been developed but only 12 vehicles were delivered, explaining that the Somua MCL5 was sometimes replaced by the Laffly S35T.

The Laffly S35 has been developed to tow the 155mm GPF gun, the 155mm GPFT gun and the 220mm C M^{le}1916 heavy mortar. Only 225 Laffly S35 had been delivered, 170 of them in the towing version with a winch. That means that the Somua MCL5 was still widely in use and that in the artillery units the heavy pieces were still mostly towed by vehicles like the Latil TARH2. All these wreckers should have been replaced by the huge Latil M4TX (8x8, 140 hp) but this one only reached the prototype level in 1940. The Latil M4TX could easily tow 100t, which is to say it could easily tow a B1bis tank with blocked or destroyed tracks.

4.6 Training / Instruction

For the DCR, the training went generally not further than the battalion level. Only the individual tank / platoon / company and battalion warfare was at level. For the DLMs, the training was excellent for the 1^{e} DLM and 2^{e} DLM, even at the divisional and corps level but was rather insufficient for the 3^{e} DLM which included many reservists. One of the best unit of the French army is probably the 1^{e} DLM. This division has been very well trained for long, all the crew were highly motivated and knew very well their tanks (mechanics, functions, armament, tactics) etc. The division had practised division-scaled trainings and inter-arms trainings (tanks + infantry + artillery) before the war. This is a perfect example of a very good mechanized unit of the French army. In opposition there is for example the 7^{e} RC (Régiment de Cuirassiers) formed after the 10th May 1940 had brand new tanks but 80% of the crew who were perfect rookies.
On the German side, as soon as 1935 the forming Panzerdivisionen had a coherent and continual training, even if Guderian like in France encountered strong opposition from pro-horse lobbies at the beginning. During the Spanish civil war several trials were made with the Panzer I, influencing the later organization of the German armored units. Nevertheless, listening to some people it seems that all the German tankers of 1940 acquired a high level of training in Spain in 1937, which is of course by far exaggerated. The Spanish civil war had also roughly nothing to do with the modern warfare of May 1940 which was even not applied in 1939 in Poland.
The maneuvers in Czechoslovakia allowed to train massive movements and the combats in Poland allowed to modify/adapt and modernize the Panzerwaffe which proved not sufficient in several cases and which was not concentrated in Poland.

4.7 Air support

Operational frontline aircrafts on 10th May 1940 on the western front : France : 879 UK : 384 (total of 416 : 100 fighter (Hurricane + Gladiator) and 316 attack/bomber (Fairey Battle + Blenheim) Belgium : 118 Netherlands : 72 Germany : 2589

The French air force was largely inferior to the German one, in numbers and quality, especially the bomber fleet which was really small in comparison.
The French air force had some 1900 aircrafts, of which only about 1,400 frontline aircrafts available (650 fighters, 240 bombers and 490 reconnaissance and observation). It was conceived as a **defensive arm**, in cooperation with / attached to the ground troops. It was therefore very dispersed and it explains the importance of the reconnaissance fleet working for the ground troops At the time of the German attack the French air force was just modernizing and reorganizing.
There were only 36 Dewoitine D520 fighters in May 1940, the others were Morane-Saulnier 406, Curtiss H75, Bloch 151, Bloch 152 and Potez 631 fighters. Only 400 fighters were operational on 10th May 1940.
Only 120 of the bomber/assault aircrafts were modern ones (10 Amiot 354, 55 Lioré et Olivier 451, 45 Bréguet 691 or 693, 10 Potez 633) with 85 being operational. The others were older ones : 75 Bloch 200 or 210, 10 Farman 221 or 222 and 35 Amiot 143 with about 100 considered operational.
From the 490 reconnaissance aircrafts only 370 are really operational and rather modern ones : Bloch 174, Potez 637 and Potez 63/11. Older Mureaux 115 and 117 were also still in use.
Great Britain sent 416 aircrafts in France and kept about 800 aircrafts in Great Britain but all the allied planes available (1340 French + 416 British + about 190 for Belgium and the Netherlands = 1946) was still inferior to the about 3,000 / 3,500 German aircrafts effectively used during the 1940 western campaign. Nevertheless the RAF was also active from Great Britain, especially during the battle of Dunkirk. At the beginning of the German attack mostly all the Dutch and Belgian aviation are destroyed on the ground as well as 232 French aircrafts.

The German air force was conceived as an **offensive arm** with very numerous fighters and a powerful tactical bombardment/attack fleet to support the ground troops like aerial artillery. They had 1,264 fighters (1016 single-seat fighters like the Me109 and Me110) and 1,120 bombers (He111, Do17, Ju88). The VIII.Fliegerkorps concentrated 300 Ju87 "Stuka" dive bombers and 42 Hs123 "assault" biplanes for close air support. There were also about 700 observation and reconnaissance planes (Fi156, Hs126, Do17, He111 and Ju88) and about 450 transport planes for a total of about 3900 aircrafts. The Germans had a powerful fighter's fleet, which combined with a very powerful mobile AA artillery covering the advancing troops was decisive to gain the air superiority. More of the 892 destroyed French aircrafts were shot down by the AA guns than by the German fighters. On 13th May 1940, the Luftwaffe was able for the first time of history to concentrate about 1500 aircrafts over the small area of Sedan were only weak French divisions were defending an overstretched front.

The Panzewaffe was actually trained to cooperate closely with the Luftwaffe, especially the VIII.Fliegerkorps, which concentrates all the dive bombers and assault aircrafts, specialized in close air support, and providing a new kind of mobile artillery to support the advance of the Panzerdivisionen. The Germans were able to concentrate all their tanks in the Panzerdivisionen but also all their dive bombers in one Fliegerkorps. The Germans had also the advantage of having omnipresent observation aircrafts to support them.

5. QUALITY OF THE FRENCH TANKS

French tanks were generally slower and less mobile than the German tanks. The German main advantages were speed, ability to concentrate tanks and better capacity to change the attack axis thanks to the radio sets.
The main French advantages were a thick armor even for the light tanks (40-60mm for the French tanks versus 13-30mm for the German tanks), able to resist to many German hits and sometimes a better armament with the 47mm SA35 L/32 gun. It is able to destroy all the German tanks up to 800-1000m but generally the French rate of fire is slower because of the 1-man turret where the commander is also spotter, loader and gunner.
French tanks were generally more adapted to heavy and brutal charges against slow or immobile targets but were not really conceived for a war in which speed and mobility rules. And this speed and mobility was created by the revolutionary Panzerdivisionen. Only the Somua S35 cavalry tank could really compete with the German tanks in terms of speed, mobility and autonomy.

5.1 Speed and autonomy of the tanks

	Top Speed (km/h)	autonomy (by road, in km)
GERMAN TANKS		
Panzer I	40	170
Panzer II	40	200
Panzer III	40	165
Panzer IV	40	165
Panzer 38(t)	**42**	**250**
Panzer 35(t)	35	190
FRENCH TANKS		
Renault FT17	7.5	35
Renault AMC-34 (YR)	40	200
Renault AMC-35 (ACG1)	**42**	160
Renault R35	20	140
Renault R40	20	140
Hotchkiss H35	35	150
Hotchkiss H39	36.5	150
FCM36	24	225
Renault D1	18	90
Renault D2	23	100
Somua S35	**44**	**255**
Renault B1	28	180
Renault B1bis	28	160
Renault AMR-33	***54***	*200*
Renault AMR-35	***55***	*200*

German tanks are generally faster and more mobile : 7-10 hp/ton for the French tanks which are heavier and 15-20 hp/ton for the German tanks. The autonomy of the French tanks is not that bad at all compared to German tanks. The autonomy was good for the Somua S35 cavalry tank, in adequacy with its role, but it remained insufficient for the Renault B1bis and the Hotchkiss H39 tanks.
Nevertheless, the Renault B1bis tanks used much fuel because the engine was not only used for advancing but also largely used for aiming the 75mm SA35 hull gun in combat. Even if not advancing the engine was used to make the tank turn in place and aim the 75mm SA35 hull gun. The maximum speed are good for the French tanks but due to lower hp/ton ratio they needed generally more time than German tanks to reach it.

The German tanks were generally able to move at about 30 km/h offroad. For a Renault R35, the top speed in medium difficult offroad terrain was only 8.7 km/h. The Hotchkiss H39 was better with 16 km/h in medium difficult offroad terrain and even the heavy Renault B1bis was better with 21 km/h (easy offroad) to 10-15 km/h (hard offroad). The mean speed of the Somua S35 was measured at 35 km/h onroad, 32.3 km/h in easy/medium offroad terrain (fields etc.) and 11.19 km/h in hard offroad terrain (rough, ditches etc.), which makes of it a tank able to compete with the German ones.

5.2 Conception of the turrets, the French 1-man turret issue

On the French side all of the tanks and armored cars had a 1-man turret except :

- **FCM-2C** (11 men with 3 in the front turret with the 75mm gun and 1 in a rear MG turret)
- **AMD White** (2-men turret)

- **AMD Laffly 50AM** (2-men turret)
- **AMD Panhard 165/175** (2-men turret)
- **AMD Panhard 178** (2-men APX3 turret)
- **AMC Renault ACG-1** (2-men APX2 turret – 1.395m turret ring)
- And actually the **Somua S-35's APX1CE turret is sometimes described as a "one-and-a-half-man turret"**, as the enlarged turret ring (1.130m instead of 1.022m), compared to the APX1/4 found on the B1/B1bis, allowed the radio operator to easily provide assistance to the commander/gunner/loader. The radio operator could get out of his seat and stand up to function as the "loader".

For the 1-man turrets :
The APX-R turret weights 1552 kg (Renault R35/39/40, Hotchkiss H35/39) - 40mm armor – cast
The APX1 = 2100 kg (Renault B1) - 40mm armor - cast – 1.022m ring
The APX4 = 2570 kg (Renault B1bis, Renault D2) - 60mm armor – cast
The APX1CE = ???? kg (between 2100 and 2500 kg) (Somua S35) - 40-42mm armor - cast – 1.130m ring
The FCM = 1287 kg (FCM36) - 40mm armor - RHA (+cast) plates welded together

For the modern 2-men turrets :
The APX2 = ???? kg (Renault ACG-1) - 25mm armor - cast plates bolted together – 1.395m ring
The APX3 = ???? kg (Panhard 178) - 26mm maximum armor on the front hull – RHA

For example the turret of the Panzer IV F1 weights 3050 kg. Nonetheless the armor increased at least two times between the Panzer IV used in France and the Ausf.F1.

Germans had 1-man turrets for their Panzer I and Panzer II (except the late war model Panzer II Luchs with 2 men). In the Panzer II like in the Somua S-35 one crew member not sitting in the turret could be the loader. The Panzer III and Panzer IV had 3 men in the turret. The British Matilda I also had a 1-man turret.
In the French 1-man turret the commander is also spotter, loader and gunner and sometimes platoon or company/squadron leader. When looking for a new shell in the darkness of the hull (no ammunition stored in the turret), nobody is spotting or firing, the tactical awareness could therefore become rather bad. In the Renault B1bis or Somua S35 for example the situation is better because at least one crew member assisted the tank commander and acted as loader. The Somua S35 had a larger turret ring favoring such help.
The B1bis command tanks had one crew member more, theoretically a second radio (but generally he was also commander's assistant/loader), the crew was therefore composed of 5 men instead of 4 men for a regular tank. In fact the team of each B1bis included also 2 engineers who should normally not have taken part to the fights inside the tank, but there are many examples of engineers having volunteered to be part of the crew, especially to assist the tank commander, which was alone in the turret. The crew was therefore very commonly of 5 men (even 6 men sometimes) instead of 4 men in a Renault B1bis.

The French tanks due to their 1-man turret were probably a bit more intricate to use. For rookie tank crews it has proven to be very hard, a rookie crew will probably be more effective in a German tank than in a French one. Lieutenant-colonel Baillou who was tank commander in the 3^{e} DLM in 1940, officer in the 2nd French armored division in North Africa and France and instructor from 1945 to 1950 described well the issue of the 1-man turret. He also explained that c ontrary to the 1^{e} DLM and 2^{e} DLM who had well trained crews, the 3^{e} DLM (except some officers from the other DLMs) had only reservists who did their military service on horse and some of them discovered their tank a short time before being engaged. To worsen the situation, most of the Somua of the 3^{e} DLM went to combat with 2 crew members instead of 3, many tankers were in permission at the beginning of the combats and therefore nobody was there to help the commander to reload. In these tanks the Somua had really a 1-man turret instead of a 1 ½ one. This can explain why *one* German source (even not specified) is quoted in Gunsburg's article "battle of the Belgian plain" about the bad gunnery skills of the French tankers. The 3^{e} DLM in Hannut which had a very high proportion of reservists sustained heavy losses while the more experienced crews of the 2^{e} DLM (also less engaged) in the same battle had only light losses. Nevertheless the 3^{e} DLM reservists inflicted significant losses to the elite of the Panzerwaffe. Each counter-attack made by a small formation of Somua S35 tanks was seen as critical by the Germans. For this division, there was of course the absence of tracer shells and the fact that roughly all the Hotchkiss tanks of the 3^{e} DLM had 37mm SA18 L/21 guns with only poor anti-tank efficiency. It is a miracle that they could fight so well against the elite Panzerwaffe in Hannut. They had better tanks (considering the Somua S35 tanks) than most of the German crews but mostly with crews lacking training. In 1940, the French tanks like the Somua S35 had better armor and main gun than the German tanks but the crews of the 3^{e} DLM were less experienced than their enemy. Other units had experienced crews. One can absolutely not generalize about bad French tankers as it is often said in a typical French bashing spirit.

In 1940, when the French crews were experienced with their tanks they were at the level of the German tankers. They knew how to operate their tanks, even if it was a bit different than for a German crew. The 2^{e} DLM in Hannut / Gembloux had rather light losses and proved to be a dangerous opponent. Many German tanks were knocked out but as the ground was later controlled by the Germans they could recover/repair the damaged ones unlike the French which had also to abandon several tanks due to mechanical breakdowns. A French tank is more intricate

and becomes really a deadly and efficient weapon only with experienced crews. A rookie crew will have several drawbacks. History has shown that the experienced French crews were at level with their German opponents. An other example of that is the engagement of 10 Somua S35 tanks of the 4e regiment de cuirassiers (1e DLM) in the town of Jolimetz on 18th May 1940 against half of the 5. Panzerdivision. In 10 vs 1 odd, the French lost 10 tanks (destroyed or abandoned) and the Germans 26 tanks, including many Panzer IVs. That is a perfect example of what well-trained French crews were able to do.
Baillou explained that in 1943-1945 the situation was inverted : they were more experienced than most of the German crews they met which on their side had better tanks (Panthers in his explanation). They also took advantage of a drawback of the Panther : when the slope was to important in a hilly countryside, the turret became too heavy to be rotated for the Panther, they had to turn all the tank. The French transposed the cavalry spirit to the French armored division of the liberation, and many officers were veterans from the DLMs, applying the cavalry speed and tactics but this time with the Sherman which had an intercom system and a radio. Often they checked the range of a target by firing tracer rounds with the coaxial machinegun. They had observed that until range X it corresponded roughly to the ballistics of the main gun. Many French tankers and commanders who were defeated in 1940 were again in armoured units for the liberation and drew their tanks in the heart of Germany and Austria.

5.3 Vision means in the French turrets

Renault R35/39/40 and Hotchkiss H35/39 tanks vision means

Hull :
1x E2B episcope (early models) (28° vertical field of view) OR 1x PPL RX 180 P episcope (30° vertical field of view)
2x lateral slits

APX-R or APX-R1 (37mm SA18 or 37mm SA38 gun) turret (1552 kg) :
1x L.739 sight (37mm SA18 gun) OR 1x L.767 sight (37mm SA38 gun)
3x diascopes (28° vertical field of view) (early) OR 3x PPL RX 160 episcopes (30° vertical field of view)
1x rear slit

Cupola :
1x Estienne slit (114° field of view – 120mm x 10mm slit protected by a 24mm thick armored shutter) (early) OR 1x PPL RX 180 P episcope (APX-R1) (30° vertical field of view)

FCM-36 tank vision means

Hull :
1x PPL RX 160 episcope (68° horizontal field of view, 24° vertical field of view)
2x lateral slits

FCM turret (1287 kg) :
1x L.739 sight (37mm SA18 gun) OR 1x L.767 sight (37mm SA38 gun) but rare.
3x PPL RX 160 episcopes (68° horizontal field of view, 24° vertical field of view)
3x slits

Renault B1bis tank vision means

Hull :
2x L.710 sights for the 75mm SA35 gun (stereoscopic telemeter, each with 3.5x magnification, field of view 11.15° and range ladders, adjustable drum up to 1600m).
1x adjustable slit with PPL RX 160 episcope (E2B episcope on the B1)
2x lateral slits
1x periscope (about 180° horizontal field of view)

APX4 turret (56mm armor, 2570 kg) :
1x sight for the 47mm SA35 gun (4x L.762 sight, + reticle, field of view 11.82°)
2x PPL RX 160 episcopes (68° horizontal field of view and +3° to -21° = 24° vertical field of view)

Cupola :
1x periscopic binocular (4x magnification, 8.91° field of view)
1x PPL RX 160 episcope (68° horizontal field of view and +2° to -22° = 24° vertical field of view)
1x Estienne slit (114° field of view – 120mm x 10mm slit protected by a 24mm thick armored shutter)

Somua S35 tank vision means

Hull :
3x PPL RX 160 episcopes (68° horizontal field of view, 24° vertical field of view)

APX1CE turret (42mm armor, about 2100 kg) :
1x sight for the 47mm SA35 gun (4x L.762 sight, + reticle, field of view 11.82°)
2x PPL RX 160 episcopes (68° horizontal field of view, 24° vertical field of view)

Cupola :
1x periscopic binocular (4x magnification, 8.91° field of view)
1x PPL RX 160 episcope (68° horizontal field of view, 24° vertical field of view)
1x Estienne slit (114° field of view – 120mm x 10mm slit protected by a 24mm thick armored shutter)

According to Robert Le Bel, a former Hotchkiss tank commander, periscopes were also used from inside the tank, out of the copula !

5.4 Armor and turret rotation speed

Armor is the main advantage of French tanks with 40-60mm thickness (only 35mm for the Hotchkiss H35). It enables them to sustain numerous hits without being damaged. Many Renault B1bis received 40-140 3.7cm and even 7.5cm hits without having to break the combat and many German AT guns were simply crushed under their tracks, being unable to stop them.
With the Somua S35 such situations were also common and during the battles of Hannut/Gembloux many Somua S35 came back with 20-40 hits without serious damage. Even the lighter Renault R35/40 and Hotchkiss H35/39 resisted rather well to the German AT guns.
On French tanks cast armor allowed for better profiled armor. The armor was often rounded and had also often more sloped area than on the German tanks.

Except for the Renault B1bis all the French armor are generally cast. The values of the angles are therefore difficult to give in a table because there is a huge number of rounded angles and parts. Nevertheless on can for example mention the surface of the front (turret and hull) really exposed to the enemy fire :
- **For a Renault R35 : 2.00 m^2 with only 0.65 m^2 with a slope inferior to 30°**
- **For a Hotchkiss H35 : 6.00 m^2 with only 3.24 m^2 with a slope inferior to 30°**

That gives a good idea of the few vulnerable surfaces of these little tanks.

Type of armor and turret rotation speed (360°) :
RHA = Rolled Hardened Armor
FH RHA = Face Hardened Rolled Armor
APX = Atelier de Puteaux = Puteaux workshop / factory

- **Hotchkiss H35 and H39 (APX-R and APX-R1 turret - hand 27 seconds + 10° traverse for the gun)**

APX-R turret (1552 kg) is cast and hull is cast bolted armor.
The turrets are hand-cranked in the H35/39 and R35/39/40 tanks and could also be unlocked from the training crank and moved with the rotation of the gunner's body for quick snap-turns.

- **Renault R35 and R40 (APX-R and APX-R1 turret - hand 27 seconds + 10° traverse for the gun)**

APX-R turret (1552 kg) is cast and hull is made of 3 cast parts + RHA bolted armor elements.
The turrets are hand-cranked in the H35/39 and R35/39/40 tanks and could also be unlocked from the training crank and moved with the rotation of the gunner's body for quick snap-turns.

- **Renault B1 (APX1 turret - electric 28 seconds + hand : 2°21 per wheel turn)**

APX1 turret (2100 kg with the 47mm SA35 gun, 1.022m ring) is cast and hull is RHA bolted armor.

- **Renault B1bis (APX4 turret - electric 36 seconds + hand 55 seconds)**

APX4 turret (2570 kg with the complete armament, 1.022m ring) is cast and hull is RHA bolted armor.

- **Somua S35 (APX1CE turret - electric 20-30 seconds + hand)**

APX1CE turret (1.130m ring) is cast and hull is cast welded armor.

- **FCM-36 (FCM turret - electric 21 seconds + hand)**

FCM turret (1287 kg) is RHA+cast welded armor and hull is RHA welded armor.

• **Renault D1 (ST2 - electric + hand)**
ST2 turret is cast and hull is RHA bolted.

• **Renault D2 (APX1 and APX4 turret - electric 28 seconds (APX1) or 36 seconds (APX4) + hand)**
APX1/4 turret (1.022m ring) in cast and hull is cast welded armor.

• **AMR-33 and AMR-35**
RHA bolted armor.

• **AMC-34 and AMC-35 (AMC-35 = APX2 turret, AMC-34 = APX1 or APX2 turret)**
APX2 turret (1.395m ring) is made of cast plates bolted together, the hull is RHA bolted armor.

• **Panhard P-178 (APX3 turret)**
Turret and hull are RHA bolted armor.

France's metallurgical industries were competitive in WW2 but French armor seems slighlty inferior in purity to German steels at the beginning of WW2. French steel was mainly extracted/produced in north-eastern **France (Lorraine)** but also imported from **Sweden** and **Germany** (the Ruhr was occupied by France after WW1 and during the 20's and many resources were taken from this area). French RHA was a Cr-Ni steel and delivered about the same effective protection as German Cr-Ni free steel, but slightly less than German Cr-Ni steels. There is therefore no deficiency multiplier for French RHA armor but French used very often cast armor. The **rounded cast armor** on some French tanks like the APX turrets, the hull front of the Somua S35 etc. plays an important role in defeating the German shells. The French army did not use FH RHA.
The German FH RHA benefit is sometimes reduced when using APC and APCBC shells**. Almost all the French AT rounds were AP capped**, except the shells from the 75mm SA35 L/17 (B1bis hull gun), the 25mm L/72 AT guns and the 25mm L/60 (or L/47.2 ?) AT gun from the Panhard 178. The British ammunitions were also uncapped during the battle of France.

French translations :
Bolted = "riveté"
Welded = "soudé"
Cast = "moulé" or "coulé"
Rolled = "laminé"

Concerning the B1bis "invicibility", penetration from the front is minimized due to the frontal sloped armor, penetration on the turret is minimized due to rounded construction and the armor thickness in 60mm RHA on the front hull and 56mm cast on the turret (+ the gun mantlet on the front turret).

The 3.7cm PaK earned it's nickname of "door knocker" when faced against the British Matilda II tanks (only 23 in the 1940 western campaign) and/or the Renault B1bis tanks, the last one being called "Kolossus".

Concerning the usage of German APCR rounds (Pzgr.40) available in small number for the PzKpfw III F and 3.7cm PaK in June 1940, the round is VERY light. After 250m, the APCR round looses its amount of overall energy at an incredible rate. After about 300m, standard AP shot will do more than APCR will be able to do. From 0-250m though, even the Renault B1bis and Matilda II are both at risk if a good shot from an APCR round is attained. Under 250m range from favourable angles, the B1bis is easily susceptible to penetration by the 3.7cm APCR round fired from the PzKpfw III F, especially in the side and rear hull which are vertical plates.

At most combat ranges from favorable angles, the B1bis is susceptible to penetration by the 4.7cm Pak(t) auf PzKpfw I Ausf B (PanzerJäger I Ausf. B), especially in the side and rear hull which are vertical plates.

The B1 bis, in most regards, is "invincible" to most rounds otherwise from all German calibers, including 7.5cm shells fired from the PzKpfw IV and StuG III. At close range (< 100m) the 7.5cm shells are a threat but not the 3.7cm AP shells which are not sufficient. The Renault B1bis, in most combat conditions is a very dangerous opponent. Once it looses it's ability to maneuver (e.g. track knocked off) or when outnumbered and loosing tactical awareness, it is a sitting duck for a skilled commander (with the help of smoke rounds also for example).
On 16th May in Stonne, a single B1bis tank (the B1bis "Eure" from Lieutenant Bilotte) pushed in the town itself into the German defenses and went back. He attacked a German column of Pz.Rgt.8 and destroyed 2 PzIV, 11 PzIII and 2 PaK36 guns. The first shots destroyed simultaneously the first (with the 47mm gun) and the last tank (with the 75mm gun) of the column. The first German tanks were at less than 50m range. The armor of the B1bis was scattered with 140 impacts, no one penetrated or really damaged the armor.
During the battle of Abbeville the B1bis "Jeanne d'Arc") sustained more than 90 impacts from 3.7cm PaK without being penetrated and simply crushed several AT guns.

The B1bis was almost invincible when engaged by 3.7cm AT guns if not a point-blank range and a lot of luck. Mostly all the B1bis that had been lost due to the enemy had been destroyed by 8.8cm Flak, indirect artillery fire, direct 10.5cm artillery fire and anti-tank mines. Many others have been abandoned after mechanical breakdowns or being out of fuel.

5.5 Rate of fire

Typical early WW2 ammunitions like the French 25mm, 37mm and 47mm were rather small and easy to handle, much lighter in weight compared to later bigger shells (the German 8.8cm shell for example). Big shells are more heavy and difficult to handle inside a tank. Practical rate of fire in tanks is about 4-12 rpm.
The French tank guns had a semi-automatic system on the breech (**SA = semi-automatique = semi-automatic**) : block opening, ejecting case and drawing a firing pin were automatic. The gunner had just to introduce the shell and to fire. After firing, the recoil opened the breech and the shell case was automatically ejected. This semi-automatic breech allowed winning precious time.
Not only caliber and ammo type used had an effect on rate of fire, also crew ergonomics and number and how their tasks were arranged played great role, especially in combat. In the APX4 turret of the B1bis tank, the practical rate of fire of the 47mm SA35 gun was 6 rpm in accurate aiming/firing (15 rpm theoretical) but it could drop down to 2-3 rpm in combat. The rate of fire of the 47mm turret gun in the B1bis is probably slightly lower than in the Somua S35 turret which had a larger one (APX1CE, CE means "chemin élargie", enlarged turret ring), enabling a crewman to provide direct help to the tank commander / gunner. **Nevertheless the B1bis crew was often increased from 4 to 5 men, one additional man assisting the commander.** And last but not least factor, the training of the crew had obviously also an effect on rate of fire.
After firing many rounds the spent cases will be in the gunner's way on the floor of tank, stuck in the turret mechanism. The crew had to throw them out to avoid interfering with the movement of the turret and gun and dangerous. The B1bis and Somua S35 tanks for example had several little traps to get rid of ammunition cases.
The ergonomics and rate of fire was superior in German turrets. Therefore only well trained men were able to use the French turrets really efficiently but for new recruits a French turret was more intricate to operate than a German turret. The German tanks were generally firing 2-3 times more than the French ones but the French tanks could far better resist to the hits.

5.6 French guns and shells

There are 2307 modern French tanks (2777 tanks with the obsolete FT17 and FCM-2C tanks) and about 575 armored cars or light reconnaissance tanks. That makes 3056 French tanks (if the AMR33/35s are counted as tanks) :

- only about 480 French tanks armed with a 47mm SA35 (including the B1bis tanks with their 75mm hull gun)
- about 300-350 which have a 37mm SA38 gun.
- from the 279 AMR33/35s, 259 are only armed with a single 7.5mm or 13.2mm MG and 20 AMR35 have a 25mm SA35 gun, which is also better than the German 3.7cm gun.

That makes **800-850 French tanks (26-28%) with an excellent to good anti-tank capacity**.

The huge majority of the French tanks (2206-2256 tanks) are light tanks armed with the 37mm SA18 gun or only MGs. The 37mm SA18 gun can be used at 300-400m against the Panzer I and Panzer II but to knock out a Panzer III Ausf.E/F (the previous models are less armored and easier to destroy) or a Panzer IV Ausf.C/D, they have to get as close as < 25-100m, whereas the enemy can destroy them at about 300m (3.7cm KwK) to 500m (7.5cm KwK) and even from longer range if you consider the obsolete Renault FT17.

The characteristics of each gun and shell are detailed in an other document but the different ones are listed here :

8mm Hotchkiss M^{le}1914 MG

- Cartouche M^{le}1886 D (am) (**heavy ball**)
- Cartouche de 8mm à balle traceuse (**T**)
- Cartouche de 8mm à balle perforante (**AP**)
- Cartouche M^{le}1932 N (**very heavy ball**)

7.5mm 'Reibel' MAC M^{le}1931 MG

- Cartouche M^{le}1929 C
- Cartouche M^{le}1929 D (**heavy ball**)
- Cartouche M^{le}1929 T (**T**)
- Cartouche M^{le}1929 P and TP (**AP and APT**)
- Cartouche M^{le}1929 I (Incendiary)

13.2mm Hotchkiss M^{le}1930 HMG
- Cartouche M^{le}1935 (**heavy ball**)
- Cartouche M^{le}1935 T (**T**)
- Cartouche M^{le}1935 PT (**APT**)
- Cartouche M^{le}1935 P (**AP**)

25mm SA35 (L/47.2 or L/60 ?)
- Cartouche de 25mm M^{le}1934 à balle perforante (charge forte) (**AP**)
- Cartouche de 25mm M^{le}1934 à balle traçeuse perforante (**APT**)

37mm SA18 and SA18 M37 L/21
- Obus de rupture M^{le}1892/1924 (**APHE**)
- Boulet de rupture M^{le}1935 (**AP/API**)
- Obus de rupture M^{le}1937 (**AP**)
- Obus explosif M^{le}1916 (**HE**)
- Boîte à balles M^{le}1908 (**canister**)
- Boîte à balles M^{le}1918 (**canister**)

37mm SA38 L/33
- Obus de rupture M^{le}1938 (**APC**)
- Obus explosif M^{le}1938 (**HE**)

Note concerning the the APX-R and APX-R1 turret armed with the 37mm SA18 or 37mm SA38 guns :
Elevation of -16° to +20°
Traverse of 5° right and 5° left but it could be blocked to aim only with the turret rotation and so that the coaxial MG was always well aligned with the main gun.

47mm SA34 L/30
- Obus de rupture Mle1892G (**APHE**)
- Obus explosif Mle1932 (**HE**)

47mm SA35 L/32
- Obus de rupture M^{le}1935 (**APC**)
- Obus explosif M^{le}1932 (**HE**)

75mm SA35 L/17.1
- Obus de rupture M^{le}1910 (**APHE**)
- Obus explosif M^{le}1915 (**HE**)

The 75mm HE shells are able to destroy the armored cars, Panzer I and Panzer II and are very efficient at short range against the tracks and lower parts of the heavier tanks. The HE shell has a penetration of 17mm/30° even at 800m.

The French tanks had all AP/APC/APHE AND HE shells unlike the British cruisers which had only AP shells and only HE shells in their CS version (infantry support). Nonethelss, in the French tanks and especially the light tanks, there were generally more HE shells than AP shells (3/5th HE shells), illustrating the infantry support role seen as primary task. The French tanks (except the 25mm guns and of course possibly the 8mm, 7.5mm and 13.2mm MGs) had no tracer shells unlike the German tanks. It was therefore often harder to find the range of a spotted target.

On the German side, the only Pzgr.40 (APCR) shells produced in 1940 were for the 3.7cm L/45 KwK36 of the PzIII or the 3.7cm PaK which were equipped with a very small number of APCR shells during the battle of France, probably even only to several Panzer III. The 4.7cm Pak(t) (on the Panzerjäger I mainly) received the APCR shell only in July 1940. The Pz35(t) and Pz38(t) did not have an APCR shell until the Russian campaign started. The 2.0cm Pzgr.40 was introduced in December 1940 or the first months of 1941, the other Pzgr.40 types also until May 1941. The 7.5cm L/24 KwK37 of the PzIV Ausf.A/B/C/D or the StuG III Ausf.A in France in May/June 1940 could fire the K.Gr.rotPz. (AP) at 385m/s (penetration of 41mm/30° at 100m) but also a HEAT shell (Gr.38 HL/1) at 452m/s which was available in very small numbers but allowed a penetration of 45mm/30° at any range. There was no HEAT shell ready for the campaign in Poland. The Gr.38 HL/1 made the final tests in December 1939 and the shooting of the ballistic tables was finished in March 1940. The shells is listed in the ammo manual of the 7.5 cm KwK from July 1940. HEAT shells use chemical penetration instead of kinetic penetration thus the same amount of armor penetration could be achieved despite striking velocity. HEAT shells also tended to do better with striking armor plates at an angle, but were also easily defeated by employing spaced armor or side skirting. HEAT shells could also be used as a substitute for HE shells. HEAT shells in early WW2 Panzers were not strong enough to

penetrate the stronger French tanks, however later revisions (Gr.38 HL/A, HL/B, HL/C) proved more successful on the eastern front.

If we exclude the direct artillery fire and the 8.8cm L/56 Flak, the 4.7cm Pak36(t) L/43.4 mounted on the Panzerjäger I seems to be the most dangerous gun for the French tanks (except the HEAT shell of the 75mm L/24 beyond 500m). The French 47mm L/53 AT gun is the best AT gun before the 5.0cm Pak38 and 7.5cm Pak40.
On the French side, the Laffly W15 TCC (tank destroyer) was really deadly against German tanks with its 47mm L/53 and the M^{le}1936 APCBC shells, still 72mm/0° at 1000m according to French tests.
The best French tank gun is the 47mm SA35 L/32 which is superior to the German tank guns. The best German tank guns are the 3.7cm L/47.8 (t) of the Panzer 38(t) and the 7.5cm L/24 KwK37 of the PzIV Ausf.A/B/C/D or the StuG III Ausf.A. The French 47mm SA35 gun is better than the German 3.7cm guns with AP shells but it is outclassed by the APCR shells of the 3.7cm L/45 at close range and by the 7.5cm L/24 gun at medium/long range with its HEAT shells. The APCR shells of the 3.7cm L/45 gun are able to penetrate the front armor of a Renault B1bis tank at 100m. The 47mm SA35 L/32 gun APC shells are slower than the AP shells of the 3.7cm L/45 gun (660 versus 745 m/s) but much heavier (1.620 kg versus 0.685 kg) and capped. The French 47mm has a higher KE and a better T/D ratio, leading to a better penetration.

MAIN GUNS USED IN FRANCE IN MAY/JUNE 1940

GERMAN GUNS

Weapon name	Shell type	Projectile weight (kg)	M.V. (m/s)	Penetration 100m/30° (mm)	Penetration 500m/30° (mm)	Vehicles mounting weapon or AT guns
2.0cm L/55 Kw.K.30/38	PzGr. (AP)	0.148	780	20	14	Sd.Kfz. 222; 231; 232 Pz.Kpfw. II
3.7cm L/45 Kw.K. or Pa.K.	PzGr. (AP)	0.685	745	35	29	Sd.Kfz. 251/10 Pz.Kpfw. III Pak36 AT gun
	PzGr. 40 (APCR) **RARE**	0.368	1020	64	31	
3.7cm L/47.8 Kw.K. 38(t)	PzGr.(t) (AP)	0.815	750	41	33	Pz.Kpfw. 38(t)
3.7cm L/40 Kw.K.34(t)	PzGr.(t) (AP)	0.815	675	34	29	Pz.Kpfw. 35(t)
4.7cm L/43.4 Pa.k.36(t)	PzGr.36(t) (APC)	1.650	782	54	48	4.7cm PaK(t) auf Panzer I Pak36(t) AT gun
7.5cm L/24 Kw.K.37 and 7.5cm L/24 Stu.K.37	K.Gr.rot.Pz. (APCBC)	6.800	385	41	38	Pz.Kpfw. IV StuG III Ausf. B
	Gr.38 HL/1 (HEAT) **RARE**	4.500	452	45	45	
8.8cm L/56 Fla.K.18	PzGr. 39 (APCBC)	10.200	773	120	110	8.8cm Flak auf Sd.Kfz.8 Flak 18 AA/AT gun

FRENCH GUNS

Weapon name	Shell type	Projectile weight (kg)	M.V. (m/s)	Penetration 100m/30° (mm)	Penetration 500m/30° (mm)	Vehicles mounting weapon or AT guns
13.2mm M^{le}1930	M^{le}1935 P (AP)	0.052	800	12	8	AMR-35 ZT1 Laffly AM80
25mm SA35 L/60 or L/47.2	M^{le}1934 P (AP) Ch. f.	0.320	950	35	30	Panhard 178 AMR-35 ZT2 and ZT-3
25mm SA34/37 L/72	M^{le}1934 P (AP)	0.320	920	35	30	25mm SA34/37 AT gun
37mm TR16 L/21	M^{le}1935 (AP / API)	0.390	600	*18mm /35° at 400m (FRENCH DATA)*		37mm TR16 infantry gun
37mm SA18 L/21	M^{le}1937 (AP)	0.500	600	25	19	Renault R35; FCM36 FT17c; Hotchkiss H35/39
37mm SA38 L/33	M^{le}1938 (APC)	0.700	705	29	23	Renault R39/40; FCM36 Hotchkiss H35/39
47mm SA34 L/30	M^{le}1892G (APHE)	1.480 (50g HE)	480	*25mm/30° at 400m (FRENCH DATA)*		Renault D1; D2; B1; AMC34
47mm SA35 L/32	M^{le}1935 (APC)	1.620	660	39	33	Renault B1bis; D2 Somua S35
47mm SA37/39 L/53	M^{le}1936 (APCBC)	1.726	855	57	50	47mm SA37/39 AT gun Laffly W15 TCC
75mm SA35 L/17.1	M^{le}1910 (APHE)	6.400 (90g HE)	470	*40mm /30° at 400m (FRENCH DATA)*		Renault B1 / B1bis hull gun
75mm M^{le}1897 L/29.7	M^{le}1910M (APHE)	6.400 (90g HE)	570	*40mm /30° at 400m (FRENCH DATA)*		FCM-2C
75mm M^{le}97/33 L/36.3	M^{le}1910M (APHE)	6.400 (90g HE)	580	*50mm /30° at 400m (FRENCH DATA)*		75mm M^{le}97/33 AT gun