NOTES ABOUT INFANTRY / CAVALRY UNITS

INFANTRY

There are many different types of infantry troops:

- Infantry
- Light infantry
- Light infantry, type Overseas
- Motorized infantry
- Mechanized infantry
- Mountain infantry
- Light mountain infantry
- North African infantry
- Colonial infantry

And different types of infantry units:

- Infantry Brigade
- Metropolitan Infantry Regiment type "North-East"
- Metropolitan Infantry Regiment type "Overseas"
- Half-Brigade and Battalions of Chasseurs
- Zouave Infantry Regiment
- North African Tirailleurs Regiments
- Mountain Infantry Regiment
- Half-Brigade and Battalions of Alpine Chasseurs
- Pyrenean Half-Brigade and Battalions
- Motorized Infantry Regiment
- Mechanized Infantry Battalion
- Foreign Legion Regiment, Battalion, Half-Brigade, Brigade
- Half-Brigade and Battalions of Light Infantry
- Fortress Infantry Regiments
- Alpine Fortress Half-Brigades and Battalions
- Machine-gun Battalions

Dragons portés

"Dragons Portés" (Portés means roughly carried by a vehicle) is a motorized infantry kind of unit. The Dragons Portés were professional units of better morale, though few personnel had any combat experience (senior officers were often WW1, Poland and/or Rif war veterans though). They were the motorized infantry in the Division Légère Mécanique (DLM) and Division Légère de Cavalerie (DLC). The firepower of the squads was high since each was armed with two LMGs instead of only one for a typical infantry squad. The Dragons Portés squad was designed to cover a large ground area and as such during initial planning for these units (in the early 30's), each squad received 2 LMGs. At the beginning, all squads were equipped with 2 vehicles (Citroën-Kégresse P19) carrying each 1 LMG and 7 men: in fact 1 half-squad of 6 men + 1 driver. So a Dragons Portés squad had 12 men (1 VB launcher, 2 LMGs) and 2 vehicles. The problem was the number of vehicles. So a bigger vehicle has been designed (Laffly S20TL for the Dragons Portés) to carry the whole squad, but this time reduced to 10 men, keeping the same armament (1 VB launcher, 2 LMGs). Each Laffly S20TL was equiped with two AA mounts, which could possibly be fitted on each aft corner, on each side, and on the center of the first row of rear seats. The devices could accomodate either a FM 24/29, a 8mm Saint-Etienne M*1907 MG or a 8mm Hotchkiss M*1914 MG (often two vehicles in a company convoy were equipped with a Hotchkiss or Saint-Etienne AAMG for the AA protection). However for combat, both LMGs of the squad were supposed to be used by the squad (only during transport would the LMGs be used in an AA role. (RDP = regiment de Dragons Portés). Generally all the 4 VB launchers of a squad were concentrated in the platoon HQ.

Chasseurs portés

"Chasseurs Portés" is a mechanized (or motorized) infantry kind of unit. Chasseurs Portés were professional units of better morale, though few personnel had any combat experience (senior officers were often WW1, Poland and/or Rif war veterans though). They were usually the mechanized infantry issued to the Division Cuirassée (DCR) in the
BCP (bataillon de chasseurs portés). The firepower of the squads was high since each was armed with two LMGs. The Chasseurs Portés squad consisted of 10 men (1 VB launcher, 2 LMGs) and typically one Lorraine 38L APC.

**Infanterie (infantry)**

The infantry can be found in infantry divisions (DI = division d'infanterie) and motorized infantry divisions (DIM = division d'infanterie motorisée). In the Infantry divisions, each infantry squad consisted of 12 men. The "Voltigeurs" is in fact not a type of squad but just a name in the French infantry. The squad is virtually composed of 2 half-squads:

- one half-squad is the "fire element" with the FM 24/29 (it is called the "Fusiliers" half-squad)
- one half-squad is the "shock element" with the VB launcher (it is called the "Voltigeurs" half-squad)

That's why the French infantry squad is also sometimes called a "Fusiliers-Voltigeurs squad". Each French squad works usually with the previously explained half squad, that's why generally all French infantry squads are composed of 12 men. Exception: cavalry 13 men, motorcyclists 10 men and the Dragons and Chasseurs reduced to 10 men as indicated because of the vehicle problem (but they have two FM 24/29 instead of only one).

A typical "North-East" infantry regiment was composed of:

- Regimental staff and command company (état-major et compagnie de commandement)
- Headquarters company (compagnie hors-rang)
- Regimental weapons company (compagnie régimentaire d'engins)
- 3 infantry battalions (bataillons d'infanterie) each comprising:
  - a battalion staff and command platoon (état-major et section de commandement)
  - 3 rifle companies (compagnie d'infanterie / compagnie de fusiliers voltigeurs)
  - a support company (compagnie d'accompagnement)

For a total of: 3090 soldiers

- 81 officers
- 342 NCOs
- 317 corporals
- 2350 men

The total number of weapons in each regiment is:

- 112x FM 24/29 LMGs
- 144x VB launchers (rifle grenades)
- 48x Hotchkiss M1914 MGs
- 12x 25mm AT guns
- 9x 60mm mortars
- 8x 81mm mortars

Regiment equipments:

- 287x horses/mules
- 190x wagons
- 6x liaison vehicles
- 39x trucks
- 5x heavy trucks
- 9x Renault UE
- 42x motorcycles
- 140x bicycles

The total number of weapons in each battalion is:

- 36x FM 24/29 LMGs
- 48x VB launchers (rifle grenades)
- 16x Hotchkiss M1914 MGs
- 2x 25mm AT guns
- 3x 60mm mortars
- 2x 81mm mortars

**Infanterie motorisée (motorized infantry)**

The first motorised infantry divisions were formed during the early 30's. Initially there were to be 5, but by the spring of 1935 this was increased to 7. Despite their name they were not fully motorised units, they had no organic vehicles to move all the infantry. They even had an allotment of horses and wagons. Each regiment only possessed enough vehicles to move the regimental and battalion headquarters. The motorized infantry squads of a motorized infantry regiment are classical 12-men infantry squads but carried by trucks or buses (Laffly S20TL and Lorraine 38L are only for the Dragons Portés and Chasseurs Portés units). The troops of the division were moved by a GTP "groupement de transport de personnel" for strategical movements, which when not transporting the division was withdrawn for other duties near to where the regiment was stationed. Usually 3 GTPs are assigned to a motorized infantry division (DIM), one per regiment roughly. One GTP consisted of a staff and 3 transport groups, each group having 4-5 transport companies (1 GTP = 2 companies of trucks and 3 companies of buses for about 200 trucks and 200 buses).

**Infanterie de forteresse (fortress infantry)**

The fortress infantry units where serving along and in the Maginot line fortifications.
• RIF = regiment d'infanterie de forteresse
• DIF = division d'infanterie de forteresse

The organization of a RIF could vary a lot according to the various "secteurs fortifiés" (fortified sectors) of the Maginot line.

The fortress infantry divisions were the result of the reorganization of fortress troops during the spring of 1940. In all 5 were formed and were conversions of existing secteurs fortifiés and secteurs défensifs. They were based on the infantry and artillery units already present, supplemented by engineer, signal and transport elements. They were intended to be "static" divisions with no offensive capability. Most had no service units relying on district or army level assets for medical and quartermaster services. The formed divisions were:

- 101ᵉ DIF in the Secteur Fortifié (SF) of Maubeuge
- 102ᵉ DIF is the SF of the Ardennes
- 103ᵉ DIF in the SF of the Bas-Rhin
- 104ᵉ DIF in the SF of Colmar
- 105ᵉ DIF in the SF of Mulhouse

The fortress infantry division had the following organic units:

- HQ staff
- 1 to 4 fortress infantry, infantry, MG regiments (RIF)
- a fortress infantry training battalion (not the 102ᵉ and 105ᵉ DIF)
- a fortress divisional training center (not the 102ᵉ and 105ᵉ DIF)
- a static artillery regiment (régiment d'artillerie de position) (only one group – 12 guns – in the 104ᵉ and 105ᵉ DIF and 2 groups – 24 guns – in the 101ᵉ DIF)
- a fortress divisional artillery park (103ᵉ DIF only)
- a fortress engineer company (2 in the 103ᵉ DIF)
- a fortress telegraph company (103ᵉ DIF only)
- a fortress radio company (103ᵉ DIF only)
- a mixed signal company (104ᵉ and 105ᵉ DIF only)
- a HQ motor transport detachment (102ᵉ DIF only)
- a divisional quartermaster group (102ᵉ and 103ᵉ DIF only)
- a divisional medical group (102ᵉ and 103ᵉ DIF only)

The RIF is often composed of:

- HQ staff
- Headquarters company
- 3 MG battalions, each with:
  - a battalion staff and command company
  - a headquarter company
  - 3 MG companies
  - 1 weapons and rifle company

But a RIF can also be organized as following:

- HQ staff
- Headquarters company
- 3 classical infantry battalions each comprising:
  - Battalion staff and command platoon
  - 3 rifle companies
  - Support company

The kind of RIF including 3 MG battalions (e.g. in the Metz fortified area) had 3474 soldiers:

- 96x officers
- 345x NCOs
- 3033x corporals and men

The total number of weapons in each regiment is in that case:

- 105x FM 24/29 LMGs
- 108x Hotchkiss M1914 MGs
- 27x 25mm AT guns
- 18x 81mm mortars

This kind of RIF with 3 MG battalions had therefore a higher number of automatic weapons, AT guns and medium mortars than a classical RI but it had less logistics/transport capacities. The logistics equipments issued to a RIF are:

- 130x horses
Légion Etrangère (French Foreign Legion)
The legionnaires are elite soldiers found in infantry units like the DBLE (demi-brigade de la Légion Etrangère), the REI (régiment étranger d'infanterie) or the RMVE (régiment de marche de volontaires étrangers).

At the eve of WW2 the French Foreign Legion has the highest number of men of its history with about 45,000 men. The 11° REI, 12° REI, 97° GRDI, 21° RMVE, 22° RMVE and 23° RMVE are wiped out during the combats of 1940. The new 13° DBLE will illustrate itself in Norway in 1940, then it fought from Bir Hakeim until VE day, beside the 1° REC and the new RMLE.

The first Legion units were formed in 1831, initially for use as static defensive units or as labour. In the successive years they were used in many of the conflicts France involved herself in throughout the world; Legion units often being wiped out or so weakened they had to be withdrawn for reformation. During WW1, the "Régiment de Marche de la Légion Etrangère" (RMLE) was the second most honoured unit of the French Army.

By August 1939 there were 5 REI (Régiment Etrangers d'Infanterie), with a 6th formed in the Levant from 4 battalions of the 1st REI at the start of October 1939. The 1st REI was also used to supply officers for other Legion units from its HQ and training depot, the "Dépôt Commun des Régiments Etrangers" (DCRE) at Sidi-Bel-Abbès. The Legion units used in France conformed to the same organization as the metropolitan infantry regiment, while those in French North-Africa and Indochina were on the "overseas" establishment. The 1st REI originally had seven battalions plus other companies but after reorganization in October 1939 was like the other overseas regiments with 2 or 3 battalions.

In metropolitan France two more foreign infantry regiments were also formed, the 11th and 12th REI, by recalling reservists to serve under officers and NCOs from active list. The 97th GRDI (Groupe de Reconnaissance de Division d'Infanterie), a foreign divisional reconnaissance group (roughly from the size of a battalion) was also formed, from the Legion cavalry.

Other units raised included the 13th DBLE (Demi-Brigade de la Légion Etrangère), which is created in February 1940 with 2 battalions, in French North-Africa, for use in Scandinavia (Narvik). The 21st, 22nd and 23rd RMVE (Régiment de Marche de Volontaires Etrangers) were raised in 1940 from foreign volunteers and refugees resident in France. A 24th RMVE was to be formed but was never created. Other units formed include the BMVE (Bataillon de Marche de Volontaires Etrangers) formed on 1st March 1940 at Barcarès; this unit was sent to the Levant where it was designated 11th battalion of the 6th REI. An emergency unit, the "bataillon de marche de légion étrangère du dépôt de Sathonay" (next to Lyon) was formed during June 1940. A pioneer battalion, the "bataillon de pionniers de volontaires de légion étrangère", was raised in May-June 1940 and assigned to the IVth Army.

The 11th REI, the first of these units to be formed, was also the first under fire. On 11th June 1940, in the Verdun sector, it distinguished itself during an heroic defense against a German division. It was almost completely wiped out. The survivors fought until the armistice, when forced at last to lay down their arms, they were disbanded and the regimental flag was burned. Of 700 Legionnaires POWs, nearly 500 escaped from Verdun. They would reappear later in North Africa, in the backbone of the new French army until the victory.

The 13th DBLE is commanded by lieutenant-colonel Magrin-Vernerey who has been WIA 17 times during WW1. This half-brigade had been intended at first to be sent to Finland, to help fight the Soviet invasion, but it was finally sent to Norway, a strangely arctic destination for a unit formed on the sands of North Africa. Embarking at Brest on 22nd April 1940, the 13th DBLE reached Liverpool on 25th April, departing four days later to arrive on 6th May at Ballangen, the advanced base for operations at Narvik. At dawn on the 13th May, the Legionnaires landed on the soil of Norway. In a matter of hours, the 1st battalion took Bjervik and the 2nd battalion took Moebey. The next day, a patrol destroyed German aircrafts based on Lake Hartvivand. But the main objective was Narvik, on the other side of Rombakfjord. The 13th DBLE fought in close cooperation with Norwegian troops.

The second landing took place on 28th May. The 2nd battalion climbed the cliffs, hard combats followed along the railway track linking Narvik to Sweden, until nightfall which saw the 1st battalion in the heart of Narvik itself. The French let the Norwegian troops enter at first in the city. The operation was completely successful, and the days that followed saw the Germans driven back to the border. Nonetheless all the troops were needed in France to fight the German invasion and the Legionnaires had to re-embark in haste, it was over on 6th June. After spending several days trying to organize a defensive position in Brittany, the 13th DBLE found itself once again climbing the gangplanks at Brest, and crossing to England. There it was offered a choice, either to continue the fight under general De Gaulle, alongside the British, or to return to Morocco. The 2nd battalion, whose commander, Gueninchault, had been killed at Narvik, and in which the influence of the Georgian prince, Captain Amilakvari, was strong, chose Free France. The 1st battalion preferred repatriation to North-Africa.

- 67x wagons
- 7x liaison vehicles
- 27x trucks
- 20x Renault UE
- 67x motorcycles
- 250x bicycles

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On 31st August, the dissidents (who had provisionally awarded themselves the title of 14th Half Brigade, but who soon reverted to 13th DBLE) embarked once more in England. Their destination was Africa. After a check before Dakar, which remained loyal to marechal Pétain, the Legionnaires sailed right around the south of Africa. Their first operation was against the Italians in Eritrea where, on 8th April 1941, they took the port of Massawa from a garrison of 1,400 soldiers. But it was in the Western Desert that the real glory awaited the Legionnaires of the 13th DBLE.

The 21st RMVE was assigned to the 35th DI on 1st May 1940, replacing the 49th RI. The 13th company (pioneers) of the 21st RMVE leaves on 28th May. The 21st RMVE is defeated during end June 1940 and captured.

The 22nd RMVE is affected to the 19th DI on 9th May 1940 and is crushed while facing 2 Panzerdivisionen on 8th June 1940. The 22nd RMVE includes many Spanish republicans refugees and Jews who fled central Europe, all very motivated by the anti-fascist fight and for some of them already war veterans. From 5th to 7th June, the 22nd RMVE fights valiantly and receives a citation. Completely surrounded by enemy armored units, heavily bombarded by the Luftwaffe as well as by the artillery, the regiment holds its area during 48 hours and defeats all the German attacks. After violent close combats only 800 men are still operational from the 2500 initially available and they are captured by the German troops. Some of them were sent to the concentration camp of Mauthausen.

The 23rd RMVE is initially assigned to the 17th DI, which should have been formed with the 22nd and 23rd RMVE, but it, finally, gives rise to the 59th DLI (Division Légère d'Infanterie). The 22nd RMVE is affected to the 19th DI on 9-10th May 1940 and the 23rd RMVE to the 8th DI on 5th June 1940.

**Infanterie Coloniale (Colonial Infantry)**

The "colonial infantry" is born from the previously "Infanterie de Marine" (Marine Infantry), also called or "Marsouins" or "Bigors". The marine infantry is still existing today as part of the army.

Most of these units had a very high amount of Europeans in 1940 but included also Senegalese tirailleurs. In the artillery there were also Malagasy soldiers. Among the officers there were also Africans, there is at least an example of a Senegalese captain.

There are initially 4 DIC in the active army plus 3 DIC formed at the mobilization. In April, a 8th DIC began to be created but was transformed in 8th DLIC. A 9th DIC was planned during June 1940 but was never formed. The 2nd DIC had 2 mountain infantry regiments. The colonial divisions were not in fact part of the French Army but officially under the control of the Minister of the Colonies.

Among the 3 infantry regiments there could be 3 European regiments (colonial), 2 European and 1 African, 1 European and 2 Africans etc.

- DIC = division d'infanterie coloniale
- RIC = régiment d'infanterie coloniale (Europeans)
- RICMS = régiment d'infanterie coloniale mixte sénégalais (includes one or more Senegalese battalion beside the European ones) when the DIC without Africans received several Senegalese battalions
- RTS = régiment de tirailleurs sénégalais

**North African infantry units**

These units include Europeans roughly all the officers and many NCOs, European troops (Zouaves and several metropolitan infantry regiments) but they are largely formed with natives from the North African colonies : Goumiers (Moroccan), Tirailleurs (Senegalese, Tunisian, Moroccan, Algerian etc.).

1) **A DINA** is a Division d'Infanterie Nord-Africaine (North-African Infantry Division).

There were initially 4 DINA and 2 more after the mobilization. A 7th DINA was created on 16th March 1940 but the only North African element was the infantry. These division were roughly identical in organization to the other type "North East" infantry divisions, except the infantry and artillery regiments which were type "Nord Africaine". The exception was 5th DINA, a "white" North African Division with Zouave infantry and colonial artillery regiments. In October 1939, a regiment of North African troops from the 2nd, 3rd and 4th DINA were each replaced by a "white" regiment. Finally the infantry regiments in 1940 in the DINA are :

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<tr>
<th>1st DINA</th>
<th>2nd DINA</th>
<th>3rd DINA</th>
<th>4th DINA</th>
<th>5th DINA</th>
<th>6th DINA</th>
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<td>5th RTM</td>
<td>-11th RZ</td>
<td>-12th RZ</td>
<td>-7th RZ</td>
<td>-14th RZ</td>
<td>-24th DBCP * / 11th REI in April 1940</td>
<td>-31st RTA</td>
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<td>-27th RTA</td>
<td>-13th RTA</td>
<td>-14th RTA</td>
<td>-23rd RTA</td>
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<td>-28th RTT</td>
<td>-22nd RTA</td>
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* (3rd BCP + 19th BCP + 69th BCP)

2) The Infantry Divisions type "Overseas" are based in the colonies except 2 divisions.

There were 3 categories of type overseas infantry division mobilized in September 1939 (a bit like the active, A and B divisions in metropolitan France). All were mobilized in North Africa (and based there). Except the 3 Moroccan divisions they are designed as Diversions d'Infanterie d'Afrique.

- 1st category :
By May 1940 only 81st DIA and 83rd DIA still existed, the others had been sent in metropolitan France with most elements converting to type "North East"

- 2nd category:
  84th DIA, 85th DIA and 86th DIA

- 3rd category:
  2nd DM, 3rd DM, 87th DIA, 88th DIA, 181st DIA, 182nd DIA and 183rd DIA

The 180's series were static protection divisions as the 2nd DM which was later called "troupes de protection du Maroc".

- DINA = division d'infanterie Nord-Africaine
- DM = division marocaine
- DIA = division d'infanterie africaine
- RZ = régiment de Zouaves (European regiment formed with white colonists from Algeria)
- RTA = régiment de tirailleurs algériens
- RTT = régiment de tirailleurs tunisiens
- RTM = régiment de tirailleurs marocains
- RTS = régiment de tirailleurs sénégalais

**Corps franc**

The corps franc is a special infiltration and deep reconnaissance unit. It is the equivalent of the German Stosstruppen. Concerning WW2, these corps francs were created in September 1939 with specially selected volunteers at the battalion, regimental and/or divisional level. These elite troops had the mission to infiltrate behind the enemy lines, to collect information, to organize ambushes or raids and to take prisoners.

The smallest element of a corps franc is a team of 6 men called "l'équipe" (= the team) or "sizaine". All the members of the team have a combat knife, a handgun (revolver or pistol) and many grenades for close combat. These men are usually armed with the mousqueton (carbine) Berthier M*1892 M16 and in each team there are usually 1-2 SMGs (typically Erma-Vollmer but also MAS38 SMGs, Suomi M31 from which 150 had been sent on the north-eastern front in 1939 and even German captured SMGs and even German captured SMGs) and 1 FM 24/29 LMG to increase the firepower (some captured MG34s are also used). Some shotguns were also used during the patrols. They carried also satchel charges if the mission required explosives. Several teams could be grouped together, for example a squad of 12 men will include 2 FM 24/29 LMGs and 2-4 SMGs and has therefore more automatic weapons than a regular infantry squad. The bigger unit including several teams is called the "groupe franc" (or "trentaine") with 5 teams (30 men), it corresponds roughly to a platoon. The "groupe franc" is generally commanded by a lieutenant and is completely independent. Several "groupes francs" can be grouped for a specific mission into a "groupement franc". Such a "groupement franc" includes usually a maximum of 6 "groupes francs" (180 men), roughly a company.

**Chasseurs alpins (alpine infantry)**

The Chasseurs alpins are considered "elite" mountain troops like the German "Gebirgsjäger".

- BCA = bataillon de chasseurs alpins (alpine troops battalion)
- RIA = régiment d'infanterie alpine (alpine infantry regiment)
- DIA (DIAlp sometimes) = division d'infanterie alpine (alpine division)

There were 14 Demi-Brigades de Chasseurs Alpins (DBCA) (alpine troops half-brigades) : 4 active and 10 mobilized in August/September 1939. Each half-brigade consisted in 3 battalions (BCA) and is organized like that:

- a half-brigade HQ staff and command company (état major et compagnie de commandement)
- a weapons company (compagnie d'engins)
- 3 mountain infantry battalions (BCA) each comprising:
  - a battalion staff, command platoon and ski scout platoon - SES (état-major, section de commandement et section d'éclaireurs skieurs – SES)
  - an HQ company (compagnie hors-rang)
  - 3 rifle companies
  - a support company (compagnie d'accompagnement)

An alpine half-brigade included 88 officers, 373 NCOs and 3129 corporals and men = 3590 soldiers. There were also 526 horses/mules, 8 wagons, 8 liaison vehicles, 78 trucks, 4 heavy trucks, 6 Renault UE, 76 motorcycles and 34 bicycles.

→ SES : the "Section d'Eclaireurs Skieurs" (ski-scouts platoons) are elite deep reconnaissance troops. They play the same role than the corps francs but they are specialized in mountain warfare and winter conditions.
Chasseurs pyrénéens (mountain infantry)

The Pyrenean Chasseur half-brigade (Demi-Brigade de Chasseurs Pyrénéens – DBCPyr) was a relatively new unit in the French army. In fact they did not exist as a peacetime unit but were to be mobilized in south western France from a local regular cadre and reservists of the first reserve (30-35 years old) of the region. They were an idea of general Gamelin in response to concerns of the security of the frontier with Spain after Franco’s victory, especially the possibility of foreign troops remaining on Spanish soil. They formation was authorized in February 1939 with 5 two-battalion half-brigades to be mobilized under the command of the Détachement d'Armées de Pyrénéées and were to be deployed along the frontier blocking the likely avenues of attack across the Pyrenees. However, the initial good relation between Spain and France and the departure of Italian and German troops meant these deployments were never realized. The half-brigades were progressively withdrawn from the Pyrenees, being sent to the Alp sector, replacing units that had been transferred to the North Eastern front. On 20th November 1939, the 3rd half-brigade was dissolved and its 5th and 6th battalions were assigned to the 4th and 1st half-brigades respectively. The bataillon de chasseurs pyrénéens (BCPyr) was identical in composition to the bataillon de chasseurs alpins (BCA) except they lacked the ski scout platoon. This difference ended for the battalions of the 4th half-brigade when it was assigned to the Army of the Alps and a platoon was formed in each battalion from the SES left behind by the alpine infantry regiment that had moved north.

The initial composition of the Pyrenean Chasseur half-brigade was:
- a half-brigade HQ staff and command platoon
- 2 mountain infantry battalions each with:
  - battalion staff and command platoon
  - a headquarters company
  - 3 rifle companies
  - a support company

The choice of a command platoon for the half-brigade instead of a company like for the alpine troops was a mistake, especially for the half-brigades which had later 3 infantry battalions. The lack of signals, logistics and medical elements produced numerous problems. The lack of a weapons company produced complaints for the commanders of these units. A pyrenean half-brigade with 2 battalions included 76 officers, 328 NCOs and 3100 corporals and men = 3414 soldier. There were also 492 horses/mules, 6 liaison vehicles, 69 trucks, 35 motorcycles and 31 bicycles.

Engineers: Sapeurs-mineurs and pioneers

Among the units that can be seen as "engineers" there are:
- the "sapeurs-mineurs" (combat engineers, mine laying, mine clearing, destructions)
- the bridging units
- the signal units (telegraph and radio)
- the pioneers (building, support and logistics) – in fact part of the infantry and not of the engineers

In each French infantry division there is:
- A divisional pioneer company (13th company from an infantry regiment or 5th company from a chasseurs battalion).
  Unlike the "sapeurs-mineurs" (engineer) battalion of the division, the pioneer company is just responsible for the construction needs of the division, it isn't really a combat unit. The company is linked to the senior regiment of the division.
  In a typical "North East" infantry division, the company includes 3 officers, 16 NCOs, 19 corporals and 181 men = 219 soldiers. Beside the rifles and pistols/revolvers they have only 2 FM 1915 Chauchat LMGs. The company includes also 7 horses, 3 wagons, 2 trucks, 2 motorcycles and 3 bicycles.
  In a motorized infantry division, the company includes 3 officers, 16 NCOs, 19 corporals and 180 men = 218 soldiers. Beside the rifles and pistols/revolvers they have only 2 FM 1915 Chauchat LMGs. The company includes also 1 car, 3 trucks, 1 heavy truck, 2 motorcycles and 3 bicycles.
- An engineer battalion (bataillon de "sapeurs-mineurs")
  In a typical "North East" infantry division, the battalion includes 2 companies for a total of 10 officers, 50 NCOs, 504 corporals and men = 564 soldiers. The battalion includes 76 horses/mules, 36 wagons, 10 motor vehicles and 12 bicycles.
  In a motorized infantry division, the battalion includes 2 motorized companies for a total of 10 officers, 50 NCOs, 464 corporals and men = 554 soldiers. The battalion includes also 28 motor vehicles, 16 motorcycles and 16 bicycles.
  Note: In a Division Légère Mécanique for example, the engineer battalion is reinforced and consists in 3 motorized companies and 1 bridging company.
- A telegraph company
- A radio company
Note about AT mines and explosive charges in the typical "North East" infantry division:

There are about 1500 AT mines the infantry regiments. The GRDI has about 580 AT mines and the engineer battalion has probably also a number of AT mines available. There are therefore at least 2080 AT mines in the infantry division.

There are at least 324 explosive charges (135g) in the infantry regiments. The GRDI has 300 kg explosives and the engineer battalion has at least 868 kg explosive charges (434 kg in each company and 108kg in each platoon):
- 10kg charge : 8 (plus probably a few 20 kg charge at the battalion level)
- 1kg charge  : 96
- 135g charge  : 3800
- 100g charge  : 1536
- 60g charge  : 400

"Aide-mémoire" pour les travaux d'état major (1939)" mentions 450 kg explosives for each engineer company (900 kg for the battalion). There are therefore about 1211-1243 kg explosives available in the whole infantry division.

Note about AT mines and explosive charges in the motorized infantry division:

There are about 4500 AT mines the infantry regiments. The BDAC has 700 AT mines, the GRDI about 580 AT mines and the CDAC about 3500 AT mines. The engineer battalion has probably also a number of AT mines available. There are therefore at least 9280 AT mines in the motorized infantry division.

There are at least 324 explosive charges (135g) in the infantry regiments. The GRDI has 150 kg explosives and the motorized engineer battalion has about 6000 kg explosive charges (3000 kg in each company). There are therefore about 6194 kg explosives available in the whole motorized infantry division.

The sapeurs-mineurs are the combat engineers whereas the pioneers have different tasks:
- Building of field fortifications, AT ditches etc. or heavier concrete fortifications
- Building of air strips/bases
- Various works in the forests (lumbering)
- Organizing the defense against the combat gases
- Camouflage of the units
- Building / deployment of medical posts and field hospitals
- Building of fuel and ammunition dumps
- Handling / packing works

Beside the divisional pioneer companies, there are pioneer regiments (RP = Régiment de Pionniers) attached to the armies, the army corps, the fortified areas and the general reserves.

Sniper

Each French infantry platoon in 1940 had a sniper (theoretically), equipped with a 3x magnification APX1921 scope usually mounted on a Lebel M°1886/93 or Berthier M°1916 specially dedicated rifle.

Infanterie de l'air (airborne infantry)

In 1935 Captain Geille creates an airborne center in Avignon-Pujaut. The first French airborne troops were called "infanterie de l'air" and officially created on 1st April 1937, after a decision taken on October 20, 1936. Two "Groupes de l'Infanterie de l'Air" (GIA) were formed (601st in Reims and 602nd in Baraki in Algeria).

Each group is composed of:
- one HQ
- one transport aircraft squadron
- one airborne infantry company (= CIA = Compagnie d'Infanterie de l'Air): 175 men organized in 3 platoons + 1 support platoon (with 2 37mm TR infantry guns and 2 Hotchkiss M°1914 HMGs).

In 1940 they fought only as foot infantry and several of these soldiers were selected to form four brilliant corps francs. Each 12-men squad is armed with Mousqueton Berthier M°1892 M16, 2 FM 24/29 LMGs per squad, one VB launcher and hand grenades (36 carbines and 6 LMGs in one platoon) ... and later Erma Vollmer SMGs in the corps francs. Seven Boys anti-tank rifles were also already used in the Corps Francs in 1939.

From 14th February to 11 March 1940 they led 28 patrols and 23 ambushes, sometimes more than 3 km behind the German lines. They lost only 2 KIAs and killed about 30 German soldiers.

CAVALRY

The word "cavalerie" stands for cavalry units in the DLC (Division Légère de Cavalerie) or DLM (Division Légère Mécanique). There were various cavalry units:
- "Cuirassiers"
- "Chasseurs à Cheval" (horse mounted)
- "Hussards"
- "Dragons"
- "Chasseurs d'Afrique" (North African cavalry)
- "Spahis" (North African cavalry – usually horse mounted in 1940)

Except for "Chasseurs à Cheval" and "Spahis" (before 1941/43) these terms correspond also to armored units (Panhard 178, Hotchkiss H35/39, Somua S35). Before WW1/WW2 there were also other French cavalry units like the Lanciers and the Chevau-Légers. Each horse mounted cavalry squad consisted of 13 men.

The North African horse mounted cavalry was usually a elite cavalry if they were well commanded. The men were tough fighters and good sharpshooters.

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Active Infantry Divisions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1940</td>
<td>28 * active infantry divisions</td>
</tr>
<tr>
<td></td>
<td><strong>7 motorized</strong> infantry divisions (1e, 3e, 5e, 9e, 12e, 15e, 25e DIM)</td>
</tr>
<tr>
<td></td>
<td>10 infantry divisions (10e, 11e, 13e, 14e, 19e, 21e, 23e, 36e, 42e, 43e DI)</td>
</tr>
<tr>
<td></td>
<td>3 mountain infantry divisions (27e, 29e, 31e DIA)</td>
</tr>
<tr>
<td></td>
<td>4 colonial infantry divisions (1e, 2e, 3e, 4e DIC)</td>
</tr>
<tr>
<td></td>
<td>4 north African infantry divisions (1e, 2e, 3e, 4e DINA)</td>
</tr>
</tbody>
</table>

* there were only 20 in early 1939

Fortress infantry divisions: 101e, 102e, 103e, 104e and 105e DIF (administratively divisional organization but infantry regiments spread all along the Maginot Line).

The mobilization allowed to constitute:

- 24 “A” type reserve infantry divisions (equipment rather complete):
  - 2e, 4e, 6e, 7e, 16e, 18e, 20e, 22e, 24e, 26e, 31e, 32e, 35e, 41e, 44e, 45e and 47e DI
  - 28e and 30e DIA
  - 5e, 6e and 7e DIC
  - 5e and 6e DINA

- 19 “B” type reserve infantry divisions (older men, many equipments and officers lacking):
  - 51e, 52e, 53e, 54e, 55e, 56e, 57e, 58e, 60e, 61e, 62e, 63e, 65e, 66e, 67e, 68e, 70e and 71e DI
  - 64e and 65e DIA

A total of 71 infantry divisions (+5 fortress infantry divisions) at the beginning of the campaign.

There were also 4 armored divisions (1e, 2e, 3e and 4e DCR) depending from the infantry, 3 created between January and May 1940 and the fourth during the campaign.

For the cavalry, there were originally 3 cavalry divisions (1e, 2e and 3e DC) later reorganized to form 5 light cavalry divisions (1e, 2e, 3e, 4e and 5e DLC). There were also 3 light mechanized divisions (1e, 2e and 3e DLM) formed before May 1940 (the 3e DLM being mostly formed by reservists) plus the 4e and 7e DLM formed during the campaign on reduced establishments from two shattered cavalry divisions.

The fortress divisions could be considered active units as their components were originally active units. The ratio of active and reserve troops in the active, series A and series B divisions probably varied widely among those of the same type. It should also be pointed out some active divisions had to give up a large part of their active elements to form the series A and B divisions; they could almost be called series A themselves.

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
The French army had 400,000 motorized vehicles including motorcycles, cars, trucks, tanks, armored cars etc. in 1940 (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). On 10th May 1940, there were about 3000 French tanks facing 3000 Germans tanks. Nevertheless the German were schematically organized in 10 Panzer divisionen of 270-300 tanks whereas the French army had only 960 tanks issued to 7 big mechanized/ armored division. The remaining 2000+ tanks were spread in all the territory and in all kind of units in small numbers, unable to face any whole German armored unit. French tanks often had to face 4-10 time more numerous German tanks.

- **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.

- **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 Mle1929 (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.

- **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 term 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).

- **DLC** = Division Légère de Cavalerie = Light Cavalry Division

- **DLM** = Division Légère Mécanique = Light Mechanized Division

- **BCC** = bataillon de char de combat = tank battalion

- **RCC** = Régiment de Chars de Combat = tank regiment

- **CACC** = Compagnie Autonome de Chars de Combat = independent tank company

- **RAM** = Régiment d’Auto-Mitrailleuses = armored cars regiment

The French army had tanks belonging to the infantry or to the cavalry arm, no separate command (armor arm) like in the German army:

**Infantry tanks:**
- Renault FT-17BS (light)
- FT-17c (light)
- FT-17m (light)
- FCM-36 (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)
RENAULT FT17

The Renault FT17 is probably the first modern and one of the most successful tanks of WW1. This light tank was the first of the classic tank design, which featured a turret with a 360° traverse. Thanks to its small size it could enter wooded areas, where larger British Mark or French Saint-Chamond and Schneider CA-1 were useless. The main task of tank units was to eliminate MG nests and destroy barbed-wire obstacles, enabling infantry to cross the no-man's-land and to pierce the enemy lines. The main advantages of the Renault tanks were their small size, agility on the battlefield and large numbers. French troops praised their support and although tank/infantry cooperation was at first poor due to lack of training, infantry units always requested the support of the tanks in offensive operations. The tactics were improved and the tanks were not only associated to infantry attacks but also cooperated with the artillery and the aircrafts. The first beginnings of the tank/aircraft couple were there. Renault FT17 tanks took part in 4356 engagements during WW1. Field guns were the main threat for the tanks, accounting for 356 totally destroyed Renault FT17 tanks of the 440 lost during the war. Anti-tank trenches, shell holes and wide infantry trenches temporarily put more tanks out of action than enemy fire. This tank remained in service right up to 1944 when the Germans used them in the street fighting in Paris and in various auxiliary tasks. The allies encountered a few following the Torch landings in 1942.

The FT17m was armed with a 8mm Hotchkiss MG and in 1931 it was replaced by a Reibel MAC31 in 7.5mm (these tanks are called FT31), the FT17c was armed with a 37mm SA18 L/21 gun and the FT-17BS had a 75mm Schneider L/9.5 gun. There will be many more versions: a command radio version (TSF), a FT17 minesweeping tank with 2 plough shares mounted on the front, a searchlight variant for police use and a version carrying fascines, which could be dropped into wide trenches. The first 100 FT17 are armed with a MG and have a completely cast and rounded turret. This first turret is not adapted for the mounting of the 37mm gun. Two kinds of turrets, able to receive either a MG or a gun, are then adopted: the polygonal OMNIBUS turret (made of bolted rolled armor plates) and the rounded GIROD turret made of several cast armor parts.

3728 Renault FT17 tanks had been built in France until 1921 (2100 with MG, 1246 with 37mm gun, 39 with 75mm gun, 188 TSF, 155 for school units) with more than 3177 during WW1 alone (by the Renault, Berliet, Somua and Delaunay Belleville factories). During WW1, the Germans only produced about 35 tanks, the British about 2600 tanks and the French 3977 tanks (3177 Renault FT17, 400 Schneider CA-1 and 400 Saint-Chamond). It has also been widely exported: Belgium, Spain, Brazil, Canada, China, Czechoslovakia, Finland, Netherlands, Japan, Poland, Yugoslavia etc. Italy produced the Fiat 3000 on the basis of the Renault FT17. The USA produced about 100 Renault FT17 and 450 copies called "six tons". The USSR also produced the MS1, MS2 and MS3 based on the Renault FT17 tank. The French and the Spanish armies used the Renault FT17 during the Rif war between 1919 and 1926. The first Polish tank unit was formed with French tanks and French crews and officers in 1919. The 1st Polish tank brigade used this tank in 1919-1920 against the Bolsheviks. 1297 FT17 tanks were still in service in 1940: 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 platoons protecting important buildings protection etc.

Weight: 6.7t
Length: 4.10m
Width: 1.74m
Height: 2.14m
Crew: 2 men

Maximum armor: 22mm on the turret, 16mm on the hull and 8mm on the top

Maximum speed: 7.5 km/h (Renault engine, gasoline, 35 hp at 1500 rpm, 4480 cm³, water cooled)

Autonomy: 35 km

Armament: a 8mm Hotchkiss TMG (4800 cartridges), a 7.5mm MAC1931 TMG (34x150 cartridges drum magazines), a 37mm SA18 L/21 gun (240 shells including 12 canister shells) or a 75mm L/9.5 BS gun (probably 40-50 HE shells)

Detailed armor thickness (mm):

<table>
<thead>
<tr>
<th>Component</th>
<th>Thickness (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Turret Front</td>
<td>22mm/12.5°</td>
</tr>
<tr>
<td>Turret Sides</td>
<td>?/10°</td>
</tr>
<tr>
<td>Turret Rear</td>
<td>?/14°</td>
</tr>
<tr>
<td>Turret Top</td>
<td>8mm/75° and 90°</td>
</tr>
<tr>
<td>Hull Front</td>
<td>16mm/18° and about 50°</td>
</tr>
<tr>
<td>Hull Sides</td>
<td>?/0°</td>
</tr>
<tr>
<td>Hull Rear</td>
<td>?/67°, 74° and 0°</td>
</tr>
<tr>
<td>Hull Top</td>
<td>8mm/90°</td>
</tr>
<tr>
<td>Hull Bottom</td>
<td>?/90°</td>
</tr>
</tbody>
</table>
FCM-2C
The very heavy tank FCM-2C was built by the "Société des Forges et Chantiers de la Méditerranée". It was developed as a heavy breakthrough vehicle in WW1. The order called for a vehicle that would span all German trenches (it could cross 4.25m wide ditches), that explains the length of the tank (10.27m), it was not very wide (2.95m) in order to be transported by train and it was 4.01m high. The FCM-2C was the very first heavy tank (68t, the British WW1 Mark V had 26t), seriously armored (40mm) and armed with a 75mm gun in a turret (320° traverse) for the first time of history. The tank had a powerful engine and a modern architecture for its time, including 2.5x stroboscopic sights. 300 FCM-2C tanks are ordered on 21st February 1918 but none is delivered before the armistice. Only 10 tanks were built between 1919 and 1921 and named as follows in 1940 (previously named n°1-10) : n°90 'Poitou', n°91 'Provence', n°92 'Picardie', n°93 'Alsace', n°94 'Bretagne', n°95 'Touraine', n°96 'Anjou', n°97 'Lorraine' (later renamed 'Normandie'), n°98 'Berry', n°99 'Champagne'. In 1923 all 10 FCM-2C tanks were in the 3rd battalion of 511st tank regiment. The tank n°99 received a turret with a 155mm short gun in 1926 (it was the unique FCM-2Cbis). In February 1929 the regiment was disbanded and these tanks formed the 51st BCC in Bourget. Only 8 tanks remained available to form 51st BCC in September 1939. The battalion moved to Brie and began active training. The tanks n°93 and n°94 were decommissioned and their turrets were possibly sent to Tunisia for the Mareth Line. The tanks n°92 and n°95 had their engine out of service and were scuttled on 12th June 1940. The n°97 'Normandie' is the command tank of the battalion and received additional armor resulting in a weight increase of 10% : it reached 90mm on the front and 65mm on the sides. In June 1940, the tanks loaded onto special railroad cars, were blocked on the wagons south of Neufchâteau since the rail-road and an other train in front of the convoy had been destroyed by the Luftwaffe. The tanks could not be unloaded in this area and all of them were scuttled on 15th June 1940 by explosive charges except the tank n°99 for which the charge failed to explode. The tank n°99 was therefore captured intact by the Germans and brought back to Berlin. It was tested on a range near Cossen. The electrotransmission of the FCM-2C interested Ferdinand Porsche for his later heavy tanks. In 1942, it was seen in France at the Renault plant being overhauled. Brought back to Germany, the tank was eventually captured by the USSR and was last seen in 1948 in East Germany according to several sources. From the other wreck, several intact turrets were used on the Atlantic wall.You can find numerous German propaganda photos claiming that these tanks have been destroyed by German tanks, the wrecks where moved all around to take "victorious" photos, sometimes tanks had fired at point blank against them to prove that they had been destroyed etc. but they were simply abandoned and scuttled and never saw action.

**Weight :** 68-70t
**Length :** 10.27m
**Width :** 2.95m
**Height :** 4.01m
**Crew :** 12 men (3 men in the front turret and 1 man in the rear turret)
**Maximum armor :** 30-40mm (RHA bolted armor) (90mm for the n°97)
**Maximum speed :** 12 km/h (2x Maybach or Daimler-Benz, 2x 6 cylinders, 520 hp, 16950 cm³)
**Autonomy :** 150 km
**Armament :** four 8mm Hotchkiss Mle1914 HMGs (9504 rounds) and one 75mm L/29.7 Mle1897 gun (124 shells).

Detailed armor thickness (mm) :
- **Turret Front** : 30-40mm/?
- **Turret Sides** : ?
- **Turret Rear** : ?
- **Turret Top** : ?
- **Hull Front** : 30-40mm/? (90mm/? for the n°97)
- **Hull Sides** : 22mm/? (65mm/? for the n°97)
- **Hull Rear** : ?
- **Hull Top** : 10mm/90°
- **Hull Bottom** : 13mm/90°

RENAULT R35
In 1933 the French High Command called for the design of a 6-ton tank as a replacement for the aging Renault FT17. The vehicle was designed to have a crew of two and to be armed with one or two 7.5mm MGs or a 37mm gun. Renault, "Forges et Chantiers de la Méditerranée" (FCM) and the "Compagnie Générale de Construction des Locomotives and Delaunay Belleville" took part in the design process. The first prototype was manufactured by Renault at the end of 1934 and was based upon the AMR 1935 type ZT. The armor specifications were increased to 40mm after tests with the 25mm SA34 AT gun. The vehicle was called the Renault ZM (prior to acceptance) and immediately sent into trials in the winter of 1935. By spring, an order for 300 was placed. The tank was now called "char léger modèle 1935-R" (R35). On 10th May 1940, the Renault R35 was the most common tank in the French army with 945 R35 tanks in metropolitan France and 125 R35 tanks in the French colonies. More of them were pressed into service in May/June 1940. If the exported R35 tanks and the tanks in the schools are counted, about 1,500 R35 were produced until the armistice. The tank was equipped with the APX-R turret (cast) and the hull
consisted of three cast sections that were bolted together. The side plates carried bogies and front driving sprocket. The final drive and differentials were housed under nose plates. It was steered through a Cletrac geared differential and brakes. The driver was located to left side and had 2 splits and an episcope. The turret had 3 episcopes and a domed cupola with binoculars. There was a seat for the commander and the hatch in the rear of the turret that opened down could be used as a seat. The machine-gun spent cases went down a chute through a hole in the floor. The engine was to the right in the rear with the self-sealing fuel tank on the left.

The Renault R35 had no radio set (except the 24<sup>e</sup> BCC, the single R35 battalion in which all the tanks have the ER54 radio set) and the 37mm SA18 L/21 gun was rather inefficient against other tanks. The 37mm SA18 gun could be used at 300m against the Panzer I and Panzer II but to knock out a Panzer III Ausf.E/F (the previous models were less armored and easier to destroy) or a Panzer IV Ausf.C/D they had to get as close as < 25-100m, whereas the enemy could destroy them at about 300m (3.7cm KwK) to 500m (7.5cm KwK).

Several tanks were rearmed with a 37mm SA38 L/33 gun in May/June 1940 and named Renault R39 (only a few tanks for platoon and company leaders). During travel the spare MG stored in the tank was sometimes dismounted and put on the AA mount on the rear of the turret. The main gun was then facing the rear of the vehicle. The tank is rather slow even compared to the heavier Renault B1bis and the suspension is poorly designed. The tank lacks mobility and crossing capacities in difficult off-road terrain because it is too short and the weight distribution is uneven. The crossing capacity was sometimes enhanced by the addition of the AMX M<sup>le</sup>1938 crossing tail. The main advantages of the Renault R35 tank are its 40mm armor and the fact that it is exceptionally robust and sturdy. This tank could cross 500 km without a single maintenance or oiling operation if needed.

The Renault R35 tank has also been exported in Romania (200 ordered, 41 delivered in September 1939 + later 34 ex-Polish R35s. About 30 R35s were rearmed with Soviet 45mm tank gun in 1943-1945), Turkey (50), Poland (50) and Yugoslavia (54).

**Weight**: 10.6t  
**Length**: 4.02m  
**Width**: 1.87m  
**Height**: 2.13m  
**Crew**: 2 men  
**Maximum armor**: 43mm (APX-R turret is cast and hull is cast armor + RHA bolted elements)  
**Maximum speed**: 20-23 km/h (Renault engine, 4 cylinders, gasoline, 85 hp, 5880 cm<sup>3</sup>, 2200 rpm, water cooled)  
**Diameter of turning circle at 6 km/h**: 8.50m (Jentz)  
**Transmission**: 4 forward, 1 reverse  
**Autonomy**: 140 km  
**Ground pressure**: 0.86 kg/cm<sup>2</sup> (compared to 0.73 for PzIIC, 0.92 for a Pz III e/f and 0.83 for PzIVd)  
**Armament**: a 37mm SA18 L/21 gun and a 7.5mm MAC1931 CMG (100 shells with at least 10 AP shells* and 2400 cartridges - elevation of -16/+20° and traverse of -5°/+5°, but could be blocked to aim only with the turret rotation).  
* The Renault FT17, Renault R35 and FCM36 infantry light tanks, which were not included in an armored divisions had often only a dozen AP shells, illustrating their infantry support role seen as primary task. They were depending from armies' HQs and were attached to various infantry units for support. They only had AP shells for self-defense against tanks but were not thought to be engaged in big tank battles. In the case of Renault R35 tanks included in an armored division like it was the case with the 4<sup>e</sup> DCR (2<sup>e</sup> BCC and 24<sup>e</sup> BCC), the ammunition loadout included more AP shells (about 40 probably). The situation was also different with e.g. the Hotchkiss cavalry light tanks, which had 60 HE and 40 AP shells and of course with all the heavier tanks like the Somua S35 or the Renault B1bis which had more numerous AP shells. The Somua S35 had 40 APC and 78 HE shells. The Renault B1bis, in the last loadout type had 72x 47mm shells (APC and HE) and 74x 75mm shells (7 APHE and 67 HE).  

**Detailed armor thickness (mm)**:
- Turret Front: 40mm/5° and 28° + gun mantlet  
- Turret Sides: 40mm/28°  
- Turret Rear: 40mm/30° (rear hatch is 40mm thick)  
- Turret Top: 25mm/90°  
- Copula: 40mm/round  
- Hull Front, Upper: 43mm/37° (driver's hatch is 40mm/23°)  
- Hull Front, Lower: 40mm/round  
- Hull Sides, Upper: 40mm/10°  
- Hull Sides, Lower: 40mm/0°  
- Hull Rear: 32mm/24°  
- Hull Top: 25mm/90°  
- Hull Bottom: 10mm/90°  

The surface of the front (turret and hull) really exposed to the enemy fire: 2.00 m<sup>2</sup> with only 0.65 m<sup>2</sup> with a slope inferior to 30°.  

1<sup>st</sup> gear – speed: 3.5 km/h  
2<sup>nd</sup> gear – speed: 5.5 km/h  
3<sup>rd</sup> gear – speed: 10 km/h  
4<sup>th</sup> gear – speed: 20 km/h (23 km/h according to Russian data measured on a captured Polish R35)  
Top speed in medium difficult off-road terrain: 8.7 km/h  
Maximum slope to climb 23° on soft ground.
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 turret (1350 kg with 37mm SA18 gun and 1540 kg with the 37mm SA38 gun) :
1x L.713 / 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 (68° horizontal field of view and +3° to -21° = 24° vertical field of view))
1x slit in the rear turret hatch

Cupola :
1x slit (150mm x 7mm slit protected by a 15mm thick armored shutter) (early) OR 1x PPL RX 180 P episcope (APX-R1) (30° vertical field of view)

After action reports involving R35 tanks :

1) 35e BCC
During the battle of Gembloux (14th-15th May 1940) in Belgium, the 15e DIM and the 1e DM are supported respectively by the 13e BCC (45 Hotchkiss H35) and the 35e BCC (45 Renault R35). One infantry battalion of each division is kept in reserve with a tank battalion attached to it for future counter-attacks. The tank commanders are ordered to launch on their own immediate counter-attacks against German tank incursions. They are facing Hoepner's XVI.Panzerkorps (3.PzD and 4.PzD) which leads the attack against Gembloux. In addition, Hoepner disposed of the 20.ID (mot) and 35.ID.

The 35e BCC is supporting the 1e DM and is led by battalion commander Ragaine (1 tank). The tank companies are commanded by :
- 1/35e BCC : capitaine Pelletier (13 tanks)
- 2/35e BCC : capitaine Murati (13 tanks)
- 3/35e BCC : capitaine Richard (13 tanks)
- the reserve company (compagnie d'échelon) : capitaine Maury (5 reserve tanks)

During the 1939/1940 campaign, the battalion will lose 14 KIA, 35 WIA, 14 MIA and 18 POWs. The 45 tanks will be lost. The battalion will earn 1 citation and its men will be awarded 68 individual ratified citations, 5 Legion of Honor medals and 4 Military Medals.

A combat command is constituted with the III/2e RTM (capitaine Saut) and the 35e BCC. This tactical combat group is placed under the command of battalion commander Ragaine and used to launch counter-attacks on the Gembloux-Énage railroad, forcing the Germans to retreat. The Germans will never break the French lines at Gembloux but largely because of the excellent French artillery and the inability of the Luftwaffe to silence this artillery.

2) 10e BCC
40 Renault R35 of the 10e BCC were engaged with the newly created 7e DLM around Juniville (south of Rethel and Aisne River) against the 1.PzD (+ elements of 17.ID and 21.ID). There were only 65 French tanks including only 20 with the 37mm SA38 gun against the advancing 1.PzD.

The 37mm SA18 of the Renault R35 was insufficient against the Panzers, they had to close too much (25-50m) at a range were the good armor was not sufficient anymore. On 10th June evening, from the 27 Renault R35 tanks engaged by the 2/10e BCC and 3/10e BCC (two companies of 13 tanks and the battalion commander's tank) : 10 have been destroyed, 10 are damaged but recovered and under repair and 7 are fully operational. The 1/10e BCC has 13 more tanks and there are also the 5 replacement tanks (manned then by the surviving crews) of the battalion for a total of 20-25 operational tanks.

3) 3e BCC and 23e BCC
Renault R35 tanks from the 3e BCC and 23e BCC were also engaged for example on 9th and 10th June with the 14e DI and the 2e DI on the Aisne River.

→ FRONT OF THE 14e DI (east of Rethel) : from Thugny-Turny to Attigny
The German assault (73. and 86.ID) begins at 4h20 after a 35 minutes long artillery preparation. The 170IRD (73.ID) manages to cross the Aisne River at Thugny-Trugny and begins to infiltrate in the French lines. The 31e BCP is very close to be encircled in the town. De Lattre sends colonel Paraire to counter-attack with elements from the 25e GRDI, the 2e BCP and 9 Renault R35 tanks coming from the 3e BCC. They pull the German regiment back inflicting them heavy losses. On all the front hold by the 14e DI the attack of the XXIII.AK is a failure.

→ FRONT OF THE 2e DI : from Château-Porcien to Thugny-Turny (including Rethel)
The 2e DI is attacked by the 17.ID and the 21.ID, leading to heavy street fights in Château-Porcien and the southern part of Rethel. No German bridgehead can be established; at each attempt the French troops launch a vigorous counter-attack that defeats the Germans. About 500 German POWs are captured by the 2e DI. During the afternoon two breaches will be opened and enlarged in the French lines. West of Rethel 6 assault groups from the 3.IR (21.ID) crosses the river on a lock in Nanteuil despite heavy losses. This breakthrough allows the Schützen of the 3.IR to take some hills south of Nanteuil and to cut the Avançon-Rethel road. Immediately the engineers of the 21.ID build a bridge over the Aisne to allow the tanks to cross the river.

A second breach is made east of Château-Porcien which is now threatened to be encircled by the two breakthroughs. The front is broken in this area despite the resistance of the II/31e RI. The garrison in Château-Porcien will fight until being out of ammunition and surrendered only after violent close combats, delaying the building of an engineer bridge for about 6 hours.

A counter-attack is rapidly organized with the 1st company of the 23e BCC (Renault R35 tanks), two infantry platoons and two dismounted cavalry platoons but it fails due to heavy bombardment from the German artillery and aviation as well as a very efficient anti-tank artillery destroying 9 from the 13 R35 tanks. At 7h00, the German have achieved a bridgehead south of the Aisne River, deep of about 5 km from Château-Porcien to Avançon. The engineers build bridges for Guderian in Château-Porcien and Taizy.

4) 12e BCC

The 12e BCC south of Amiens on the Somme River is split : 2/12e BCC with the 16e DI and 3/12e BCC with the 13e DI. On 5th June 1940, the 2/12e BCC is on the Essertaux plateau with the mission of stopping German armored elements. One Renault R35 is destroyed by a Panzer IV during an ambush on the move to the deployment area. The first platoon (lieutenant Provoost) faces a German tank attack. The 3 Renault R35 tanks are hit by numerous 3.7cm projectiles which do not penetrate the armor of the tanks. 2 R35 tanks are immobilized by the fire of Panzer IIs and IVs. The crews continue to fire until all the shells have been used and they evacuate their tanks and join the French lines. The 3rd tank (caporal Deives) is scattered with 3.7cm impacts and retreats in the French lines. On the evening the 2 abandoned R35 tanks are recovered and towed in the French lines too.

For the 3/12e BCC the things are harder in the Essertaux - Aliy-sur-Noye area and several R35 tanks are destroyed or damaged (5 tanks) by 75mm shells from Panzers IVs. During this day the 12e BCC took part in blocking the German advance. The battalion had lost 5 WIA/KIAs, 3 destroyed tanks and 3 damaged and later recovered tanks transferred to the repair company.

To illustrate the facts in a larger context the German attacks in the area are largely defeated by the French artillery batteries firing in direct AT fire. On 5th June, the German XIV.Panzerkorps (9.PzD, 10.PzD, 13.ID (mot), 9.ID and “Grossdeutschland” regiment) assaults the French positions south of Amiens on the Somme River. The 14-20 km front (including the plateau of Dury) is hold by the 16e DI supported by 2 companies (26 Renault R35 tanks) of the 12e BCC. More than 400 German tanks and about 64,000 men are launched against about 18,000 French troops and 26 tanks. The French troops are organized in strongpoints in the towns and woods on a depth of about 10 km sometimes. These hedgehogs include infantry, HMGs, 25mm and 47mm AT guns, 75mm field guns used in AT role, AT mines etc. for a 360° defense. The advancing German tanks are rapidly cut from their supporting infantry and confronted on the rears to French 75mm, 105mm and 155mm artillery batteries engaging them in direct fire. On 8th and 9th June the 16e DI rears are reinforced by the 24th DI. After 5 days the German operation is stopped in that area, it failed and the Germans sustained heavy losses. The XIV.Panzerkorps is then moved and engaged behind the XVI.Panzerkorps in Péronne. The German troops lost 196 destroyed or damaged tanks (136 against the 16e DI and 60 against the 24e DI), including many definitively destroyed ones especially against French artillery batteries firing directly on the enemy tanks. The 2 French divisions have lost 60-70% of their strength but they stopped a Panzerkorps. Unlike in Gembloux the French troops had no strong artillery support since the artillery was mainly engaged in direct fire missions. After this battle the number of operational tanks of the XIV.Panzerkorps dropped to 45%.

5) 24e BCC

The battalion part of the 4e DCR but unlike the other units of the 4e DCR it was not constituted in the emergency with everything that was available. This BCC had been created in August 1939 and participated already to the attack on the Sarre area on in September 1939.

On 16th May the battalion is attached to the 4e DCR. The platoon (3 tanks) of sous-lieutenant Jeanney (3/24e BCC) is ordered to defend the bridge of Chivres. At 19h30 a German column with 3 armored cars and motorcycles is destroyed. During the night 2 more side-cars are destroyed. At 5h30 on 17th May another German column is attacked. The German column is destroyed : 23 KIAs, 33 POWs, 1 armored car destroyed, 2 75mm field guns destroyed or captured, 18 soft skin vehicles destroyed or captured, 6 motorcycles destroyed or captured and numerous radio sets captured.

The 24e BCC takes part to the attack on Montcornet (except this platoon). The town of Lislet and Montcornet are reached as well as the bridges on the Serre River, but the French tanks in Montcornet lack infantry support. Several tanks are destroyed by AT mines but they resist to the 3.7cm PaK except to the close range shots. Finally the battalion looses 7 tanks.

During the attack on Montcornet the French engages 90 tanks from various units :
- 46e BCC (about 30 Renault B1bis tanks)
• Elements of the 2e BCC and of the 24e BCC (Renault R35 tanks)
• Renault D2 tanks from the 345e CACC
• Infantry from the 4e BCP

They face German troops from various units including:
• AA 90 (10.PzD)
• very few tanks from the 10.PzD coming just out of the repair unit
• 666.Pionier battalion
• 56. Flak battalion
• Luftwaffe (Stuka dive bombers attacks)

The French units advances on 12 km and goes back. From the 90 engaged tanks 23 are lost (9 B1bis tanks, 2 D2 tanks and 12 R35 tanks), largely because of the 8.8cm FlakK. The French human losses are nonetheless weak: 14 KIAs, 6 WIAs and 9 MIAs. On the German side the French reports having killed about 100 Germans captured 130 POWs.

On 18th May the 24e BCC is in defense in front of Laon and on 19th May it takes part to the attack on Crécy-sur-Serre and looses no tanks this day. On 20th May the battalion is attacked by the Luftwaffe and at 10h00 it defeats a German cavalry unit which sustains heavy losses. The 24e BCC defends then various accesses at Aubigny, Corbeney and Ville-au-Bois. The 1/24e BCC and tanks of the 3/24e BCC are ordered to rescue a French motorized column encircled in La Ferme d’Hurtebise. They attack the German AT defenses and manage to rescue most of the French troops but 1 Renault R35 is lost and the crew MIA. The battalion is then retreating and during this time 10-11 tanks are destroyed or abandoned for various reasons.

The battalion is then resting in Compiègne and takes part with the 4e DCR to the attack on the Abbeville bridgehead. Later it will fight during the retreat to the Loire River.

6) 44e BCC

The 44e BCC is engaged against the bridgehead of Abbeville as part of the 4e DCR but the French tanks are defeated by 8.8cm and 10.5cm guns used in AT role.

7) After the 1940 Western campaign, one can for example mention Operation Exporter (invasion of the French Levant = Lebanon + Syria) from 8th June to 11th July 1941.

In May 1940 in the Levant (Syria + Lebanon) there were the 63e BCC (40+5 Renault R35) and the 68e BCC (40+10 Renault R35). There were also the 56 former Renault FT17 tanks from the 63e BCC. Most remained in parks but the CACL (compagnie autonome des chars du Levant was created) with 3 groups of 10 tanks (9+1 replacement tank = 3x FT17m, 6x FT17c, 1x FT17BS) in the cities of Beyrouth, Alep and Damas for a total of 30 Renault FT17 tanks. In June 1940, the CACL is reinforced by 6 FT-17 tanks (1x FT17c in each groups and 3 FT17m for the protection of the airbase in Estabel in Lebanon).

Therefore about 90 Renault R35 and possibly about 36 Renault FT17 tanks from Vichy saw action against the allies who had a lot of difficulties when facing the Renault R35 tanks because they lacked proper AT guns to counter them. This tank was the strongest one in the area. The Boys AT rifles were powerless against the Renault R35 tanks and the 25 Pdr field guns had to fire point blank to have a chance to knock them out. During this campaign, the Renault R35 tanks fought with great success and all their counter-attacks succeeded. At Kounitra for example they forced the 1st Battalion, Royal Fusiliers to surrender for the first time of its history (470 POWs). It was cut off by a Vichy counter-attack and the entire battalion was lost.

RENAULT R40

The Renault R40 is the final variation of the R35. Renault was well aware of the limitati on of the suspension of the Renault R35 and on the Renault R40 the suspension designed by the Atelier de Construction d’Issy-les-Moulineaux (AMX) is a completely modified and largely improved version. This suspension has a strong resemblance to the D2 one and solves most of the weight distribution issues. The track looks like a B tank variant and the suspension includes 12 pairs of small road-wheels on each side mounted in pairs and vertical coil springs. The suspension is protected from projectiles and mud by 8mm thick armored skirts.

This vehicle mounted as standard the long barreled 37mm SA38 L/33 gun in the APX-R1 turret and had an AMX M41938 skid tail. About 130 tanks had been built in May and June 1940. They equipped the 40e BCC (30 R40 and 15 R35), the 48e BCC (29 R40 and 16 R35), the reconstituted 28e BCC (24 R40 and 21 R35) in beginning June the Free Polish armored brigade in France.

The final evolution of the Renault R35 (the R40) had as short a career as it was eventful. The 37mm SA38 L/33 gun gave it a true anti-tank capacity unlike with the 37mm SA18 L/21 gun of most of the French tanks. The completely new suspension compared to the R35 enabled it to fulfill its intended role and gave him a far better mobility. A testimony speaks of a Renault R40 struck by no less than thirteen 37mm shots from short range, including 4 in the suspension, without impairing the tank fighting capacity!

Weight : 12t
Length : 4.02m
Width : 1.87m
Height : 2.13m
Crew : 2 men
Maximum armor : 43mm  (APX-R turret is cast and hull is cast armor + RHA bolted elements)
Maximum speed : 20-23 km/h (Renault engine, 4 cylinders, gasoline, 85 hp, 5880 cm³, water cooled)
Transmission : 4 forward, 1 reverse
Autonomy : 140 km
Armament : a 37mm SA38 L/33 gun and a 7.5mm MAC1931 CMG (100 shells and 2400 cartridges - elevation of -16 to +20° and traverse of 5° right and 5° left but could be blocked to aim only with the turret rotation).

**Detailed armor thickness (mm)**:
- Turret Front : 40mm/5° and 28° + gun mantlet
- Turret Sides : 40mm/28°
- Turret Rear : 40mm/30° (rear hatch is 40mm thick)
- Turret Top : 25mm/90°
- Copula : 40mm/round
- Hull Front, Upper : 43mm/37° (driver's hatch is 40mm/23°)
- Hull Front, Lower : 40mm/round
- Hull Sides, Upper : 40mm/10°
- Hull Sides, Lower : 40mm/0° + 8mm for the protective skirts
- Hull Rear : 32mm/24°
- Hull Top : 25mm/90°
- Hull Bottom : 10mm/90°

The surface of the front (turret and hull) really exposed to the enemy fire : **2.00 m² with only 0.65 m² with a slope inferior to 30°**

**HOTCHKISS H35**

Its conception is close to the Renault R35, the H35 is equipped with the same APX-R turret. The H35 is equipped with the 37mm SA18 L/21 gun and sometimes with a 37mm SA38 L/33 gun. Some were fitted with AMX crossing tails. About 400 Hotchkiss H-35 have been produced. An easy tip to distinguish between R35 and H35/39 tanks : the Hotchkiss tanks have 6 wheels mounted in pairs on bogies while the R35 tanks have only 5 wheels (the 1st mounted independently, the other 4 on 2 articulated bogies).

- Weight : 10.6t
- Length : 4.22m
- Width : 1.95m
- Height : 2.15m
- Crew : 2 men

Maximum armor : 40mm  (APX-R turret is cast and hull is cast armor)
Maximum speed : 35 km/h (Hotchkiss 6L6 1935 engine, 6 cylinders, gasoline, 75 hp, 3480 cm³, 2700 rpm, water cooled)
Transmission : 5 forward, 1 reverse
Autonomy : 150 km
Armament : a 37mm SA18 L/21 gun or a SA38 L/33 gun and a 7.5mm MAC1931 CMG (40 AP, 60 HE, 1350 standard cartridges (9 magazines) and 900 armor piercing cartridges (6 magazines) – for the 37mm SA18 elevation of -16 to +20° and traverse of 5° right and 5° left but could be blocked to aim only with the turret rotation).

**Detailed armor thickness (mm)**:
- Turret Front : 40mm/5° and 28° + gun mantlet
- Turret Sides : 40mm/28°
- Turret Rear : 40mm/30° (rear hatch is 40mm thick)
- Turret Top : 25mm/90°
- Copula : 40mm/round
- Hull Front, Upper : 35mm/30° and round
- Hull Front, Lower : 35mm/ round
- Hull Sides : 35mm/15°
- Hull Rear : 35mm/about 50° and 30°
- Hull Top : 22mm/88° and 90°
- Hull Bottom : 12mm/90°

The surface of the front (turret and hull) really exposed to the enemy fire : **6.00 m² with only 3.24 m² with a slope inferior to 30°**

**HOTCHKISS H35 model 1939 (HOTCHKISS H39)**

The Hotchkiss H-39 is derived from the H35. The main differences are a more powerful engine (120 hp instead of 75 hp) and heavier armor. The H35 and H39 could both be equipped with the 37mm SA18 L/21 or 37mm SA38 L/33 gun. In fact all the Renault R35, Hotchkiss H35, Hotchkiss H39 and FCM 36 were intended to be equipped with the 37mm SA38 L/33 gun but the program was not achieved when the war begun and the Hotchkiss H39 were equipped in priority. At the outbreak of the war 610 Hotchkiss H39 had been delivered. The Hotchkiss H39 was also sent in Norway in 1940 in the 342° CACC (compagnie autonome de chars de combat). This unit was formed...
with the tanks of the 1st company of the 42nd BCC belonging to the 3rd DCR. The 15 tanks of this company (commander = Capitaine Dublineau) were originally to be converted into flame-thrower tanks. The company was assigned to the 4th DLCh (1st Division légère de chasseur). It was sent to Norway, later being evacuated to Morocco. The unit served later in the Free French forces in Gabon. The H39 was also the first tank of Tito’s partisans. Just after the war, Israelis got hold of a dozen units, the first model they had in numbers, and used them until 1956.

Weight: 12.1t
Length: 4.22m
Width: 1.95m
Height: 2.15m
Crew: 2 men
Maximum armor: 40mm (APX-R turret is cast and hull is cast armor)
Maximum speed: 36.5 km/h (Hotchkiss 6L6 1938, 6 cylinders, gasoline, 120 hp, 5970 cm³, 2800 rpm, water cooled)
Diameter of turning circle at 6 km/h: 8.25m (Jentz)
Transmission: 5 forward, 1 reverse
Autonomy: 150 km
Ground pressure: 0.9 kg/cm² (compared to 0.73 for PzIIC, 0.92 for a Pz III e/f and 0.83 for PzIV d)
Armament: a 37mm SA18 L/21 gun or a SA38 L/33 gun and a 7.5mm MAC1931 CMG (40 AP, 60 HE, 1350 standard cartridges (9 magazines) and 900 armor piercing cartridges (6 magazines) – for the 37mm SA18 elevation of -16 to +20° and traverse of 5° right and 5° left but could be blocked to aim only with the turret rotation).

**Detailed armor thickness (mm):**
- Turret Front: 40mm/5° and 28° + gun mantlet
- Turret Sides: 40mm/28°
- Turret Rear: 40mm/30° (rear hatch is 40mm thick)
- Turret Top: 25mm/90°
- Copula: 40mm/round
- Hull Front, Upper: 40mm/30° and round
- Hull Front, Lower: 40mm/round
- Hull Sides: 40mm/15°
- Hull Rear: 40mm/32° and 30°
- Hull Top: 22mm/88° and 90°
- Hull Bottom: 12mm/90°

Maximum slope to climb:
- on soft ground: 26° (note that in German manuals the slope on soft ground was generally listed as maximum slope to climb unlike in French manuals, indicating the maximum slope on hard ground).
- on hard ground:
  - in 1st gear: 38°
  - in 2nd gear: 22°
  - in 3rd gear: 8°
  - in 4th gear: 4°
  - in 5th gear: 2°
  - in backwards gear: 35°

Vehicle could move safely with a lateral slope up to 25°.

Ground pressure: very hard ground 4.75 kg/cm², firm road 0.9 kg/cm², soft ground (sinking in 25 cm) 0.8 kg/cm².

1st gear – speed: 3.65 km/h
2nd gear – speed: 7.3 km/h
3rd gear – speed: 13 km/h
4th gear – speed: 24 km/h
5th gear – speed: 36.5 km/h
Backwards gear – speed: 4.5 km/h
All speeds are indicated with engine on 2800 rpm.
Top speed: 36.5 km/h on-road and 16 km/h in medium difficult off-road

**FCM 36**
The FCM-36 was built by the "société des Forges et Chantiers de la Méditerranée", designed to be an infantry support tank. This was the first mass produced French diesel powered tank. 100 units have been built and used against the Germans in the 4th and 7th BCC. It had a modern look, sloped armor and an octagonal shaped FCM turret but a poor armament with its 37mm SA18 L/21 gun and a coaxial MG (very few could be rearmed with the 37mm SA38 L/33 gun). It was liked because of its bigger autonomy and mobility (smaller turning circle) compared to the Renault R35 for example.

Weight: 12.35t
Length: 4.51m
Width: 2.14m
Height : 2.20m
Crew : 2 men
Maximum armor : 40mm (turret is RHA+cast welded armor and hull is RHA welded armor)
Maximum speed : 24 km/h (Berliet-Ricardo engine, 4 cylinders, diesel, 91 hp, 8400 cm³, water cooled)
Diameter of turning circle at 6 km/h : 6.50m (Jentz)
Transmission : 5 forward, 1 reverse
Autonomy : 225 km
Ground pressure : 0.75 kg/cm² (compared to 0.73 for PzIIc, 0.92 for a Pz III e/f and 0.83 for PzIVd)
Armament : a 37mm SA18 L/21 gun and a 7.5mm MAC1931 CMG (102 shells and 3000 cartridges)

**Detailed armor thickness (mm)**:
- Turret Front : 40/27°, 19° and round + gun mantlet round covering about 70% of the front surface
- Turret Sides : 40mm/30°
- Turret Rear : 40mm/35°
- Turret Top : 15mm/90°
- Hull Front : 40mm/27° and about 60°
- Hull Sides : 20-30mm/44° + sloped protective skirting plates to protect the wheels
- Hull Rear : 20mm/66° and 74°
- Hull Top : 15mm/90°
- Hull Bottom : 13mm/90°

**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.713 / L.739 sight (37mm SA18 gun) OR 1x L.767 sight (37mm SA38 gun) but rare.
3x PPL RX 160 episscopes (68° horizontal field of view, 24° vertical field of view)
3x slits

**RENAULT D1**

French plans to create new modern infantry support tanks after WW1 led to the development of the Renault D1, it is the direct following of the Renault FT17. Only 160 units were built between 1932 and 1935. They were at first equipped with the Schneider ST-1 prototype turret but standard models were fitted with the ST-2 model in 1933. It was armed with a 47mm SA34 gun, a coaxial and a ‘bow’ 7.5mm MAC31 MG (fixed). The tank had an amazing radio set with a triangular aerial behind the turret. In 1940, the 67e BCC is equipped with D1 tanks. It moved from Tunisia to France in June and faced the Germans during the battle of Souain in a mission of sacrifice. The others remained in Tunisia in the 61e and 65e BCC. After armistice they are issued to the 2e, 5e and 7e Regiment de Chasseurs d’Afrique (RCA) and in November 1942 they saw shortly action against the US troops. After that, about 45 of them were used against axis troops in Tunisia in 1942-1943.

Weight : 14t
Length : 4.81m
Width : 2.16m
Height : 2.40m (with antenna)
Crew : 3 men
Maximum armor : 40mm for the ST2 turret (cast armor) and 30mm RHA bolted for the hull
Maximum speed : 18 km/h (Renault, water cooled, 6 cylinders, gasoline, 74 hp, 6080 cm³)
Transmission : 5 forward, 1 reverse
Autonomy : 90 km
Armament : a 47mm SA34 L/30 gun (112 shells) and two 7.5mm MAC1931 (TMG and fixed BMG) (5100 cartridges)

**Detailed armor thickness (mm)**:
- Turret Front : 40mm/? (11°) + gun mantlet
- Turret Sides : 40mm/? (23°)
- Turret Rear : 40mm/? (22°)
- Turret Top : ?
- Hull Front : 30mm/?
- Hull Sides : 30mm/? + protective skirting plates to protect the wheels
- Hull Rear : ? (30mm/?)
- Hull Top : ?
- Hull Bottom : 14mm/90°
RENAULT D2

Even while the Char D1 was being produced, work was proceeding on the Renault D2. Prototypes were equipped with ST turrets but production models were fitted with the APX1 turret (like on the B1 tank). 100 of these tanks were produced between 1937 and 1940. The 50 first tanks were armed with a 47mm SA34 gun in the APX1 turret (20 were rearmed with a 47mm SA35 gun) and the last 50 tanks had an APX4 turret (same turret than the B1bis tank) with a 47mm SA35 gun. They had a coaxial 7.5mm MAC1931 MG and a fixed bow 7.5mm MAC1931 MG. From the 50 first produced tanks, 5 were issued to schools and 45 equipped the 19e BCC. In April, the first company (1/19e BCC) was issued with 14 brand new D2 tanks (47mm SA35 gun) and became temporary the 345e CACC.

The 14 old tanks should have been transformed in flamethrower tanks (60m range). Later the 346e CACC was equipped with 10 tanks and 12 tanks were issued to the 350e CACC.

Weight : 19.75t
Length : 5.46m
Width : 2.22m
Height : 2.66m
Crew : 3 men

Maximum armor : 40mm (56mm when fitted with APX4 turret)
Maximum speed : 23 km/h (Renault, water cooled, 6 cylinders, gasoline, 150 hp, 9500 cm³)
Transmission : 5 forward, 1 reverse
Autonomy : 100 km
Armament : a 47mm SA34 L/30 (120 shells) or 47mm SA35 L/32 gun (108 shells) and two 7.5mm MAC1931 (TMG and fixed BMG) (5100 cartridges)

Detailed armor thickness (mm) with APX4 turret:
- Turret Front : 56mm/0° + gun and CMG mantlet (56mm/round covering about 50% of the front surface
- Turret Sides : 56mm/22.5°
- Turret Rear : 56mm/22.5° (rear hatch is 56mm thick)
- Turret Top : 40mm/24° and 50°
- Copula : 48mm/25° and 90° (round)
- Hull Front : 40mm/0° + protective skirting plates to protect the wheels
- Hull Sides upper : 40mm/60°
- Hull Sides lower : 40mm/0° + protective skirting plates to protect the wheels
- Hull Rear : 30-40mm/71° and 0°
- Hull Top : 20mm/90°
- Hull Bottom : 20mm/90°

RENAULT B1 and B1bis

Conceived by general Estienne (father of French tanks since 1915) in 1920, this tank had an original conception. In 1929-30, Renault and FCM built three prototype models. These later became designated B tank. These three pilot models were extensively reworked and modified for tests. The first one, reengined and uparmored became the early prototype for the B1ter in 1937. The B1 tank was the production version of the B tank. Production began in 1935. Only a small number were built before construction changed to the more powerful B1bis in 1937. The B1bis was the heavy tank of the French army in 1940 and was nicknamed "Stahlkolosse" (iron colossus) by the Germans. Considered one of the most powerful and advanced tanks in the world, it was hampered by it's low autonomy and cost of production. The B1ter did not go beyond prototype stage. The B tank series had self-sealing fuel tanks, grouped lubrication, electric starter, and a floor escape hatch. There were the first French tanks to have electric powered traverse. It was steered through a double differential combined with the Naeder (a hydrostatic unit). Differential steering allowed both tracks to go in opposite directions and therefore the B1bis could rotate on the spot (without moving forward) unlike German tanks. The driver used the Naeder steering system to point the 75mm gun as it couldn't move left or right (only 1° traverse ; on the future B1ter the 75mm hull gun had a +6°,-6° traverse). Armor components and armor plates were mounted to steel girders running along each side to form the hull of the vehicle. The suspension assemblies, which incorporated 3 vertically mounted coil springs on each side, were fixed to these girders so that the springs projected upwards into the hull. Armored skirting plates protected the suspension system, which was developed from the Holt system. There were three main assemblies each side, each of four bogies mounted in pairs on plates pivoted at the centre. Each of these plates was mounted at the end of a similar one balanced at the base of vertically mounted coil springs, whilst semi-elliptic leaf springs also came into play as dampers under extreme compression. In addition, there were four independently mounted bogies (three forward, one rear) controlled by leaf springs. Unusually, the front idler wheel (tensioner) was also spring-mounted. The tracks were driven by the rear sprocket and adjustments for track tension were made from inside the fighting compartment. All this involved considerable lubrication of bearings and guides, but the task was made easier with an arrangement of grease nipples in four groups each side behind small doors in the armored skirting plates. The B1 had the APX1 turret (40mm armor) and the B1bis tanks received the revised APX4 turret (56mm armor). The B tanks were used in the 4 French armored divisions (1st, 2nd, 3rd, and 4th DCR = Division Cuirassée de Réserve). Each division had 2 battalions of theoretically 34 B1/B1bis tanks (1 command tank, 3 companies of 10 tanks and 3 replacement tanks) and 2 battalions of 45 light tanks (1 command tank, 3 companies of 13 tanks and 5
replacement tanks). There were also B1bis distributed to 4 independent companies (347th, 348th, 349th and 352nd CACC = Compagnie Autonome de Chars de Combat. 34 B1 (December 1935 – July 1937) and 369 B1bis (July 1937 - June 1940) tanks have been built for a total of 403 B tanks.

**RENAULT B1**
Weight : 28t  
Length : 6.35m  
Width : 2.50m  
Height : 2.79m  
Crew : 4-5 men  
Maximum armor : 40mm (APX1 turret in cast and hull is RHA bolted armor)  
Maximum speed : 30 km/h (Renault engine, 6 cylinders, water cooled, gasoline, 272 and 300 hp)  
Transmission : 5 forward, 1 reverse  
Autonomy : 180 km  
Armament :  
- one 47mm SA34 L/30 gun (50 shells - 30 APHE, 20 HE - traverse 360° and elevation -18 to +20°)  
- one coaxial 7.5mm MAC1931 in the turret (traverse 10° left and right and elevation -18 to +20°)  
- one 75mm SA35 L/17 gun (80 shells - 7 APHE, 73 HE - traverse 1° left and right and elevation -15 to +25°)  
- one fixed 7.5mm MAC1931 MG in the hull (32x150 rounds MAC31 drum magazines, for a total of 4800 cartridges for the 2 MGs)

**Detailed armor thickness (mm)**:  
Turret Front : 40mm/0° + gun and CMG mantlet (40mm)/round covering about 50% of the front surface  
Turret Sides : 40mm/22.5°  
Turret Rear : 40mm/22.5° (rear hatch is 40mm thick)  
Turret Top : 25mm/74° and 90°  
Copula : 40mm/25° and 90° (round)  
Hull Front, Upper : 40mm/20°  
Hull Front, Lower : 40mm/45°  
Hull Sides, Upper : 40mm/20°  
Hull Sides, Lower : 40mm/0°  
Hull Rear : 40mm/43° and 0°  
Hull Top : 14-27mm, mostly 25mm/90°  
Hull Bottom : 14mm/90°

**RENAULT B1bis**
Weight : 31.5t  
Length : 6.35m  
Width : 2.50m  
Height : 2.79m  
Crew : 4-5 men  
Maximum armor : 60mm (APX4 turret in cast and hull is RHA bolted armor)  
Maximum speed : 28 km/h (Renault engine, 6 cylinders, water cooled, gasoline, 307 hp, 16500 cm³, 1900 rpm, 2 Zenith type 70 AR 172 carburettors, 2 SEV G6 type 160 magnetos)  
Transmission : 5 forward, 1 reverse  
Autonomy : 160 km  
Ground pressure : 0.85 kg/cm² (compared to 0.73 for PzIIc, 0.92 for a Pz III e/f and 0.83 for PzIV d)  
Armament :  
- one 47mm SA35 L/32 gun (72 shells - maybe 52 APC and 20 HE or 42 APC and 30 HE - traverse 360° and elevation -18 to +18°)  
- one coaxial 7.5mm MAC1931 in the turret (traverse 10° left and right and elevation -18 to +18°)  
- one 75mm SA35 L/17 gun (74 shells - 7 APHE, 67 HE - traverse 1° left and right and elevation -15 to +25°)  
- one fixed 7.5mm MAC1931 MG in the hull (35x150 rounds MAC31 drum magazines, for a total of 5250 cartridges for the 2 MGs).

**Detailed armor thickness (mm)**:  
Turret Front : 56mm/0° + gun and CMG mantlet (56mm)/round covering about 50% of the front surface  
Turret Sides : 56mm/22.5°  
Turret Rear : 56mm/22.5° (rear hatch is 56mm thick)  
Turret Top : 30mm/74° and 90°  
Copula : 48mm/25° and 90° (round)  
Hull Front, Upper : 60mm/20°  
Hull Front, Lower : 60mm/45°  
Hull Sides, Upper : 55mm/20°  
Hull Sides, Lower : 55mm/0°
### Hull Dimensions

- **Hull Rear**: 55mm/43° and 0°
- **Hull Top**: 14-27mm, mostly 25mm/90°
- **Hull Bottom**: 20mm/90°

According to B1bis veteran crews, the French tankers were really confident in their powerful heavy tank. Most of the battalions were well formed and the moral was very high from the beginning to the end of the 1940 campaign, despite the events and losses. The hull interior of the B1bis was organized in two compartments separated by a firewall. The 4 crew members (commander/gunner, driver/hull gunner, driver's assistant/loader and radio/loader) were in the front compartment and the engine, tanks and transmission in the rear compartment. 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 the 4 theoretical men in a Renault B1bis.

The hull of the tank was composed of RHA and the turret was cast. The driving post hood on the front hull was eventually made of cast armor (and could perhaps therefore be a "weak" point compared to the 60mm surrounding RHA, but only in the improbable case of being it at a proper 0° angle). The driver was seated on the left side of the bow and the hull-mounted 75mm SA35 gun was mounted to his right. His visions means consisted in a front episcope with an adjustable slit from 12mm to 100mm opening, 2 lateral slits and a periscope (giving a vision of about 180°). Behind the driver was the radio operator and to his right was the loader. The commander was the single occupant of the turret.

The first radio set in the B1/B1bis tanks was the ER53 M1932 (ER is Emetteur-Récepteur, or transmitter-receiver), with a 15km range. It was operated by morse key, broadcast on a frequency range of 40-100m, and weighted around 80kg. Only 100 of this radio were produced. It was then replaced by the ER51 M1938, weighting 50kg only and operated by voice (3km range) and/or morse key (15-20km range) on the same frequencies. The communications had usually to be coded before being emitted. A tank or a unit was ordered to go to a precise location for example. During offensive operations messages were sometimes send clearly and by voice to coordinate two companies for example. Nevertheless in the heat of a combat and with all the noise, the radio was often not used at all and each tank manoeuvred roughly alone, keeping a view on the 2 other tanks of the platoon and if possible on other platoons. The battery (2 Cd-Ni batteries mounted in series, 103 AH but initially 130 AH was planned) of the tank had about 2 days autonomy (note that the company command tank had a replacement battery). The battery was used for 4 main tasks:

- starting the 307 hp engine (which could also be started by the VIET compressed air system) (24 V)
- powering the radio (36 hours autonomy in continuous use) (24 V)
- powering the RAGONOT turret electric engine (1/4th hp, 12V - when not powered by the main engine)
- provide light inside the tank (12 V)

If the battery was empty it was replaced (command tank) or charged again. After 7-8 hours of running the main tank engine the battery was totally charged again.

If needed, the electric engine could therefore power the tank turret while the main engine was off. A tank that ran out of fuel could still power the turret electrically. If both main engine and battery were out of use, the turret could still be hand cranked. While in combat situation, the main engine was nevertheless rarely shut off because it could sometimes be difficult to start again and an immobile tank is in danger.

The crew communicated in the tank by speaking/shouting but there was also an order transmitter with some lights on the driver's instrument panel which allowed the commander in the turret to order simple thinks like: forward, turn right, turn left, speed up, slow down, warning, cease fire etc. The radio had a specific aluminium helmet with a speaker and headphones. A complete intercom installation was tested in the B1bis tank, allowing the crew members to communicate together thanks to laryngophones and headphones. A complete drawing of the system can be seen in a document dated from March 1940 and from several photos it seems that it has been used in May/June 1940 by several tanks or even tank battalions.

The driver utilized a steering wheel to direct the vehicle, the wheel connected by a chain and control rod system to the Naeder hydrostatic steering system at the rear of the tank. Interestingly, the driver also doubled as the hull gunner, while the wireless operator, who had relatively little to do, was seated further back near the turret and provided help to the loader. The loader, who was seated behind the 75mm gun, was kept very busy loading the 75mm hull weapon and passing 47mm ammo up to the commander/gunner in the turret. The Naeder steering system provided very fine and precise directional control for the hull gun, this steering system being a fairly advanced regenerative controlled differential system. It provided for a graduated turning radius independent of the transmission gear chosen, a system known as hydrostatic. The Naeder worked with ricin oil. The driver's 75mm SA35 L/17.1 gun sight was mounted just below his forward episcope. These two L.710 sights were prismatic binocular sights (stereoscopic range finder, each sight with a 3.5x magnification, a field of view of 11.15° and range ladders, adjustable drum up to 1600m) and they rotated behind a pair of vertical slits beneath the
driver’s scope. From the front of the vehicle these two slits are easily seen below the driver’s main vision port. Another interesting feature of this tank was the gyroscopic direction indicator, driven by a compressor. The same compressed air system (système VIET) also assisted in starting the engine when the normal electric starter failed.

The Renault engine was set up so the clutch was at the rear of the power plant and it then directly transferred power to a five-speed gearbox and then through a differential to both the rear sprockets. The Naeder hydrostatic steering pump sat on top of the gearbox and obtained its power from a chain drive takeoff from the main drive shaft, just before the gearbox. This type of steering system is also commonly called a double differential steering system, the design originally manufactured at the Schneider Company under the direction of E. Braillié in the early 1920s. The hydrostatic steering drive (‘hydrostatic’ is just another word for ‘hydraulic’) gave infinity of turning radii for each case. The rear compartment was divided into 3 areas: the central area with the engine and the transmission. The steering was controlled by two clutches that transferred the power to the second differential (again, mounted on top of the main unit) and then to a set of cross-shafts running parallel to the main shafts. This second set of cross-shafts controlled the speed of the primary drive shafts because they rotated in the opposite direction. In this way the Naeder system could slow either drive shaft that it was associated with and thereby slow the attached sprocket, the action depending on which of the steering clutches was engaged by the driver as he used the levers up at the front of the tank. Although it was complicated, the Naeder steering system allowed the small and precise corrections in steering that were necessary to accurately turn the vehicle just inches in one direction, allowing surprisingly accurate aiming of the hull-mounted 75mm gun. As an example an 8.8cm Flak was destroyed at Abbeville with the 75mm hull gun from a range of 1500m. If the Naeder system was damaged or out of use the tank could still turn like other tanks, by using the brakes.

The 75mm SA35 L/17.1 was installed in a mount that provided an elevation of +25° to -15°. The gun was fixed in traverse, being aimed solely by the driver, in elevation by a hand wheel, and in traverse by turning the entire tank (thanks to the Naeder system). Another unusual feature of the B1bis tank bis was the air compressed system LUCHARD which automatically blow fumes out the howitzer barrel after firing the gun and before opening the breech (an early fume extractor). The driver via a cable connection fired the hull 7.5mm Châtellerault M°1931 machine gun. The hull MG is fixed, under and on the right of the 75mm gun. The same system allowed the commander to also fire this MG if needed.

All the 47mm shells were ready to be fired as well as the 75mm APHE shells (no fuze at the tip of the projectile but an ignition system on the base of the projectile) but concerning the 75mm HE shells only 6 had already a fuze on them. They were in fact equipped with a long RYG 1921 fuze for better anti-personal efficiency. This long fuze explains why there were only 6 armed shells in the B1bis and 6 longer emplacements for them in the ammunition racks. For the following 75mm HE shells the loader and/or another crew member had to mount the fuzes on the shells. The theoretical 15 rpm rate of fire for the 75mm SA35 gun probably decreased to 2-6 rpm in combat. Concerning the 47mm SA35 turret gun, the theoretical rate of fire of the gun was also 15 rpm but in accurate aiming it was 6 rpm according to the French tests. During combats the rate of fire could drop down to 2-3 rpm according to the crews: time needed to spot the target, to block the turret, to aim, to fire, to reload etc. There was a system for blocking the turret, otherwise it would have turned slightly to the right after each 47mm gunshot and the gunner would have had to aim again. Nevertheless, according to veterans, the B1bis did well against other tanks, even when firing at moving targets. The fact that the tank had two guns increased the rate of fire of the tank even sustained fire and accurate aiming: 47mm turret gun (2-6 rpm) and 75mm hull gun (2-6 rpm) for a total of 4-12 rpm if shooting together at the same target. But there is also an advantage of having two guns as illustrated by the B1bis “Eure” (Lieutenant Billotte) in Stonne, which destroyed at the same time the first tank and the last tank of a German column.

The B1 and B1bis tanks were conceived as infantry support tanks, 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 allowed without problem to prepare the new HE shells. The B1/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.

There were three primary entry/exit hatches for the crew (one on the right hull wall, one above the driver, and one on the right rear of the turret). But there were also two emergency escape hatches provided (one floor escape hatch and one in the roof of the engine compartment). Several little traps allowed throwing away shells and cartridges cases. The rear compartment was divided into 3 areas: the central area with the engine and the transmission. The right area where after a hatch a passage way gave access to various fuel tank and engine indicators and to part of the ammunitions. In this same area there were two self-sealing fuel tanks (200 liters and 100 liters). An other self-
sealing fuel tank (100 liters) was located in the left area for a total of 400 liters. In this left part there was also a cooling intake: 2 radiators and 2 ventilators which took fresh air from outdoor through a shutter (with slats) for the cooling of the engine.

According Bernard Lemaire, a former B1bis tank commander, the main advantages of the B1bis (compared to the Renault R35 for example) were:

- good suspension
- good speed
- good crossing capacity
- good visibility for the commander through his episcopes
- very good armor

The main drawbacks were the mechanical breakdowns of the Naeder system which were not uncommon (if damaged, the aiming of the 75mm hull gun became very difficult) and the fact that the tank could not be hull-down if the crew wanted to use the 75mm hull gun.

**Renault B1 and B1bis tank vision means**

**Hull:**
2x L.710 sights for the 75mm SA35 gun forming prismatic binocular sights - may constitute a stereoscopic range finder together – (each sight with 3.5x magnification, field of view 11.15° and range ladders, adjustable drum up to 1600m for the HE shells and 1560m for the APHE shells).
1x adjustable slit with PPL RX 160 episcope for the driver / hull gunner (+ armored shutter whose opening could vary from 12 to 100mm)
2x lateral slits (driving post)
1x periscope (about 180° horizontal field of view for the driver / hull gunner)

**APX1 turret (40mm armor, 1950 kg with the 47mm SA34 gun and 2100 kg with the 47mm SA35 gun):**
1x sight for the 47mm SA34 gun (3.8x L.671 sight, V reticle, field of view 9.56°) or for the 47mm SA35 gun (4x L.724 sight, V and later + reticle, field of view 11.25°)
2x PPL RX 160 episcopes (68° horizontal field of view and +3° to -21° = 24° vertical field of view)
2x slits: forward left (80mm x 3mm) and rear left (80mm x 15mm)

**OR**

**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)

**Notes about the APX4 turret (September 1939):**

- Weight: 2570 kg with the complete armament
- Ring: 1.022m

1) **HAND ROTATION OF THE TURRET (360°):**
If angle of the turret is 0°:
55s if operator is standing (which is always the case in combat in this narrow turret)
60s if operator is sitting
(1 wheel turn for a rotation of about 2.21°)

If angle of the turret is 25° (tank is not on flat ground)
64s if operator is standing (mostly the case in combat in this narrow turret)
102s if operator is sitting

2) **ELECTRIC ROTATION OF THE TURRET (360°):**
10° / second = 36s for a complete rotation (28-30s for the APX1 turret)

3) **COPULA ROTATION (360°):**
Always by hand: 12 s
Look all around with the 3 means of observation (binocular, episcope, slit) and to return to the weapons: 5s
Time to find a target in the gunsight that has been first spotted in the copula’s episcope and inversely: 3s

All these values are from tests, not in combat situation.
1st gear – speed : 2.1 km/h (at 1600 rpm)
2nd gear – speed : 6.9 km/h (at 1600 rpm)
3rd gear – speed : 9.6 km/h (at 1600 rpm)
4th gear – speed : 17 km/h (at 1800 rpm)
5th gear – speed : 28 km/h (at 1800 rpm)

Usual top speed :
25 km/h on-road
21 km/h easy off-road
15 km/h hard off-road

If the engine has not been running during the day it has to be started and ran at 600-800 rpm (idle rpm range) during about 10 minutes. Otherwise, the driver started in 3rd gear and let the engine reach 1200 rpm before starting the tank.

Big obstacles are negotiated at slow speed (and 1st to 2nd gears) but between obstacles the tank has to run at normal speed to avoid loosing time. For that purpose there is the FIEUX circuit breaker system that allows going directly to 4th gear (from the 1st one for example) without having to change gradually all the gears and to accelerate much more rapidly.

The cooling intake shutter on the left side of the B1bis:

This area has roughly a size of 110x80 cm. The cooling intake shutter on the left side has the same length on the B1 and the B1bis but it is even slightly higher and therefore larger on the B1bis. This rather wide area clearly visible on the left side of the tank was not seen as a weak point at all by the French army and was composed of the same hardened molybdenum steel than the rest of the hull (only the driving post hood and the turret were cast armor).

Behind the shutter there are 2 radiators and 2 ventilators which took fresh air from outdoor through a shutter (with slats) for the cooling of the engine. There is also one of the big vertical coil spring (the suspension included 3 vertically mounted coil springs and semi-elliptic leaf springs on each side).

The cooling intake being a weak point of the tank is rather a myth. First of all it cannot be "black" as often mentioned since it is only an intake of fresh air, no engine gas are expelled through this shutter at all. It may perhaps appear darker in some light conditions. Concerning the radiator cover / shutter, the slats on the side are of 23-28mm/45° thick armor and are shaped in a closely stacked pattern like that if you look at them in the length:

\[ \text{interior} \quad \text{exterior} \]

The slats on the side are of 23-28mm/45° thick and are shaped in a closely stacked pattern. A projectile would have to pierce 2 successive 23-28mm plates each at 45° (although it is probably at least 3 plates at any angle). This shutter offers probably a protection roughly equal to the side armor of the B1bis (55 mm). This layered armor is therefore not a weak point of the tank and a 3.7cm PaK AP shell will not penetrate this thickness of armor. It would actually serve no real purpose to aim at the shutter.

There is apparently only 1 very peculiar example of a B1bis tank being knocked out after a hit on this shutter, on 15th May 1940 in front of Stonne. This area was not especially targeted and hit during the whole campaign. It is probably one of the very rare cases of a B1bis tank being knocked out by what seems to be a 3.7cm PaK (but at which range, angle, was the tank already damaged before during the battle e.g. fuel leaking etc.)

When asked about this supposed weak point on the B1bis, the pgm manager for Lockheed Martin Missiles and Fire Control replied this: "Well if we are talking about a 37mm threat (and we are this early in WW2) I don't see it as a huge weakness. Several US vehicles of the 50's era (principally APCs) had single slat grill designs ... In other words the slat was linear and angled downwards to provide a curtain over the radiator/fan tower against bullets and frags. From the internal plans that I have seen of the B1bis grill - its a V-shaped slat which is going to be alot more effective than a straight slat. Further its more than an inch thick so its no simple sheet metal stamping that we are talking about here. When you get into light caliber rounds and you get induced yaw or instability on impact their penetration goes to heck in a hand basket. From what I can see of that design it stands a good chance of inducing yaw as there it no solid plate for the projectile to bite into. Think of this as higher drag on one projectile side than the other. Get it turned even 5 degrees and when it hits the next portion of the slat its in serious trouble in terms of further penetration. That's the simplistic view...in summary no, I don't see it as a design weakness being a Ved or double slat... if it was a single slat it would be."

An other myth is that B1bis would move in a zigzag manner, exposing this cooling intake to the German gunners every two turns. French veterans having served in the B1bis all agree that it is not true. The B1bis will expose its thicker armor to the enemy, the frontal one and it had to move in the enemy's direction to be able to fire the 75mm hull gun, which is a fixed gun. It is mainly the 75mm gun with its powerful HE shells that was used to neutralize the German AT guns.
The French B1bis gave the Germans a bad licking resisting 3.7cm and even 7.5cm tank gunners with their superior armor. The Renault B1bis receive many nicknames from the Germans: "Stahlkolosse" (iron colossus), "Stahlriesen" (iron giants), "Stahlfestungen" (iron fortress), "stählerne Kasten" (iron boxes roughly), "Riesentiere" (giant beasts), "Ungeheuer", "Ungetüme" or "Untiere" (monsters).

The Germans called the 3.7cm PaK the "door-knocker" ("Panzeranglopgerät", meaning apparatus that knocks on tanks, which came from the PaK abbreviation meaning "Panzerabwehrkanone") when facing heavy tanks, but more probably when facing the T34 tanks later in Russia. Even Guderian had not dismissed these concerns in his memories and the up-and-coming officers in the German army would never forget the impression left of fearing enemy heavy armor and the need to counter them. The B1bis was almost invincible when engaged by 3.7cm AT guns. Mostly all the B1bis that have been lost due to the enemy have been destroyed by 8.8cm FlAK, indirect artillery fire, direct 10.5cm leFH fire and anti-tank mines. Many others have been abandoned after mechanical breakdowns or being out of fuel.

On 16th May in Stonne, a single B1bis tank (the B1bis "Eure" from Lieutenant Bilotte) pushed in the town itself into the German defences and went back. He attacked a German column of Pz.Rgt.8 and destroyed 2 PzIV, 11 PzIII and 2 3.7cm PaKs. 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 then 50m range. The armor of the B1bis was scattered with 140 impacts, none of the projectiles penetrated the armor. One can see here a kind of small 'Villers Bocage'.

Still on 16th May, around 17h00, the B1bis "Riquewihr" (lieutenant Doumeq) from the 49th BCC attacked towards Stonne and encountered a German infantry column, which fired at the tank with infantry weapons including anti-tank rifles, without effect. The B1bis crushed some German troops and pushed into the town defended by the Schützen Regiment 64. When the soldiers saw the bloody tracks of the tank they fled in panic and abandoned Stonne which remained unoccupied for the night. After that action Doumeq was nicknamed 'the butcher of Stonne' by his comrades. The B1bis "Riquewihr" will be the last one of the 3rd DCR, abandoned on 18th June 1940 north-east of Dijon.

On the evening of 17th May in the bridgehead of Hauteville-Neuvilette, the 6.PzD had pulled a French heavy tank attack back. One of the 3.7cm PaK (Lieutenant Neckenauer) had hit a French tank 25 times. Only at the 26th shot the track was hit enough to immobilize the tank but NONE of the other shells damaged the B1bis tank.

On 17th May in Crécy (North of Laon), report from the 1.PzD (BA-MA, RH 27-1/170, p.29): 'One B1bis tank crushed the defenses and took the direction of Mortiers, advancing along the 1st KRAD-Schützen battalion. The Pz.Rgt.1 was totally surprised and couldn't at first react. The B1bis tank advanced through Mortiers. Then the (German) tanks fired numerous shells on the rear of the B1bis. The B1bis stopped and the crew surrendered. The B1bis was scattered with impacts of 3.7cm and a few 7.5cm but NONE of the shells penetrated the armor.'

The battle on the Aisne River lasted from 17th May to the 11th June. The 14" D1 illustrated itself by resisting to all the German attacks and it even took some 800 German POWs. De Lattre requisitioned 3 replacement B1bis tanks from the 8th BCC (bataillon de chars de combat) ("Villers-Bretonneux", "Téméraire" and "Lunéville") under the command of sous-lieutenant Robert to defend the bridges in Rethel. After 5 days of battles (17th - 21th May 1940) the area was still under French control and these 3 B1bis tanks had destroyed 20 tanks (including 5 Panzer IV), 9 armored cars, 12 motorcycles / side-cars, 10 cars and 16 trucks.

On 17th May 1940, the B1bis "Mistral" and "Tunisie" from the 3/15th BCC (3rd company of the 15th tank battalion - 2nd DCR) attacked the German troops at Landrecies, south of the Normal Forest. Advancing between two columns of armored cars, light tanks (Panzer I and Panzer II) and probably armored personnel carriers (Sd.Kfz.251) they slaughtered 50-100 German AFVs in about 20 minutes.

The testimony of sous-lieutenant Gaudet, commander of the B1bis "Tunisie" enables to tell the story from the French side. Initially 2 B1bis tanks were to attack but shortly before one of them experienced a mechanical breakdown. During there movement towards Landrecies they stayed camouflaged and immobile during about 45 minutes since the Luftwaffe was strongly bombing the towns around.

The "Tunisie" (sous-lieutenant Gaudet) and the "Mistral" (lieutenant Pompier) stop at the entry of Landrecies, at the crossing of the roads to Ors and Avesnes-Le Cateau. A French convoy is completely abandoned beside the road. It is 12h00 and Landrecies seems unoccupied.

The "Mistral" moves on among the French abandoned vehicles and is followed by the "Tunisie". Several streets and squares are crossed without noticing something interesting. Suddenly the "Mistral" stops and opens fire with its 47mm turret gun and its 75mm hull gun. The "Tunisie" moves to the left but the intense smoke prevents him to see what is happening in front of the French tanks. The "Mistral" goes on, fires several times and moves towards the center of Landrecies. The "Tunisie" is following 100m behind. Suddenly, sous-lieutenant Gaudet discovers what was the target: a whole German armored cars and light tanks parked on both sides of the street and very close to each others. The "Mistral" turns in an adjacent road 150m in front of the "Tunisie". At the end of the road, on the church square, several German armored cars are burning after the action of the "Mistral". The "Tunisie" starts to
fire meticulously and systematically on each German AFV in the street. The "Tunisie" moves two times all along the eastern part of Landrecies, firing on each spotted target.

The "Tunisie" has lost visual contact with the "Mistral" of the company commander and avoids to cross the bridge on the canal in Landrecies, assuming that the core and heavy elements of the German Panzerdivision are deployed in the western part of Landrecies. Nonetheless, two 3.7cm PaKs are defending the bridge. They fire on the French B1bis without effect and are quickly destroyed.

In Landrecies itself sous-lieutenant Gaudet says that there were probably about 200 AFVs. He destroyed two 3.7cm PaKs (for a total of 4) and many armored vehicles. He saw very few German soldiers in the street except AT gunners. All the crews fled and were hidden in the houses. The various hits on the turret of the B1bis tanks showed that the Germans fired also with AT rifles but they did not damage the tank. On the other hand, the machineguns of the B1bis tank (including AP cartridges) penetrated easily many German armored cars and put them on fire.

Fearing a counter-attack and without having achieved a complete destruction of the enemy vehicles, the "Tunisie" moves back. The streets are full of burning armored vehicles whose ammunition is exploding. Sous-lieutenant Gaudet estimates that about 100 German AFVs were burning or out of use. The "Tunisie" alone had fired 8 shells of 75mm, 27 shells of 47mm and 3 MG magazines (450 cartridges).

At 12h25, 20 minutes after being entered in Landrecies, the "Tunisie" moves to Ors on an empty road. Sous-lieutenant Gaudet meets 3 French soldiers who were POWs in Landrecies and managed to escape during the attack. In Ors the "Tunisie" meets the "Mistral" (lieutenant Pompier) but also the "Tornade" (sous-lieutenant Rival), the "Vosges" (lieutenant Willig) and the "Nantes" (sous-lieutenant Phelip), which arrived in reinforcement. The "Mistral" is covered by many hits but remains undamaged. Lieutenant Pompier has been back from Landrecies 10 minutes before sous-lieutenant Gaudet. He tells that he has destroyed two AT guns and many armored cars.

In about 20 minutes these 2 B1bis tanks have destroyed 6 AT guns and about 100 AFVs. Different sources confirm the terrific number of 100 destroyed AFVs but sous-lieutenant Raiffaud, commander of the B1bis "Indochine", also from the 3/15° BCC, speaks about 50 destroyed AFVs, which remains nevertheless a significant number.

On 28th May, during the battle of Abbeville, the B1bis "Jeanne d'Arc" from the 1/47° BCC (4° DCR) received more than 90 shells in 2 hours before being put out of combat. The attack starts at 17h00, east of Doudeainville. German AT guns fire on the "Jeanne d'Arc". Two German guns are quickly destroyed with the 75mm hull gun but one 3.7cm shell penetrates unluckily (or luckily, depends on the point of view) in the barrel of the hull gun and destroys it.

The "Jeanne d'Arc" takes the command of the 1st company and moves through Huppy (were a German infantry battalion is destroyed), firing with its MGs on the German soldiers who are met. Moving on, the B1bis crosses the RN28 road south-west of Les Croisettes and heads towards hill 104, where he is engaged by numerous German guns including 8.8cm FlaK. The turret is penetrated by 2 heavy shells and is blocked, the gunsight and the episcopes are broken. The tank commander and the loader are WIA. Completely disarmed, the tank nonetheless charges the enemy. Several AT guns are crushed under the tracks and two vehicles are rammed and destroyed. Once the slaughter achieved the B1bis tank pulls back.

Back at the level of Les Croisettes, another shell (probably a 8.8cm shell) penetrates the fuel tank on the left side and put the tank on fire. The crew bails out and hides in the hedges, avoiding all the German patrols. During the night the crew returned safely to the French lines.

SOMUA S35 and S40

The vehicle was designed and manufactured by the Société d'Outillage Mécanique et d'Usinage d'Artillerie (SOMUA) and comes from a requirement from the French High Command in 1931. It was a tank for the cavalry, fast, well armed and well protected. It was the world first tank made of whole cast armor instead of bolted plates. It entered in service with the French army in 1935/1936 and a total of 430 Somua S35 had been delivered until the defeat, they all saw action. Due to the French tactics at the time it was not used to its best effect. Many experts regarded the Somua S35, in 1940, as the best medium tank in the world. Equipped with excellent cast and sloped armor, the tank was considered hard to kill by German anti-tank gun teams as well as by German tank crews. One other advantage was that it was able to turn on the spot because of differential steering (like on the B1bis) which allowed both tracks to go in opposite directions (without moving forward), one track was slowed down while the opposite track was accelerated. Its only but serious failing was the mono-seated turret but actually the Somua S35's APX1CE turret is sometimes described as a "one-and-a-half-man turret", as the enlarged turret ring, compared to the APX4 found on the B1bis, allowed the radio operator to provide assistance to the commander/gunner/reloader. This tank was the core of the tanks battalions of the DLM (Division Légère Mécanique = light mechanical divisions), what the French made the closest to the German Panzer Divisionen. The Somua carried 118 rounds for the gun (28 HE and 90 AP) and 3750 rounds (25x150 rounds drum magazines for the 7.5mm MAC31). The Somua of the platoon commander had an ER29 radio (50 kg, range 5km) and the squadron commander had an ER29 and an ER26ter radio (150kg, range 30-60km). Both of these were mounted inside the hull. The driver sat at left front and the radio operator/loader sat on the right slightly behind him. This position allowed him to pass ammunition to the commander/gunner.

Technically the Somua S35 is a full-tracked armored hull, with a V8 engine at rear and the fighting compartment up front (with a bulkhead/firewall between). The hull itself is made of 4 castings, bolted together:

- a two-part bottom hull, joining lengthwise
- a front upper hull over the fighting compartment, with the cast turret on top
Somua S35 tanks from at least the 18th RD (Régiment de Dragons) had a complete intercom system.

In 1940, an improved version of the Somua S35 is tested and called Somua S40, 374 of these tanks were ordered 103x105mm elements.

Other unusual for the time feature concerning the Somua S35 is the automatic fire extinguishing system. Made by "Telecamit", it is made of 3 pressurized tanks containing each a litre of methyl bromide. Situated between the access hatch and the firewall and near the driver, the tanks are connected to sprinklers set around "hot" spots (carburettors, fuel dump, fuel tanks, etc.). As a plus, the 2 fuel tanks (one 100l and the other 410l) have a valve to prevent overfill (the tanks are located close to the engine, that can be hot and so set the fuel on fire). Unfortunately, some under trained crews thought (because of the valve) the tanks were full when they had in fact only filled the 100l one. The result can easily be forecast ! The tank quickly runs dry and can be lost, and the low range reputation spreads within the troops ...

Driving the Somua S35 is practiced as if in a car and there is even a direction wheel. With an average road speed of 35 km/h and a high range, the S35 capabilities are rated among the best at the time. It is even truer if you take into account the more than 40mm thick armor and the power of the 47mm SA35 gun allowing engaging and destroying the German tanks at 800-1000m. But is has a defect added to the 'one and a half' man turret : a too high hatch and the firewall and near the driver, the tanks are connected to sprinklers set around "hot" spots (carburettors, fuel dump, fuel tanks, etc.). As a plus, the 2 fuel tanks (one 100l and the other 410l) have a valve to prevent overfill (the tanks are located close to the engine, that can be hot and so set the fuel on fire). Unfortunately, some under trained crews thought (because of the valve) the tanks were full when they had in fact only filled the 100l one. The result can easily be forecast ! The tank quickly runs dry and can be lost, and the low range reputation spreads within the troops ...

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In 1940, an improved version of the Somua S35 is tested and called Somua S40, 374 of these tanks were ordered but no one delivered to the French army. The hull is 33cm wider than the one of the S35 (lower center of gravity), the sprocket is set higher on the hull and there is a longer track work (one more wheel) to increase the cross-country capabilities. It is powered by a more powerful (219 hp) Hispano diesel engine. The S40 was to be equipped with the new ARL2C turret and the new design was to be substituted to the APX1CE turret beginning August 1940.

**Detailed armor thickness (mm):**
- **Turret Front:** 42mm/0° + gun and CMG mantlet (42mm)/round covering about 50% of the front surface
- **Turret Sides:** 42mm/23°

**Transmission:** 5 forward, 1 reverse
**Diameter of turning circle at 6 km/h:** 12m (Jentz)
**Autonomy:** 255 km (on road)

- **Ground pressure:** 0.85 kg/cm² (compared to 0.73 for Pz Iic, 0.92 for a Pz III e/f and 0.83 for PzIV d)
- **Armament:** A 47mm SA35 L/32 gun (78 HE and 40 APC - traverse 360° and elevation -18 to +18°) and a coaxial 7.5mm MAC1931 in the turret (3750 rounds, RoF = 750 rpm, traverse 10° left and right and elevation -18 to +18°).

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- **Maximum armor:** 47mm

**Transmission:** 5 forward, 1 reverse
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Turret Rear   : 42mm/24° (rear hatch is 42mm thick)
Turret Top    : 30mm/74° and 90°
Copula       : 40mm/25° and 90° (round)
Hull Front, Upper : 47mm/21°
Hull Front, Lower : 47mm/round
Hull Sides, Upper : 40mm/15°
Hull Sides, Lower : 40mm, 25mm+10mm/0° (10mm of protective skirting plates to protect the wheels)
Hull Rear    : 35mm/0° and 25mm/30°
Hull Top     : 25mm/82° and 90°
Hull Bottom  : 20mm/90°

**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, probably between 2100 kg and 2570 kg) :**
- 1x sight for the 47mm SA35 gun (4x L.762 sight, + reticle, field of view 11.82° - or L.731 ?)
- 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)

**Regarding the lower hull sides of the Somua S35 :**
The 25+10mm combination is an example of a spaced plate where the outer plate is 10mm, the second plate is 25mm, being seperated by some amount in-between. Using formulas that Mr. Nathan Okun has developed, we can predict the equivalent armor resistance if using just one armored plate.
When faced against standard AP projectiles, the equivalent plate resistance of the 25+10 setup would result in an equivalent 31.9mm singular plate.
When faced against standard APC/APCBC projectiles, the equivalent plate resistance of the 10+25 setup would result in an equivalent 30.7mm singular plate.
HEAT shells are useless against the lower hull sides of the Somua S35 since they would ignite upon hitting this outer skirt, resulting in next to no damage (similar to the side skirting of late-war Pz IVs).
The spaced armor setup will generate less overall slope effect than a single plate of the equivalent thickness (since the T/D ratio will be less favourable to defeat of the projectile for each plate).

The Somua S35 with its armor and its powerful 47mm gun was able to destroy all German tanks at long range (800-1000m) unlike the German ones. At this range the Somua S35's armor cannot be penetrate by the German guns. During the Hannut / Gembloux battles, even counterattacks led by 10 Somua S35s were viewed as critical on the German side.
One of the best unit of the French army is probably the 1er 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 7é RC (Régiment de Cuirassiers) formed after the 10é May 1940 : brand new tanks but 80% of the crew who were perfect rookies.
On 18th May, 12 Somua S35 tanks of the squadron of captain De Segonzac from the 4é Régiment de Cuirassiers (1er DLM) are holding the town of Jolimetz along with one company of Moroccan tirailleurs in support. During all the day they faced half of the 5.PzD (about 120 tanks and massive infantry, field artillery, AT guns and aviation support) on the move in this area. 1 Somua S35 tank (Maréchal des logis Enfroy) is damaged during a reconnaissance and sent back to Quesnoy. Only 11 French tanks are then controlling the town. The German attack is launched and after a few losses the Germans sent preferentially the heavier Panzer IVs in the town itself. At the end of the day the town was completely surrounded. In 10 vs 1 odd, the French have lost 10 tanks (destroyed or abandoned) and the Germans 26 tanks, mostly Panzer IVs. That is a perfect example of what well-trained French crews were able to do.
1) Second series of trials of the Somua S35 AC8 prototype (close to production model):
   - Fuel: 66° octane

   Top speed on flat ground:
   - flying start (départ lancé): 43.9 km/h
   - standing start (départ arrêté): 38.6 km/h

   The test was carried out on a specific (unknown) distance, the tank starting from a stopped stance had probably not the time on this given distance to reach the 5th gear.

   Top speed on a 6% slope:
   - flying start: 27 km/h
   - standing start: 18 km/h

   Top speed on a 10% slope:
   - flying start: 18 km/h
   - standing start: 15 km/h

   Maximum slope to climb on soft ground: 33°
   Maximum slope to climb on hard ground: 41°

2) Somua S35 trials (SHAT 9N218) and German trials:
   - mean speed on roads: about 35 km/h
   - mean speed in normal off-road terrain (fields etc.): 32.3 km/h (220 l fuel / 100 km), tested on 101.6 km.
   - mean speed in hard off-road terrain (rough, ditches etc.): 11.19 km/h (883 l fuel / 100 km), tested on 137.6 km.

   **French trials**
   - Gear: none
   - Speed: 0 km/h
   - Turning radius (rayon de virage suivant l'axe): 0m
   - Outer diameter (diamètre extérieur d'inscription): 5m

   **German trials (at 2000 rpm)**
   - Gear: 1st
   - Speed: 4 km/h
   - Outer turning radius: 3m

   **Gear: 2nd**
   - Speed: 9.1 km/h
   - Outer turning radius: 5m

   **Gear: 3rd**
   - Speed: 17.8 km/h
   - Outer turning radius: 9m

   **Gear: 4th**
   - Speed: 29.7 km/h
   - Outer turning radius: 14m

   **Gear: 5th**
   - Speed: 40.7 km/h
   - Outer turning radius: 18m

   The driver started normally in the 2nd gear. The 1st gear was only used on steep slopes or for driving over obstacles. The speed values are indicated for the normal engine running speed of 2000 rpm, but it could reach 2300 rpm; allowing probably in this case to reach the maximum speed of 44 km/h if the distance was sufficient and the ground good enough. The German source giving the outer turning radius is the German Somua S35 chassis manual. The values are theoretical because the diameter increased by slipping of the track on the ground.

Lieutenant-colonel Baillou who served in the 3e DLM in 1940, in the 2e DB (1943-1945) and who was later instructor for the French armored units after WW2 wrote himself about the Somua S35 that it was one of the best tank of 1940.

- The 3 main parts of the hull could easily be removed and made the maintenance work very easy.
- the at least 40mm armor all over the tank have proven their efficiency (see for example the battle of Hannut)
- the engine was very good, sufficient to move the 19 tons of the tank at the required speed
- differential steering enabling the tank to turn on the spot
- a speed of more than 40 km/h, on hard ground during a test in Senegal Baillou reached 50 km/h top speed
- the reliability was overall satisfactory. In Tunisia in 1943, despite the lack of spare parts and the rough sandy and rocky ground, each of the Somua S35 tanks moved on about 1000 km.

The drawback was mainly the 1-man turret and Baillou said that the Somua S35 was a tank built for speed, he regretted that the tank had not a Christie type suspension like on the T34. The common lack of intercom (except a few units) was also a drawback.

After failure of the Free French to rally Senegal to their cause in 1940, the Vichy French Army succeeded in convincing the Germans forming part of the Wiesbaden "Commission d'armistice" (created to deal with the truce terms) of the need for a modern tank squadron in Africa to defend the Empire against the Allies next attack. The Germans saw it as reinforcement for the Dakar out-post against the Gaullist threat. But for the French, the true aim was to create a battle worthy amored unit away from the eyes of the Axis.

The 12° GACA (Groupement Autonome des Chasseurs d'Afrique) is created on 1st September 1941. The first elements of what will eventually become the 12° RCA (Régiment de Chasseurs d'Afrique) on 15th February 1942, unload in Senegal in November 1941. The nucleus is a motorcycle squadron built around a HQ and 4 platoons of 13 side-cars emanating from the 2° RCA and 5° RCA. But before that, the 23 Somua S35 tanks earmarked for the unit have already been released from France and unloaded on the Senegalese port of Théys on 19th July 1941. In fact, they were first delivered to Oran in Algeria and loaded on a train to Casablanca where they were brought to operational status after such a long lull since 1940, and the crews trained.

Much time was spent peacefully in Senegal (more than a year), but the 12° RCA moved back to Oran on 21st January 1943 and later to Algiers on 8th February 1943. On 20th February, the 2nd tank squadron, commanded by capitaine Gribius, was sent to the front in Tunisia where it was integrated in the 19° GBF (Groupement Blindé Français) as the 7th squadron from the 12° RCA. The French Army in Africa was then in full metamorphosis and its armored corps consisted in heterogeneous units:

- Valentine tanks in the 1st squadron of the 5° RCA
- Somua S35 tanks in the 7th squadron of the 12° RCA
- M10 tank destroyers in the 4th squadron of the 9° GACA
- a Stuart light tank company

The group fought during the last phase of the Tunisian campaign, beginning with the attack on Gafsa on 17th March 1943. The Somua squadron got its last mission in May 1943 : help the 8th Army, coming from the south, to cut the Cape Bon peninsula where 200,000 German and Italian troops were concentrated, hoping for an improbable evacuation by sea. The Somua squadron began its attack on 9th May 1943, and initially meet no serious opposition. A second platoon followed the first one 2 km behind. Their crews were the helpless witnesses of the fate of the mates, slaughtered by the guns of camouflaged Panzer IVs. They later counted up to 12x 75mm shots on one of the 2 destroyed Somua S35 tanks. The 3 other tanks of the platoons escaped thanks to their speed. On 11th May, the French troops in the 19th Army Corps crushed the remnants of the 21.PzD, and 2 days later the capitulation of the Axis forces in Africa was signed.

During these exhausting battles, the Somua S35 tank has once more displayed its inherent qualities. A total of only 4 were lost in combat. Capitaine Gribius wrote then : "the Somua tank can still be counted as one of the best of the mechanically, with the speed, range, reliability and simplicity of the best US tanks to date. But its inferiority lies in the insufficient armament, lack of communication equipments, in its well designed but not thick enough armor, and in its internal layout in the crew compartments (ergonomics) that is no more suited to the present tactics (1943)".

Among the 19 surviving tanks, 17 will be kept in the 1st squadron of the 7th Régiment de la Garde to show the flag in this part of the French Empire. But before leaving their tanks, the crews pulled away the embossed "SOMUA" plates and welded them on the Shermans received from the new US ally. Thus keeping the memory of the tank all of them saw as the best tank in the world !

**SOMUA SAu40**

This vehicle was a self-propelled gun intended to provide support to the French mechanized (DLM and DCR) units. Somua prepared 3 designs, one being chosen in 1935 and delivered in December 1937. The 75mm APX gun mounted in the hull was only finalized in 1938. It was a derivative from the "75mm M1929 de casemate" found in the Maginot line. The gun itself could be drawn inside the hull (the operation took 12 seconds) when driving in close column movements or when a crash with an obstacle (a wall for example) was planned. The traverse was 7° left and 7.8° right with an elevation of -10° to +30°. The aiming devices consisted in two 4x sights and a stereoscopic range finder for indirect fire. Ammunition supply was of 200 shells (HE and APHE) and the rate of fire was 12 rpm. The future of this self-propelled gun remained unclear for a long time but its ability to deliver direct/indirect artillery support as well as anti-tank protection won the point and the prototype was tested in 1939. The hull is based on the one scheduled for the Somua S40. A rear firing MG was installed in a command copula, whose front part received the main gun aiming devices. The SAu40 was also equipped with E26ter / R61 radio sets ranging up to 30 km (voice or morse transmission) for the moving vehicle and 60km in station (theoretically).
An order of 24 self-propelled guns and 12 command tank versions (without 75mm APX gun) was initially signed on 15th October 1939 but due to the very low availability of the 75mm APX gun it has been modified on 1st May 1940 for 72 vehicles, but this time armed with the 47mm Mle1937 L/53 AT gun instead of the 75mm APX gun. These vehicles would then be used as tank destroyers.

The prototype was made from real armor and found its way to the front in June 1940. It fought with a Somua S35 squadron near Compiègne. Some authors state that four SAu40 tanks fought in June, including one with a 75mm APX gun and 3 with the 47mm AT gun.

**RENAULT AMR-33**

The auto-mitrailleuse de reconnaissance Renault, model 1933 was a light recon armored car (aka Renault type VM), fast and having good cross country performance. The hull was bolted with the driver at the front and the commander in the turret. The turret was offset to the left of the hull and the engine to the right. The French Army used 123 AMR-33. The turret was armed with a single 7.5mm MAC1931 MG. A second MG was stored as spare armament in the vehicle and was generally installed on the AA mount of the turret during a movement. In 1932, an armored personnel carrier version to transport 7 soldiers is studied and a tank destroyer prototype (Renault VE) is also tested (5 vehicles) and armed with a 37mm Mle1934 RF gun.

- **Weight : 5t**
- **Length : 3.50m**
- **Width : 1.60m**
- **Height : 1.78m**
- **Crew : 2 men**
- **Maximum armor : 13mm (RHA bolted armor)**
- **Maximum speed : 60 km/h on-road (Renault engine, 8 cylinders, water cooled, 85 hp at 2800 rpm, 4241 cm³), mean speed off-road of 45 km/h.**
- **Autonomy : 200 km**
- **Armament : a 7.5mm MAC1931 in the Avis (Atelier de Vincennes) n°1 turret (1350 standard cartridges (9 magazines) and 900 armor piercing cartridges (6 magazines)).**

**Detailed armor thickness (mm) :**
- **Turret Front** : 13mm/?
- **Turret Sides** : 13mm/?
- **Turret Rear** : 10mm/?
- **Turret Top** : 9mm/?
- **Hull Front** : 13mm/?
- **Hull Sides** : 13mm/?
- **Hull Rear** : 10mm/?
- **Hull Top** : 6mm/?
- **Hull Bottom** : 6mm/90°

At 2500 rpm (from the maintenance manual of 1934)
- **gear 1 : 5.8 km/h**
- **gear 2 : 17.5 km/h**
- **gear 3 : 32.0 km/h**
- **gear 4 : 54.1 km/h**
- **reverse gear : 6.9 km/h**
- **Maximum slope to climb on hard ground : 50°**

**RENAULT AMR-35**

The Auto-mitrailleuse de Reconnaissance Renault, model 1935 was a light recon armored car (aka Renault type ZT). Hull and turret were riveted, the engine was this time on the rear part of the light tank unlike on the AMR-33. The AMR-35 has been produced in 6 versions for a total of 240 vehicles :

- **ZT1 :** turret armed with a 7.5mm MAC1931 MG (Avis n°1 turret – 2250 rounds, 87 vehicles produced) or Hotchkiss 13.2mm HMG (Avis n°2 turret - 1220 standard and armor piercing rounds, 80 vehicles produced) (total = 167 vehicles)
- **ZT2 :** APX5 turret armed with a 25mm SA35 gun (78 shells) and a coaxial 7.5 mm MAC31 (2250 rounds) (10 vehicles produced). This version is 650 kg heavier because of the increase of armor on the turret.
- **ZT3 :** no turret and a 25mm SA35 gun (78 shells) in the hull, designed to be a tank destroyer. (10 vehicles produced). The front hull is probably better armored and there is an observation cupola.
- **ADF1 :** a command vehicle version (13 vehicles produced). The crew consists in 3 men, there is not a turret but a casemate whose maximum armor reaches 15mm. The crew has a FM 24/29 LMG than can be installed in the casemate or dismounted. Concerning the radio equipment, 12 ADF1 receive 1 ER26ter + 1 ER29 radio sets and 1 ADF1 receives 2 ER29 radio sets.
- **ZT4 :** an AMR-35 intended to be sent to the colonies and equipped with a FT17 tank turret. 40 vehicles produced in 1940 but without turret. They were sent in combat with simple mounts for a FM 24/29 LMG.
Like on the AMR-33, the crew had often a second MG as spare armament in the vehicle and it was generally installed on the AA mount of the turret during a movement.

- **Weight**: 6.5t
- **Length**: 3.84m
- **Width**: 1.64m
- **Height**: 1.88m
- **Crew**: 2 men
- **Maximum armor**: 13mm (RHA bolted armor) for the ZT1 version
- **Maximum speed**: 55 km/h (Renault "447" engine, 4 cylinders, water cooled, 82 hp at 2200 rpm, 5881 cm\(^3\))
- **Diameter of turning circle at 6 km/h**: 8.80m (Jentz)
- **Transmission**: 4 forward, 1 reverse
- **Autonomy**: 200 km

**Detailed armor thickness (mm)**:
- Turret Front : 13mm/
- Turret Sides : 13mm/
- Turret Rear : 10mm/
- Turret Top : 9mm/
- Hull Front : 13mm/
- Hull Sides : 13mm/
- Hull Rear : 10mm/
- Hull Top : 6mm/
- Hull Bottom : 6mm/90°

**RENAULT YS and YS 2**
The Renault YS is a command vehicle based on the Renault VM (AMR-33) with the suspension of the Renault ZT (AMR-35). It can be used as command car for officers but also used as observation vehicle (equipped with a binocular periscope and a range finder). Only 10 Renault YS were built: 4 YS for the cavalry (1 ER26ter + 1 ER29 radio sets), 2 YS for the artillery (1 ER26ter + 1 R15 radio sets), 2 YS for the infantry (1 ER26ter + 1 R15 radio sets), 2 YS for the tank units (1 ER53 + 1 R15 radio sets).

Due to a too long development time, the Renault YS was replaced by the Panhard P178 command version (with a casemate instead of a turret) in the other cavalry units. Other radio/command vehicles widely used are the Renault ADH or Laffly S20TL PC radio trucks.

In 1936, 1 Renault YS 2 is produced. It is a dedicated forward observation vehicle for the artillery equipped with 1 ER26ter + 1 R14 radio sets, 1 telephone to be connected to wire communication systems and complete mapping and observation equipments. The turret included 1 binocular periscope, 1 stereoscopic range finder. This vehicle was used by the 71\(^{e}\) RA of the 2\(^{e}\) DLM. Each Renault YS or YS 2 included also a FM 24/29 LMG with 24 magazines transported in the vehicle and eventually used for self-defense.

**AMD WHITE**
Ségur and Lorfeuvre have built the White M\(^{e}\)1917/1918 armored car on a White truck chassis (USA). It was used in France until 1933 and in the French Levant colonies (Syria and Lebanon) until 1941. It was armed with a 37mm SA18 gun and an 8mm M\(^{e}\)1914 Hotchkiss MG in the turret, in opposite direction (gun in the front and MG in the rear or inversely). This armament was innovative in 1917/1918 when there were only self-propelled guns (auto-canon) with guns or armored cars with MGs. This armored car had both armaments. About 230 have been produced until end 1918 but only few saw combat during WW1. In the 20's pneumatics are installed on this armored car.

- **Weight**: 6.0t
- **Length**: 5.60m
- **Width**: 2.10m
- **Height**: 2.75m
- **Crew**: 4 men (2-men turret)
- **Maximum armor**: 8mm
- **Maximum speed**: 45 km/h
- **Armament**: a 37mm SA18 L/21 gun and an 8mm M\(^{e}\)1914 Hotchkiss MG in the turret in opposite direction (gun in the front and MG in the rear or inversely). There were also AA mounts for the MG on the turret.

**AMD LAFFLY 50AM (also called AMD WHITE-LAFFLY)**
In 1932-1934, Laffly modernized 98 AMD White from 1917/1918. A Laffly LC2 chassis replaced the old White chassis. Except a few Laffly 50AM in the 4\(^{e}\) GRDI in north eastern France, all the Laffly 50AM armored cars are in the colonies in 1940.

- **Weight**: 6.5t
- **Length**: 5.40m
- **Width**: 2.30m
- **Height**: 2.48m
- **Crew**: 4 men (2-men turret)
Maximum armor : 8mm  
Maximum speed : 70 km/h (Laffly engine, 50 hp)  
Autonomy : 300 km  
Armament : a 37mm SA18 L/21 gun and a 8mm Mle1914 Hotchkiss MG in the turret, in opposite direction (gun in the front and MG in the rear or inversely). There were also AA mounts for the MG on the turret. Ammunitions : 92 HE and 72 AP shells, 3840 standard cartridges, 1440 armor piercing cartridges and 288 tracer cartridges.

AMD LAFFLY 80AM (also called AMD LAFFLY-VINCENNES)
In 1934-1935, Laffly again modernized 28 AMD White from 1917/1918. The Laffly 80AM had a more powerful 80 hp engine and was armed with a Hotchkiss 13.2mm HMG. Only 28 units have been produced before being replaced by the Panhard 178 on the French metropolitan territory. In 1939, all the Laffly 80AM were incorporated into two squadrons in North Africa and saw action in Tunisia in 1942 and 1943 with the Free French forces against the Italians and the Germans.

Weight : 7.5t  
Length : 5.70m  
Width : 2.10m  
Height : 2.50m  
Crew : 4 men  
Maximum armor : 20mm  
Maximum speed : 80 km/h (Laffly engine, 80 hp, 5000 cm³)  
Autonomy : 400 km  
Armament : a 13.2mm turret HMG and a 7.5mm MAC1931 in the turret, in opposite direction (HMG in the front and MG in the rear or inversely). There were also AA mounts for the MG on the turret. Ammunitions : 1690 standard and AP 13.2mm rounds, 1900 standard 7.5mm cartridges and 200 AP 7.5mm cartridges (mixed in 14 magazines).

AMD PANHARD 165/175 TOE
The Panhard 165/175 is an armored car, which entered service in 1933. Most of them were used in North Africa. It had a 2-men turret.

Weight : 6.7t  
Crew : 4 men  
Maximum armor : 9mm  
Maximum speed : 75 km/h (85 hp engine)  
Autonomy : 750 km  
Armament : a 37mm SA18 L/21 gun and a 7.5mm coaxial MAC1931 in the turret. Ammunitions : 100 AP and 94 HE shells, 2400 standard cartridges (16 magazines) and 1500 armor piercing cartridges (10 magazines).

AMD PANHARD 178
The Panhard 178 is a 4x4 armored car which entered service with the French army shortly before WW2. 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) with a Ballard episcope and its 25mm SA35 gun had good anti-tank capacities. The Panhard 178 was capable of relative high speed and had two drivers (one forward and one backward) to change direction very quickly, increasing the overall maneuverability. There was an AAMG mount on the turret where the coaxial MG (or a replacement MG) could be installed.

In the French army there was also a radio/command version, unarmed and with a casemate instead of a turret. It was equipped with one ER27 radio (200kg, 100km range for morse and 50/60km range for voice in station) for the colonel commanding several squadrons and two ER26ter for the squadron commanders (150kg, 30km range for vehicle in movement and of 60km range in station). There were also 4 Panhard 178 in Indochina with the APX5 1-man turret, like on the AMR-35 ZT2 (armed with a 25mm SA35 gun).

Some Panhard 178 armored cars had a modified turret with a 47mm SA35 gun and a coaxial MG in June 1940 (Renault turret). This version participated to combats in June 1940 with at least one vehicle. A 47mm gun version was also produced undercover by Vichy but with a CDM turret this time. The other Vichy Panhard 178 armored cars, which were officially allowed, were only armed with two turret MGs instead of the normal 25mm SA35 main gun and coaxial MG because of the restrictions imposed by the Germans. In 1942, the Germans captured some Panhard 178 CDM armored cars and used them like in Sicherungsabteilung 1000.

After the Liberation of France in 1944 production was resumed for use by the new French troops. The Panhard 178B is an improved version of the Panhard 178 ; it entered production after the Liberation of France in 1944. Its FL-1 turret mounted a 47mm gun. The Panhard 178B remained in use with the French forces into the 1960's. A few were for example also used by Djibouti and Syria. It is the ancestor of the well known Panhard EBR, Panhard AML-60 and Panhard AML-90.  

Weight : 8.2t  
Length : 4.79m  
Width : 2.01m  
Height : 2.31m  
Crew : 4 men  
Maximum armor : 26mm (turret and hull is RHA bolted armor)
Maximum speed : 72.6 km/h (Panhard ISK 4F II bis engine, 8 cylinders, gasoline, water cooled, 110hp, 2000 rpm)
Transmission : 4 forward, 4 reverse (dual drive)
Autonomy : 300 km
Armament :

- 1x 25mm SA35 L/60 (or L/47.2 ?) gun (elevation -12° to +15°) and a coaxial 7.5mm MAC1931 MG (elevation -12° to +15°, lateral +15°) (150 AP shells, 2250 standard cartridges (15 magazines) and 1500 armor piercing cartridges (10 magazines))
- 2x 7.5mm MAC1931 turret MGs (Vichy occupied zone version, later also used by the Germans)
- 1x 47mm SA35 L/32 gun and 1x 7.5mm MAC1931 coaxial MG from June 1940 and later (Renault and CDM turrets and later P178B)

Detailed armor thickness (mm) :
Turret Front : 26mm/24°
Turret Sides : 15mm/26°
Turret Rear : 15mm/30°
Turret Top : 7mm/82°
Hull Front : 20mm/21° and 0°
Hull Sides : 15-20mm/0°
Hull Rear : 15-20mm/41°
Hull Top : 7mm/90°
Hull Bottom : 7mm/90°

A testimony from the 6e cuirassiers regiment (Panhard P178) of the 1er DLM fighting in the Netherlands : On 11th May 1940, a round 21h00, detachment Dudognon defend the Moergestel bridge over the Reussel River. At 23h00, 3 German armored cars accompanied by 3 side-cars and a truck full of troops appear. Maréchal-des-logis (NCO rank) Gaulthier recalls : "the leading 2 German armored cars do not see me and head for the Panhard 178 "La Varende". The first German armored car crushes 2 of our side-cars and barely dodges the "La Varende" (tearing off a mudguard on the way) and crashes into a cement pole. The second German armored car (an 8-wheeled Sd.Kfz.231 probably) stops to my left and opens fire. Meanwhile the third German armored car turns out in front of me on the bridge. I open fire with my 25mm SA35 gun and I hit it square on. The German armored cars rolls for several extra meters before stopping to my right. At the same time, the explosive charges placed under the bridge explode as the German truck is on the bridge. I was in the turret so the deflagration stunned me and I fell inside. When I recovered and went back to the hatch I saw the second German armored car still firing on my left. I pivoted the turret and fired point blank with both the main gun and MG (with AP bullets). It quickly ceased firing. The whole action only lasted a quarter of an hour. The enemy lost around 20 dead and drowned. The 6e Cuirrasiers detachment has captured 4 men including 2 wounded. The three German armored cars whose motors cannot be started again are scuttled as well as a German side-car. Two more intact BMW side-cars will replace the 2 that were crushed and we used them up to Dunkirk." The French troops had only a few lightly wounded men.

On-road gear 1 : 13.8 km/h
On-road gear 2 : 24.3 km/h
On-road gear 3 : 40.1 km/h
On-road gear 4 : 72.6 km/h

Off-road gear 1 : 8 km/h
Off-road gear 2 : 14 km/h
Off-road gear 3 : 23.1 km/h
Off-road gear 4 : 42 km/h

Reverse gears : same speeds as off-road gears.

Turning circle at outer tire: 8 m
Maximum slope to climb on hard ground : 40°
Maximum slope to climb on soft ground : 22°

AMD Laffly S15 TOE
The AMD Laffly S15 TOE is not only a recon armored car, it is an hybrid vehicle armored car and armored personal carrier which can carry small infantry groups of 4-6 men. It saw mostly action in North Africa.
Weight : 5.2t
Length : 4.55m
Width : 1.85m
Height : 2.45m
Crew : 3 men
Maximum armor : 7mm
Maximum speed : 62 km/h (Hotchkiss 486.sp12 engine, 52 hp)
Autonomy : 1000 km
Armament : a 7.5mm turret MAC1931

**Panhard-Schneider P16 M°1929**
The AMC P16 (also called Citroen-Kégresse or Panhard-Schneider P16) is ordered in 1929. 96 vehicles were delivered and still used in 1940 in various reconnaissance battalions or GRDI (Groupe de Reconnaissance de Division d'Infanterie) as AMRs.

Weight : 6.8t
Length : 4.83m
Width : 1.75m
Height : 2.60m
Crew : 3 men

Maximum armor : 12mm
Maximum speed : 50 km/h (Panhard engine, 4 cylinders, 60 hp)

Autonomy : 250 km
Armament : a 37mm SA18 L/21 gun and a coaxial 7.5mm turret MAC1931. Ammunitions : 60 HE and 40 AP shells, 1950 standard cartridges (13 magazines) and 1050 armor piercing cartridges (7 magazines).

**RENAULT YR (AMC-34)**
The AMC-34 (aka AMC Renault Modèle 1934 type YR) was a test vehicle based on the AMR-33, only 12 vehicles had been produced in 1935. The decision to adopt AMC-35 ended the production for this vehicle. They have been rapidly transferred to units based in North Africa (1st and 5th RCA). It was armed with a 25mm SA35 gun or a 47mm SA34 L/30 gun. The AMC-34s were all retired from active service in 1940.

Weight : 9.7t
Length : 3.98m
Width : 2.07m
Height : 2.10m
Crew : 3 men

Maximum armor : 25mm (40mm)
Maximum speed : 40 km/h (Renault engine, 8 cylinders, gasoline, water cooled, 120 hp, 7120 cm³)

Autonomy : 200 km
Armament : 25mm SA35 gun or 47mm SA34 L/30 gun and a coaxial 7.5mm turret MAC1931. Ammunitions : 120 HE and APHE shells (47mm gun), 5250 cartridges (3750 standard = 25 magazines and 1500 AP = 10 magazines).

**Detailed armor thickness (mm) :**
- Turret Front : 25mm/25° (if APX2 turret)
- Turret Sides : ?
- Turret Rear : ?
- Turret Top : ?
- Hull Front : 20mm/?
- Hull Sides : ?
- Hull Rear : ?
- Hull Top : ?
- Hull Bottom : 5mm/90°

**RENAULT ACG1 (AMC-35)**
Studied by Renault already in 1936 and built in 1938/1940, the AMC-35 (aka AMC Renault Modèle 1935 type ACG1) is a fully new designed vehicle. It was a fast full-tracked cavalry combat armored car. Only 47 have been produced for France and 25 at first and finally 12 were ordered by Belgium. It was equipped with the APX2 (2-men turret – 1395mm turret ring) model turret. The Belgian ACG1 had a modified turret = APX2B with a coaxial 13.2mm Hotchkiss MG instead of the 7.5mm MG. Belgium used also several APX2 turrets in coastal forts in Zeebruge (Belgium) since they had more turrets than vehicles.

Weight : 14.5t
Length : 4.55m
Width : 2.20m
Height : 2.30m
Crew : 3 men

Maximum armor : 25mm (APX-2 turret is made of cast plates bolted together, the hull is RHA bolted armor)
Maximum speed : 42 km/h (Renault engine, 4 cylinders, gasoline, water cooled, 180 hp, 11080 cm³)

Autonomy : 160 km
Armament : 47mm SA35 L/32 gun + coaxial 7.5mm turret MAC1931. Ammunitions : 120 47mm shells (APC and HE), 5250 cartridges (3750 standard = 25 magazines and 1500 armor piercing = 10 magazines).

**Detailed armor thickness (mm) :**
- Turret Front : 25mm/25° + gun mantlet
Turret Sides : ?/20°
Turret Rear  : ?/27°
Turret Top   : ?/80°
Hull Front  : 25mm/17° and perhaps about 50°
Hull Sides   : ?/0°
Hull Rear   : ?/16° and 40°
Hull Top   : ?/90° and 76°
Hull Bottom  : 5mm/90°

The AMC-35 equipped several little units like the "Escadron Audigier" and various cavalary "groupes francs". One well-known is the "groupe franc de cavalerie" of captain Neuchêze which formed part of the defenders of Saumur on the Loire River. This unit consisted of a motorized infantry company, a mortar platoon, a single 25mm AT gun and three platoons of AFVs : 4 Panhard 178 armored cars, 5 Hotchkiss tanks and 7 AMC-35.

An other example is the 4ᵉ groupe franc de cavalerie which was formed on 25 May 1940 under capitaine Huet from elements of the 1ᵉ GRDI and consisted of a command platoon, a tank platoon (2 AMC-35), a motorcycle platoon, an infantry platoon with a two mortars, two 25mm AT guns and two 47mm AT guns. A total strength of 8 officers, 19 NCOs and 150 men. It was deployed by general Duffour to cover the crossings at Pont de l'Arche and on the 9th June the 25mm AT guns under lieutenant Petit reportedly disabled 16 German tanks. The position however was soon overrun and the groupe franc withdrew.

**BERLIET VUDB**
The Lyonnaise firm of Berliet built various armored cars between the wars, one of the earliest being this "voiture de prise de contact" (literally vehicle to make contact) which was first built in prototype form in 1929. Berliet received an order to build 50 for the French army the following year and later a further 12 were built for the Belgians. The armored cars saw service mostly in North Africa with.

- Weight : 4.95t
- Length : 4.50m
- Width : 1.94m
- Height : 2.15m
- Maximum speed : 53 km/h (Berliet engine, 6 cylinders, 40 hp, 2500 cm³)
- Crew : 1 men + 6 men from the reconaissance team
- Armament : 1-2 FM 24/29 + slits allowing the recon team to fire from the truck

**TANK DESTROYERS :**

**CITROEN-KEGRESSE P19 (CK P19) armed with a 25mm AT gun**
The 3ᵉ BDP (bataillon de dragons portés - which had already 25mm SA34 AT guns towed by Citroën-Kegresse P19 halftracks) found a new solution in 1937. The AT gun was embarked on the vehicles itself and a self-propelled AT gun version based on the Citroën-Kegresse P19 halftrack was developed. The rear body of the vehicle is modified and it carries 2 ramps to eventually embark/dismount the AT gun, but this one can fire from the vehicle (the gun is directed to the front). This solution was then adopted by the other cavalry units, for the 5 battalions there would be a total of 20 such self-propelled AT guns.

- Weight : 2.23t (live load 0.7t)
- Length : 4.70m
- Width : 1.70m
- Crew : 7 men (for the troop carrier version, probably only 4 for the self-propelled AT gun version)
- Maximum speed : 46 km/h (6 cylinders, 2442 cm³, 42 hp at 2800 rpm)
- Autonomy : 350 km
- Armament : 25mm L/72 AT gun + AAMG mounts for protection during travel

**LAFFLY S20 TL armed with a 25mm AT gun**
The idea of the self-propelled 25mm AT gun is then adopted by Laffly on the Laffly S20 TL truck. 40 of these peculiar trucks are ordered in 1938, built in in the factory (it is not a field modification) and delivered during winter 1939-1940. There are 2 ramps to embark the gun, which can this time fire to the front or to the rear. The latter solution can eventually be more interesting to fire and move away quickly. The windshield is divided in 2 parts on this version; it enables the barrel to point to the front (but the windscreen can also simply be lowered, which enables also for a better traverse).

- Weight : 3.9t (live load 1.75t and could tow 3.00t)
- Length : 5.35m
- Width : 2.00m
- Height : 1.67m (2.45m covered)
- Crew : 8 men
- Maximum speed : 65 km/h (6 cylinders, 3016 cm³, 68 hp at 3200 rpm)
- Autonomy : 138 km
- Armament : 25mm L/72 AT gun + AAMG mounts for protection during travel
LAFFLY W15 TCC (CC = chasseur de chars = tank destroyer)
The Laffly W15 TCC has been produced in the May-June panic. A prototype has been tested during the Phoney war, and was fully armored. The early May engagements revealed the need for self-propelled AT guns, and Laffly W15 chassis were requisitioned to receive 47mm L/53 Mle 37 AT guns. Only the very first vehicles were totally armored, for the others, armored plates were installed to protect the front part of the vehicle and two small other plates were added to enlarge the conventional shield of the AT gun which was directed to the rear. 70 Laffly W15 TCC were operational in May-June 1940 and saw action against the German troops. They were issued to independent anti-tank batteries (BACA = batterie d’anti-chars automoteurs) including generally 5 tank destroyers. All these independent anti-tank batteries are engaged immediately with usually a training of only several hours but they will nonetheless give brilliant results. They were for example deployed at first in the area of Abbeville in May 1940 and gave outstanding results in June 1940 on the Loire River defenses but had little impact on the whole campaign. They proved to be very successful, lightly armored but fast and adapted to hit and run tactics. The 54ᵉ BACA commanded by lieutenant Brussaux for example, engaged from 5ᵗʰ June 1940 on, destroyed 28 German tanks, 5 German armored cars and 1 downed 1 German fighter in only 8 operational days.

Weight : 4.96t
Crew : 3 men (an NCO, a gunner and a driver)
Maximum armor : 12-15mm
Maximum speed : 48 km/h (4 cylinders, 2300 cm³, 56 hp)
Armament : a 47mm SA37 L/53 AT gun (270° traverse towards rear, 30 shells) and a FM 24/29 AAMG (1000 rounds) – the crew has also a Thompson SMG with 500 rounds among other misc light armament.

ORGANIZATION OF A BACA (batterie d’anti-chars automoteurs = self-propelled AT battery)
- Tank destroyer platoon
  o 1x Laffly V15R all-terrain liaison vehicle (with a FM 24/29 AAMG with 1000 rounds and a Thompson SMG with 500 rounds)
  o 5x Laffly W15 TCC (each 1 47mm SA37 AT gun with 30 shells, 1 FM 24/29 AAMG with 1000 rounds and 1 Thompson SMG with 500 rounds)
  o 3x Unic TU1 tractors with 3 Mle 1937 infantry trailer, each tractor and trailer carrying 200 shells of 47mm ammunition (each 1 Thompson SMG with 500 rounds)
  o 2 motorcycles
- 25mm AA platoon
  o 3x 25mm Mle1939 Hotchkiss AA guns each towed each by a Laffly W15 T (towing the gun and carrying ammunition and the crew)
  o 1x extra Laffly W15 T used for recovery purpose and extra ammunition
  o 1x 5t lorry transporting eighty cases of forty 25mm ammunition (3200 shells)
  o 1x liaison vehicle
  o 2x trucks (and 2 FM 24/29 LMGs)
  o 2x motorcycles
  o 1x bicycle (transported on a truck during movements)
- Battery general services
  o 1x Laffly S25 T (towing/repair vehicle)
  o 2x trucks
  o 2x lorries
  o 1x trailer (field kitchen)

Æ 3 officers, 21 NCOs and 64 men = 88 soldiers and the armament consists in 5 self-propelled AT guns (150 shells per gun), 3 25mm AA guns, 8 LMGs, 9 Thompson SMGs and other small arms (carbines, pistols etc.).

LORRAINE 37L CC (CC = chasseur de chars = tank destroyer)
The Lorraine 37L was armed with a 47mm SA37 L/53 AT gun, designed to be a tracked tank destroyer, to ambush the German armored columns. Manufacturing started in May 1940 only and the rare vehicles that arrived to the front had little impact on the war.

SUPPLY TRACTORS :
LORRAINE 37L TRC (tracteur de ravitaillement de chars = tanks supply tractor)
The Lorraine 37L TRC was a tank unit supply carrier. It towed generally a tracked trailer with a 565 liters fuel tank, grease boxes, water, tools and a pump. The tractor itself carried ammunitions and various supplies. 482 vehicles were delivered to the French army from 1937 to June 1940. The tractor was appreciated for his cross country capacities and its armored protection.

Weight : 5.24t for the tractor + 1.2t for the trailer (live load 0.81t + 0.69t = 1.5t)
Length : 4.22m (+ 2.70m for the trailer)
Height : 1.21m (1.30m for the trailer)
Width : 1.60m
Crew : 2 men
Theoretical speeds per gear ratio, with engine giving 2800 rpm:

- Gear 1: 4.2 km/h
- Gear 2: 6.8 km/h
- Gear 3: 13 km/h
- Gear 4: 22 km/h
- Gear 5: 35 km/h
- Reverse: 4.3 km/h

**CHENILLETTE RENAULT UE**

Made by Renault (produced by Renault, AMX, Berliet and Fouga), the UE supply carrier (infantry and cavalry units) had a crew of two men and generally no armament (sometimes an AA mount with a FM 24/29 and rarely a 25mm SA34/37 AT gun). The Renault UE (model 1931) and UE2 (model 1937, produced in 1939 - modified gearbox) was the vehicle produced in the highest number before June 1940 with 5148 vehicles delivered to the French Army. During May/June 1940 several Renault UE were armed with a 7.5mm FM 24/29 LMG (even protected by sandbags) and some were equipped with a 7.5mm MAC1931 MG in an armored AMX casemate initially intended for an export version to China (1500 vehicles ordered in June 1940). Already in 1931, Renault UE chenillettes were equipped with an armored casemate armed with a MG and tested as reconnaissance vehicles. Some rare vehicles were mounting a 25mm AT gun (150 vehicles ordered in June 1940). A typical north-east infantry regiment has 9 Renault UE and a motorized infantry regiment is equipped with 15 Renault UE. The trailer that is often towed can be tracked or wheeled, depending on the ground the tracks are used or not. The Renault UE carrier is used to:

- carry ammunitions
- tow a 25mm AT gun (behind the carrier or the carrier + trailer)
- carry the equipment of a MG platoon (4 MGs) or a mortar squad (2 mortars)

The 2 crew members are side by side but separated by part of the engine. In combat situation with bullets and shrapnels all around, they cannot speak together; they are protected by armored rounded dome covers. In that case, they communicate thanks to lights on an orders transmitter panel (advance, speed up, slow down, right, left, stop, unhook, tip up etc.). If towing a 25mm SA34/37 AT gun, the Renault UE carries generally also AT mines and up to 240 shells for the 25mm AT gun in the tipper. The trailer is then only used to carry the personal equipments of the AT gun crew.

- Weight: 2.640t for the tractor (live load 0.660t) + 0.776t for the trailer (live load 0.500t) (total live load = 1.160t)
- Length: 2.80m (+ 2.59m for the trailer)
- Width: 1.74m (1.62m for the trailer)
- Height: 1.25m (0.77m for the trailer)
- Crew: 2 men
- Maximum armor: 9mm
- Maximum speed: 30 km/h (15-20 km/h off-road) (Renault engine, 4 cylinders, 40 hp at 2800 rpm, 2120 cm³)
- Transmission: 3 forward, 1 reverse (UE) or 4 forward, 1 reverse (UE2)
- Armament: sometimes FM 24/29 LMG and more rarely MAC1931 in an AMX casemate or 25mm SA34/37 AT gun.

If the Renault UE is used as ammunition supply tractor for the frontline units it can transport various loadouts like for example:

### Homogeneous loadouts:

1. **7.5mm cartridges (rifles and FM 1924/1929 LMG)**
   - Tipper: 8,100
   - Trailer: 16,200-24,300 (exceptionally up to 32,400)

2. **8mm cartridges (rifles, carbines and MGs)**
   - Tipper: 7,680
   - Trailer: 15360-23,040 (exceptionally up to 30,720)

3. **8mm cartridges on metal trays / flexible belts for the Hotchkiss Mle 1914 MG**
   - Tipper: 4,224
   - Trailer: 8,448
4) 60mm mortar shells for the 60mm Mle 1935 light mortar  
   Tipper : 240  
   Trailer : 366 

5) 81mm mortar shells for the 81mm Mle 1927/1931 medium mortar  
   Tipper : 90  
   Trailer : 162 

6) 25mm shells for the 25mm Mle 1934 or Mle 1937 AT gun  
   Tipper : 384  
   Trailer : 600 

7) 37mm shells for the 37mm TR 16 infantry gun  
   Tipper : 216  
   Trailer : 432 

→ Mixed loadouts : 

1) Ammunition for LMG and signal/illuminating flares  
   Tipper :  
   • 7.5mm cartridges : 4,050  
   • flares for flare pistol : 300  
   • VB grenades (rifle grenades) : 60  

   Trailer :  
   • 7.5mm cartridges : 16,200 

2) Ammunition for LMG, individual weapons and grenades  
   Tipper :  
   • 7.5mm cartridges : 8,100  

   Trailer :  
   • 7.5mm cartridges : 4,050  
   • 8mm cartridges : 3,840  
   • hand grenades : 200  
   • VB grenades (rifle grenades) : 384 

3) Ammunition for LMG, individual weapons and grenades  
   Tipper :  
   • 7.5mm cartridges : 18,000 (bags)  

   Trailer :  
   • 8mm cartridges : 7,680  
   • hand grenades : 200  
   • VB grenades (rifle grenades) : 384 

4) Ammunition for LMG, individual weapons, grenades and 60mm mortar  
   Tipper :  
   • 7.5mm cartridges : 18,000 (bags)  

   Trailer :  
   • 8mm cartridges : 7,680  
   • hand grenades : 100  
   • 60mm mortar shells : 60 

5) Ammunition for rifle and MG units  
   Tipper :  
   • 7.5mm cartridges : 8,100 (bags)  
   • 8mm cartridges : 2,688 (bags)  
   • hand grenades : 150  
   • VB grenades (rifle grenades) : 144  

   Trailer :  
   • 8mm cartridges : 8,448 (metal trays and flexible belts for MG)
Of course these loadouts can be modified, e.g. one of these mixed ones could include 25mm AT shells if required.

**RENAULT 36R TRC (tracteur de ravitaillement de chars = tanks supply tractor)**
The Renault ACD1 designed in the French army as Renault 36R was a tank unit supply tractor. It shared common elements with the Renault UE tractor (wheels and suspension elements, engine). It was adopted in 1936 and the production started in 1938. 260 vehicles had been delivered in 1940. It was seen as very inferior to the Lorraine 37L TRC, which was also an armored tractor. The tractor carried ammunition for the tanks (live load 822 kg) and towed a tracked trailer with a 450 liters fuel tank, 18 oil cans, 8 grease boxes, a pump and tools (live load 600 kg).

- **Weight**: 2.7t (live load 1.4 t).
- **Length**: 3.15m
- **Width**: 1.70m
- **Height**: 1.90m
- **Crew**: 2 men
- **Maximum speed**: 35 km/h (Renault engine, 4 cylinders, 38 hp at 2500 rpm, 2120 cm$^3$), 28 km/h with maximum load and with the trailer.
- **Transmission**: 4 forward, 1 reverse

**TROOP CARRIERS**:

**VLTT** : "voiture de liaison tout terrain" = cross country liaison vehicle

**VDP** : "voiture de Dragons Portés" = "Dragons Portes's car" (vehicle used to carry Dragons and/or Chasseurs motorized infantry)

**VBCP** : "voiture blindée de Chasseurs Portés" = "Chasseurs Portes's armoured car" (APC used to carry Chasseurs mechanized infantry)

**LAFFLY V15R (VLTT)**
63 VLTT were in service in 1940, usually in various HQ staffs.
- **Weight**: 2.15t (live load 0.45t)
- **Length**: 4.25m
- **Width**: 1.80m
- **Height**: 1.25m
- **Crew**: 4-5 passengers
- **Maximum speed**: 79 km/h (4 cylinders, 2300 cm$^3$, 55 hp at 3200 rpm)

**LAFFLY S15R (VLTT)**
The French army had at least 576 of these vehicles.
- **Weight**: 2.85t (live load 0.80t)
- **Length**: 4.64m
- **Width**: 1.85m
- **Height**: 2.15m
- **Crew**: 6 passengers
- **Maximum speed**: 72 km/h (4 cylinders, 2312 cm$^3$, 52 hp at 3200 rpm)

**CITROEN-KEGRESSE P19B (CK P19B) (VLTT)**
The French army used about 600 of these liaison halftracks in 1939.
- **Weight**: 2.23t (live load 0.65t)
- **Length**: 4.70m
- **Width**: 1.70m
- **Crew**: 6 passengers
- **Maximum speed**: 52 km/h (6 cylinders, 2442 cm$^3$, 42 hp at 2800 rpm)

**CITROEN-KEGRESSE P19 (CK P19) (VDP)**
Used by the French army since 1932 and still 547 halftracks in service in 1940. Sometimes also used as a tank destroyer version carrying a 25mm L/72 AT gun. These halftracks were usually issued to the Dragons (motorized infantry) regiments (RDP = Régiment de Dragons Portés) of the DLCs (Division Légère de Cavalerie).

At the mobilization in 1939, there were 547 CK P19. The 1$^e$ and 4$^e$ RDP had been completely equipped with 6-wheels vehicles (Laffly S20TL for the 1$^e$ RDP and Lorraine 28 for the 4$^e$ RDP). The former CK P19s of these units were then issued to other units during the winter 1939-1940. Most of the CK P19 took part in the May/June 1940 campaign, being issued to the RDP of the various DLC : 2$^e$, 3$^e$, 5$^e$, 14$^e$ and 15$^e$ RDP (depending from the 3$^e$, 2$^e$, 1$^e$, 4$^e$ and 5$^e$ DLC). These RDP had 2 battalions, one equipped with the CK P19 halftracks and one equipped with light trucks (Peugeot DK 5 J, Citroën 23 or Renault ADK probably).
- **Weight**: 2.23t (live load 0.7t)
- **Length**: 4.70m
- **Width**: 1.70m
Crew : 7 men  
Maximum speed : 46 km/h (6 cylinders, 2442 cm³, 42 hp at 2800 rpm)  
Autonomy : 350 km  
Armament : none except AAMG mounts for protection during travel

**LORRAINE 28 (VDP)**  
The Lorraine 28 is a softskin personal carrier adopted in 1937. **332 vehicles** were delivered but the Laffly 20TL was better and it stopped the production of the Lorraine 28. It equipped units of the **DLMs** and the **DCRs** at the beginning. In 1940 the 4th RDP was equipped with this vehicle.

- **Weight** : 3.78t (live load 2.72t)  
- **Length** : 4.84m  
- **Width** : 2.08m  
- **Crew** : 10 men  
- **Maximum speed** : 65 km/h (4 cylinders, 4710 cm³, 55 hp at 2000 rpm)  
- **Armament** : none for the carrier except AAMGs during travel (two hatches on the roof and AAMG mounts)

**LAFFLY S20 TL (VDP)**  
The Laffly S20TL is a softskin personal carrier, developed during 1934-1937, also known as "VDP" for "voiture de Dragons Portés", Dragons Portes's car. Each Laffly S20TL was equipped with two AA mounts which could possibly be fitted on each aft corner, on each side, and on the centre the first row of rear seats and the rest of the hull. The devices could accommodate either a FM 24/29 or a 8 mm Hotchkiss MG. However for combat, both LMGs were supposed to be used by the squad (only during transport would the LMGs be used in an AA role. **630 S20TL vehicles** had been delivered in 1940 to the French army for a total of 1175 ordered. The troop carriers were usually issued to the **DLMs and DCRs.** There were also other variants of the Laffly S20 : a fuel tank version (39 vehicles), a command / radio truck (69 vehicles) and a tank destroyer version of the S20 TL carrying a 25mm L/72 AT gun (40 vehicles) used for example in the 4th DCR. The characteristics of the Laffly S20 TL are :

- **Weight** : 3.9t (live load 1.75t and could tow 3.00t)  
- **Length** : 5.35m  
- **Width** : 2.00m  
- **Height** : 1.67m (2.45m covered)  
- **Crew** : 13 men  
- **Maximum speed** : 65 km/h (6 cylinders, 3016 cm³, 68 hp at 3200 rpm)  
- **Armament** : none for the carrier except an AAMG during travel, a 25mm SA34 L/72 AT gun for the tank destroyer version

**LORRAINE 38L (VBCP)**  
The Lorraine 38L is the French armored personal carrier also known as "VBCP" for "voiture blindée de Chasseurs Portés", Chasseurs Portes's armoured car. **440 vehicles** were ordered but **only 150 vehicles delivered** and usually found in the **DCRs.** French troop transports are fitted with one or more anti-aircraft mountings for the passenger's machine-guns, allowing them to fire from the vehicle. The Lorraine 38L had a carry capacity of 12 men (6 in the tractor and 6 in the trailer). The platoon leader's vehicle had only 7 occupants so there would have been ample space in the trailer for ammunitions and other items. The bigger **Lorraine 39L model**, expected to be in mass production from August 1940, had a capacity of 10 men without trailer. Only one Lorraine 39L was built before the armistice.

- **30 Lorraine 38L** have been modified in 1944 for the FFI (Free French forces of the Interior) and armed with a German MG151/15 (15mm) aircraft heavy machinegun, this model was then called **Lorraine 44.**
- **Weight** : 5.46t + 2.05t for the trailer (live load 0.5t + 1t = 1.5t)  
- **Length** : 4.20m (+ 3.42m for the trailer)  
- **Width** : 1.57m (1.55m for the trailer)  
- **Height** : 1.95m  
- **Crew** : 1 driver + 6 men in the chenillette and 6 men in the trailer  
- **Maximum armor** : 9 mm on the sides, front and rear and 6 mm for the top and roof  
- **Maximum speed** : 35 km/h (Delahaye engine, inline 6 cylinders type 135, 70 hp at 2800 rpm, 3556 cm³)  
- **Fuel capacity** : 173 liters  
- **Transmission** : 5 forward, 1 reverse  
- **Autonomy** : 135 km  
- **Maximum water depth** : 0.6 m  
- **Maximum climbable vertical obstacle height** : 1.30 m  
- **Maximum climbable slope** : 55 %
ARTILLERY TRACTORS (trucks and halftracks):

LAFFLY V15T
About 200 light artillery tractors were in service in 1940. Used to tow the 25mm AT guns in cavalry units.
Weight: 2.60t (live load 0.70t)
Length: 4.21m
Width: 1.85m
Height: 1.85m (covered)
Maximum speed: 58 km/h (4 cylinders, 2300 cm³, 55 hp at 3200 rpm)

LATIL M7 T1
About 170 light artillery tractors were in service in 1940. Used to tow the 25mm AT guns in various units.
Weight: 2.45t (live load 0.70t)
Length: 4.10m
Width: 1.80m
Height: 1.80m (covered)
Maximum speed: 60 km/h (4 cylinders, 2720 cm³, 50 hp at 2200 rpm)

UNIC TU1
About 236 infantry tractors were in service in 1940. Used to tow the 25mm AT guns and Mle1937 infantry trailer for supply task.
Weight: 2.165t (live load 0.50t + 0.66t in trailer = 1.16t)
Length: 4.20m
Width: 1.60m
Height: 1.31m
Maximum speed: 46 km/h (4 cylinders, 2151 cm³, 49 hp at 2650 rpm)

LAFFLY W15T
80 artillery tractors were in service in 1940. Used to tow the 47mm AT guns.
Weight: 3.25t (live/towed load 1.2t)
Length: 4.50m
Width: 1.90m
Height: 2.35m
Maximum speed: 51 km/h (4 cylinders, 2300 cm³, 56 hp)

CITROEN-KEGRESSE P17 (CK P17)
The French army used 1442 pieces of this halftracked artillery tractor in September 1939. Generally towing 25mm AA guns, 47mm AT guns and 75mm AT and field guns.
Weight: 1.85t (live load 0.7t + towed load 1.3t)
Length: 4.38m
Width: 1.69m
Height: 2.09m
Maximum speed: 32 km/h (4 cylinders, 1770 cm³, 31.5 hp at 2800 rpm)

UNIC P107
3932 pieces of this halftracked artillery tractor were in service in 1940. Used to tow the 75mm and 105mm C field guns. One such tractor carried 72 shells (75mm) and 6-8 men (including 1 driver and the crew of the towed gun). In the 75mm Mle1897 batteries towed by Unic P107s, each gun had immediately 72 shells available plus those in the ammunition trucks. There were also an engineer version of the P107, an air force tractor version as well as 2 vehicles converted to radio trucks (ER30 / R30 radio sets) and used by the 1e DCR.
Weight: 3.55t (live load 1.5t + towed load 1.5t in off-road, on a road it can tow 10.0t)
Length: 4.85m
Width: 1.80m
Height: 2.30m
Maximum speed: 45 km/h (4 cylinders, 3460 cm³, 62 hp at 3200 rpm)

LAFFLY S15T
411 artillery tractors were in service in 1940. Used to tow the 75mm and 105mm C field guns.
Weight: 3.90t (live load 1.4t + towed load 1.8t)
Length: 4.70m
Width: 1.80m
Height: 2.35m
Maximum speed: 51 km/h (4 cylinders, 2300 cm³, 42 hp at 2800 rpm)
**LAFFLY S25T**

108 artillery tractors were in service in 1940. Used to tow the **105mm L Schneider field guns**.

- **Weight**: 5.50t (live/towed load 1.5t)
- **Length**: 4.85m
- **Width**: 2.10m
- **Height**: 2.50m
- **Maximum speed**: 40 km/h (4 cylinders, 3450 cm³, 60 hp at 2500 rpm)

**SOMUA MCG4, MCG5 and MCG11**

The French army used 345 Somua MCG5 to tow the **105mm L Mé 1936 Schneider guns** and caissons, 315 Somua MCG4 and MCG11 to tow the **155mm C Mé 1917 Schneider guns** and 312 Somua MCG5 to tow the caissons of the 155mm C Mé 1917 Schneider guns. There are also about 440 Somua MCG4 and MCG5 recovery/towing tractors (theoretically 1 for each 47mm AT gun, 75mm Mé 1897 field gun, 105mm L Mé 1936 and 155mm C Mé 1917 battery as well as 3 for each light tank battalion). There are also 24 Somua MCG 4 halftracks in the French navy to tow 8 155mm L Mé 1932 Schneider guns (3 per gun). There is therefore a total of about 1436 Somua MCG tractors used by the French troops in 1940.

Concerning the 105mm L Mé 1936 gun: a first Somua MCG towed the gun and carried 28 shells. A second Somua MCG carried the crew of the gun (8 men), various equipments and towed a Mé 1939 Somua trailer with 64 shells. The second Somua MCG instead of the crew could carry 28 additional shells (if the crew was transported in other vehicles). Each 105mm L Mé 1936 had therefore 92-105 shells immediately available.

Concerning the 155mm C Mé 1917 gun: a first Somua MCG and towed the gun and carried 12 shells. A second Somua MCG carried the crew of the gun (8 men), various equipments towed a Mé 1935 Somua trailer with 34 shells. The second Somua MCG instead of the crew could carry 20 additional shells (if the crew was transported in other vehicles). Each 155mm C Mé 1917 had therefore 46-66 shells immediately available.

- **Weight**: 4.92t for the tractor and 6.8t for the standard halftrack (live load 1.5t + towed load 3.5t)
- **Length**: 5.20m for the tractor and 5.30m for the standard halftrack
- **Width**: 2.17m
- **Height**: 2.60m for the tractor and 2.85m for the standard halftrack
- **Maximum speed**: 31 km/h (4 cylinders, 4712 cm³, 60 hp for MCG4 and 60 hp for MCG5 and MCG11)

**SOMUA MCL5 and MCL11**

About 15 pieces Somua MCL5 (including 1 MCL11 ?) are used by the French army in 1939 to tow **155mm GPF field guns**. The French army used also 148 Somua MCL5 tractors in tank repair/recovery units.

- **Weight**: 8.50t for the MCL5 and 9.96t for the MCL11
- **Length**: 5.62m for the MCL5 and 5.40m for the MCL11
- **Width**: 2.08m for the MCL5 and 1.95m for the MCL11
- **Height**: 2.33m
- **Maximum speed**: 31 km/h (4 cylinders, 4712 cm³, 60 hp)

**LAFFLY S35T**

225 artillery tractors and towing/recovery tractors were in service in 1940. Used to tow the **155mm GPFT and 155mm C Schneider field guns**.

- **Weight**: 8.05t (live load 1.2t)
- **Length**: 5.50m
- **Width**: 2.35m
- **Height**: 2.85m
- **Maximum speed**: 40 km/h (4 cylinders, 6232 cm³, 100 hp at 2200 rpm)

**CITROEN-KEGRESSE P14 (CK P14)**

The French army used 52 pieces of this halftracked artillery tractor in September 1939. Generally towing the **155mm C Schneider field gun**.

- **Weight**: 3.6t (live/towed load 1.7t)
- **Length**: 4.87m
- **Width**: 1.75m
- **Maximum speed**: 25 km/h (6 cylinders, 2655 cm³, 48 hp at 2800 rpm)

**LATIL TAR, TAR4, TAR5 and FTAR heavy artillery tractor**

The French army used 2365 pieces of this tractor in 1940.

- **Weight**: 5.80t - 7.03t according to various versions
- **Length**: 5.90m
- **Width**: 2.25m
- **Height**: 2.10m
- **Maximum speed**: 17 km/h (43 hp, 1300 rpm) for TAR, 20 km/h (62 hp, 1500 rpm) for TAR4 and 28 km/h (60 hp, 1750 rpm) for TAR
LATIL TAR H2 heavy artillery tractor
The French army used 571 pieces of this tractor in 1940.
Weight : 6.50t (live load 3.00t)
Length : 5.90m
Width : 2.25m
Height : 2.90m
Maximum speed : 30 km/h (4 cylinders, 6082 cm$^3$, 68 hp at 1750 rpm)

Simplified table indicating which vehicle is theoretically used to tow which gun :

1) 25mm AT gun, 20-25mm AA guns etc.
   - Unic TU1 (25mm AT and wheeled supply trailer)
   - Renault UE (25mm AT and tracked supply trailer)
   - Latil M7T1 (25mm AT)
   - Laffly V15T (25mm AT)
   - Latil M7Z1 (25mm AA)

2) 47mm AT gun, 75mm field gun and 105mm C field gun
   - Citroën-Kégresse P17
   - Unic P107
   - Laffly S15T
   - Laffly W15T

3) 105mm L and 155mm C field gun
   - Citroën-Kégresse P14
   - Somua MCG (4, 5 and 11)
   - Laffly S25T
   - Latil KTL4

4) 155mm GPF and GPFT
   - Somua MCL (5 and 11)
   - Laffly S35T (dedicated to the 155mm GPFT)

5) Various heavy artillery
   - Older Panhard K13 and Renault EG still in service
   - Latil TAR, TAR4, TAR5 and FTAR
   - Laril TAR H2

Mobility of the artillery in 1940 :

<table>
<thead>
<tr>
<th>Artillery mobility</th>
<th>Type of suspension of the artillery piece</th>
<th>Average speed in convoy (km/h)</th>
<th>Stage per day (km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hippomobile</td>
<td>Wooden wheels</td>
<td>4</td>
<td>25</td>
</tr>
<tr>
<td>Truck / Halftrack</td>
<td>Wooden wheels with rubber tyre</td>
<td>12 (up to 25 km/h)</td>
<td>60 - 80</td>
</tr>
<tr>
<td>Truck / Halftrack</td>
<td>Wooden wheels but use of a 'train rouleur' (additional set of tyres)</td>
<td>20</td>
<td>150 - 200</td>
</tr>
<tr>
<td>Truck / Halftrack</td>
<td>Pneumatics</td>
<td>25 (up to 60 km/h)</td>
<td>200 - 250</td>
</tr>
</tbody>
</table>
TANK TOWING / RECOVERY TRACTORS:

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 Mle 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.

SOMUA MCL5
The French army used also 148 Somua MCL5 tractors in tank repair/recovery units.

- Weight: 10.9t (live load 2.5t)
- Length: 5.48m
- Width: 2.10m
- Height: 3.00m with crane
- Maximum speed: 31 km/h (4 cylinders, 6558 cm³, 90 hp at 2000 rpm)

LAFFLY S45T
The French army used 17 pieces of this tractor in 1940 in tank repair/recovery units.

- Weight: 8.2t (live load 2.0t)
- Length: 5.70m
- Width: 2.25m
- Maximum speed: 36 km/h (4 cylinders, 6232 cm³, 110 hp at 2200 rpm)

TANK CARRIERS:

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.

BERNARD 15-16 tons tank carrier truck

430 ordered trucks but only 73 were delivered from March to May 1940

- Weight: 11.760 t
- Length: 5.80 m
- Width: 2.50 m
- Height: 1.40 m
- Maximum speed: 48 km/h (6 cylinders engine, 8350 cm³, 110 hp at 1750 rpm, diesel, 5 forward + 1 reverse gear)
- Autonomy: 700 km

Initially the truck should have had a 150 hp engine for a top speed of 60 km/h. On the other hand the initial requirements asked for an autonomy of only 200 km. With its diesel engine the autonomy reached 700 km.
**MOTORCYCLES:**

1) Ordinary solo motorcycles:
   - Peugeot P107 and P122
   - Terrot HSTA and HAD
   - Gnôme & Rhône Major and Supermajor

2) Cross-country solo motorcycles:
   - Terrot RATT and RDTT
   - Gnôme & Rhône and Motobécane D5A
   - Simca-Sevitame B
   - Peugeot TT112
   - and a few British ones:
     - Royal Enfield 350
     - Ariel 350
     - Velocette 350
     - Triumph 500

3) Motorcycles with side-car:
   - Terrot RDA
   - Monet-Goyon L5A1
   - René Gillet K1 and G1
   - René Gillet Type L1
   - Gnôme & Rhône XA
   - Terrot VATT
   - Gnôme & Rhône AX2
   - and a few from foreign origin:
     - Indian 340B (USA)
     - Gillet-Herstal 373 (Belgium)

**CARS:**

**PEUGEOT 202 (small car)**
900 cars used by the French army in 1940.
Weight: 0.9t
Length: 4.11m
Width: 1.50m
Height: 1.55m
Crew: 3-4 men
Maximum speed: 100 km/h

**SIMCA CINQ (small car)**
About 1000 cars used by the French army in 1940.
Weight: 0.535t
Length: 3.21m
Width: 1.27m
Crew: 2 men
Maximum speed: 85 km/h

**RENAULT PRIMAQUATRE, CELTAQUATRE AND NOVAQUATRE (liaison car)**
About 2300 cars used by the French army in 1940. Characteristics of the Primaquatre BDS 2:
Weight: 1.55t
Length: 4.32m
Width: 1.60m
Height: 1.60m
Crew: 4-5 men
Maximum speed: 125 km/h
PEUGEOT 402 B and BL (liaison car)
1500 cars used by the French army in 1940.
Weight : 1.3t for the B and 1.4t for the BL
Length : 4.85m for the B and 4.92m for the BL
Width : 1.64m for the B and 1.68m for the BL
Height : 1.54m for the B and 1.65m for the BL
Crew : 4-6 men
Maximum speed : 125 km/h for the B and 115 km/h for the BL

CITROEN TRACTION (liaison car)
About 820 cars used by the French army in 1940. Characteristics of the TA11B (and 11BL) versions :
Weight : 1.10 t (1.06t)
Length : 4.65m (4.45m)
Width : 1.79m (1.67m)
Height : 1.54m (1.52m)
Crew : 4-5 men
Maximum speed : 115 km/h (120 km/h)

SIMCA HUIT (liaison car)
About 850 cars used by the French army in 1940.
Weight : 0.830t
Length : 4.05m
Width : 1.48m
Crew : 2 men
Maximum speed : 110 km/h

Other cars used for officers, HQ staff and liaison :
- Renault Vivaquatre, Vivastella and Viva Grand Sport
- Panhard Dynamic
- Hotchkiss type 680, 686, 864

VARIOUS 1.5t LIGHT TRUCKS : listing of the main trucks in troop transport version

PEUGEOT DK 5 J
About 6000 trucks used by the French army in 1940.
Weight : 1.85t (1.2t live load)
Length : 5.13m
Width : 1.85m
Height : 2.27m
Maximum speed : 70 km/h (4 cylinders engine, 2142 cm$^3$, 45 hp at 3000 rpm)

RENAULT AGC
About 5260 trucks used by the French army in 1940.
Weight : 2.5t (1.5t live load)
Length : 5.68m
Width : 1.95m
Maximum speed : 65 km/h (4 cylinders engine, 2384 cm$^3$, 44 hp at 2800 rpm)

CITROEN 23
About 12500 trucks used by the French army in 1940.
Weight : 2.02t (1.5t live load)
Length : 5.08m
Width : 1.96m
Height : 2.76m
Maximum speed : 70 km/h (4 cylinders engine, 1811 cm$^3$, 42 hp at 3500 rpm)

VARIOUS 3.5t TRUCKS : listing of the main trucks in troop transport version

CITROEN 45
About 4000 trucks used by the French army in 1940.
Weight : 4.1t (3.5t live load)
Length : 6.38m
Width : 2.33m  
Height : 3.00m  
Maximum speed : 60 km/h (6 cylinders engine, 4580 cm$^3$, 73 hp at 2500 rpm)

**RENAULT AGR**  
The French army used about 3050 trucks in 1940.  
Weight : 4.32t (3.5t live load)  
Length : 6.45m  
Width : 2.31m  
Height : 2.88m  
Maximum speed : 89 km/h (4 cylinders engine, 4000 cm$^3$, 62 hp at 2200 rpm)

**LATIL M2B3D**  
About 600 trucks used by the French army in 1940.  
Weight : 3.86t (3.5t live load)  
Length : 6.90m  
Width : 2.28m  
Height : 2.77m  
Maximum speed : 67 km/h (4 cylinders engine, 4080 cm$^3$, 67 hp at 2200 rpm)

**BERLIET VDCA**  
About 1102 trucks used by the French army in 1940.  
Weight : 4.4t (3.5t live load)  
Length : 7.00m  
Width : 2.29m  
Maximum speed : 67 km/h (4 cylinders engine, 4250 cm$^3$, 60 hp)

**PANHARD K101**  
About 670 trucks used by the French army in 1940.  
Weight : 3.6t (3.5t live load)  
Length : 6.40m  
Width : 2.35m  
Maximum speed : 59 km/h (4 cylinders engine, 3170 cm$^3$, 70 hp)

**VARIOUS 4.5t and 5.0t TRUCKS : listing of the main trucks in troop transport version**

**RENAULT AGK**  
About 1435 trucks used by the French army.  
Weight : 5.54t (5.0t live load)  
Length : 7.08m  
Width : 2.35m  
Maximum speed : 58 km/h (4 cylinders engine, 5881 cm$^3$, 80 hp at 2200 rpm)

**RENAULT AGK TTN39 (transport toute nature)**  
About 1450 trucks used by the French army.  
Weight : 6.32t (5.0t live load)  
Length : 7.57m  
Width : 2.43m  
Height : 2.94m  
Maximum speed : 58 km/h (4 cylinders engine, 5881 cm$^3$, 80 hp at 2200 rpm)

**MATFORD F917-WS**  
About 1000 trucks used by the French army in 1940.  
Weight : 3.8t (4.5t live load)  
Length : 6.88m  
Width : 2.35m  
Height : 2.78m  
Maximum speed : 74 km/h (8 cylinders V engine, 3621 cm$^3$, 72 hp at 2750 rpm)

**BERLIET GDRA**  
About 1485 trucks used by the French army in 1940.  
Weight : 5.5t (5.0t live load)  
Length : 7.58m
Width: 2.47m
Height: 2.79m
Maximum speed: 56 km/h (4 cylinders engine, 5700 cm$^3$, 70 hp)

**ROCHET SCHNEIDER 420 VLES**
About 200 trucks used in tank units as well as about 100 trucks in workshop version.
Weight: 5.52t (5.0t live load)
Length: 7.20m
Width: 2.45m
Maximum speed: 58 km/h (4 cylinders engine, 4850 cm$^3$, 70 hp)

**LATIL FB6 and FSPB4**
About 109 trucks used by the French army in 1940.
Weight: 5.655t (5.0t live load)
Length: 8.00m
Width: 2.40m
Height: 3.00m
Maximum speed: 58.5 km/h (4 cylinders engine)

**SAURER 3 CT1 MI**
About 900 trucks used by the French army in 1940.
Weight: 5.5t (5.0t live load)
Length: 7.78m
Width: 2.36m
Height: 2.82m
Maximum speed: 73 km/h

**PANHARD K125**
About 67 transport trucks and 209 workshop trucks used by the French army in 1940.
Weight: 6t (5.0t live load)
Length: 7.00m
Width: 2.50m
Maximum speed: 63 km/h (4 cylinders engine, 4850 cm$^3$, 85 hp)

**FOREIGN TRUCKS IN THE FRENCH ARMY IN 1940:**

In the French 1940 army, there were mostly various French trucks (Citroën, Peugeot, Panhard, Renault, Berliet, Bernard, Delahaye, Laffly, Latil, Matford, Rochet-Schneider, Somua, Unic, Willème etc.) but also several foreign ones.

Foreign trucks that could be found in the French army in 1940 were (number of trucks delivered):

- GMC ACK 353 (2000)
- Studebaker K 25 (2000)
- Dodge VH 48 (1500)
- GMC AFWX 354 (116 used as projector carrier by the Air Force)
- White 920 et MACK EXBX fuel-trucks (?)
- White-Ruxtall 922 tank carrier (1 of 300)
- FIAT-SPA 38 (400)
- FIAT 626N (700)

There were also other vehicles ordered but of which very few were delivered or not delivered at all, mostly "ex-French" trucks delivered to Great Britain. For example:

- Chevrolet YS 4103
- Dodge VK 62
- GMC ACK 504
- Dodge T 203
- GMC ACKWX 353
**SMALL ARMS**

**Pistolet signaleur M\textsuperscript{le}1918**
Type: flare pistol
Caliber: 25mm or 35mm
Weight (empty): 1100 g (25mm) or 1370 g (35mm)
The 25mm or 35mm flare pistol fires illuminating/signal flares with or without parachute.

**Revolver Lebel M\textsuperscript{le}1892 - German: Revolver 637(f)**
Type: Revolver (double action)
Total length: 239 mm
Weight (empty): 840 g
Barrel Length: 117 mm
Caliber: 8 mm Lebel
Magazine: 6 rounds
V\textdegree: 225 m/s

**Pistolet automatique SACM 1935A and 1935S - German: Pistole 625(f)**
Type: Semi-automatic pistol (single action)
Total length: 195 mm (A) and 190 mm (S)
Weight (empty): 743 g (A) and 768 g (S)
Barrel Length: 110 mm (A) and 106 mm (S)
Caliber: 7.65x22 mm Longue
Magazine: 8 rounds magazines
V\textdegree: 345 m/s

**Pistolet automatique Ruby - German: Pistole 624(f)**
Type: Semi-automatic pistol (single action)
Total length: 185 mm
Weight (empty): 810 g
Barrel Length: 85 mm
Caliber: 7.65x17 mm (.32 ACP)
Magazine: 9 rounds magazines
V\textdegree: 260 m/s

**Pistolet automatique Star M\textsuperscript{le} troupe and M\textsuperscript{le} officier - German: Pistole 623(f)**
Type: Semi-automatic pistol (single action)
Total length: 205 mm (troupe) 190 mm (officier)
Weight (empty): 910 g (troupe) 880 g (officier)
Barrel Length: 138 mm (troupe) 126 mm (officier)
Caliber: 7.65x17 mm (.32 ACP)
Magazine: 9 rounds magazines
V\textdegree: 260 m/s

**Pistolet Mitrailleur M\textsuperscript{le}1924 STA**
Type: Sub-machinegun
Total length: 855 mm
Weight (empty): 3.50 kg
Barrel Length: 240 mm
Caliber: 9x19 mm
Magazine: 32 rounds magazines
Rate of fire: 380 rpm
V\textdegree: 360 m/s

**Pistolet Mitrailleur M\textsuperscript{le}1939 PETTER**
Type: Sub-machinegun
Total length: 645 mm (388 mm with folded stock)
Weight (empty): 2.90 kg
Barrel Length: 200 mm
Caliber: 7.65x22 mm Longue
Magazine: 36 rounds magazines
Rate of fire: 600 rpm
V\textdegree: 380 m/s
Pistolet Mitrailleur Erma-Vollmer (Erma MP) - German : Maschinenpistole 740(f) -
Type : Sub-machinegun
Total length : 890 mm
Weight (empty) : 4.30 kg
Barrel Length : 250 mm
Caliber : 9x19 mm
Magazine : 32 rounds magazines
Rate of fire : 500 rpm
V° : 390 m/s

Pistolet Mitrailleur MAS38 - German : Maschinenpistole 722(f) -
Type : Sub-machinegun
Total length : 630 mm
Weight (empty) : 2.90 kg
Barrel Length : 220 mm
Caliber : 7.65x22 mm Longue
Magazine : 32 rounds magazines
Rate of fire : 640 rpm
V° : 380 m/s

Pistolet Mitrailleur Type ETVS - German : Maschinenpistole 721(f) -
Type : Sub-machinegun
Total length : 670 mm (420 mm with folded stock)
Weight (empty) : 2.70 kg
Barrel Length : 210 mm
Caliber : 7.65x22 mm Longue
Magazine : 32 rounds magazines
Rate of fire : 500 rpm
V° : 380 m/s

Carabine Lebel Mle1886/93 R35 - German : Gewehr 303(f) -
Type : Bolt action carbine
Total length : 959 mm (1359 mm with bayonet)
Weight (empty) : 3.750 kg
Barrel Length : 450 mm
Caliber : 8x50R mm
Magazine : 6 rounds in a tubular magazine
V° : 637 m/s

Mousqueton Berthier Mle1892 M16 - German : Karabiner 553(f) -
Type : Bolt action carbine
Total length : 950 mm (1350 mm with bayonet)
Weight (empty) : 3.25 kg
Barrel Length : 453 mm
Caliber : 8x50R mm
Magazine : 5 rounds clips
V° : 637 m/s

Fusil Lebel Mle1886/93 - German : Gewehr 301(f) -
Type : Bolt action rifle
Total length : 1307 mm (1820 mm with bayonet)
Weight (empty) : 4.18 kg
Weight (with 8 cartridges) : 4.415 kg
Barrel length : 800 mm
Caliber : 8x50R mm
Magazine : 8 rounds in a tubular magazine + 1 loaded
V° : 701 m/s (Mle1886D cartridge) or 840 m/s (AP cartridge, penetration of 6mm at 400m)
Rate of fire : 13-14 rpm (trials at the Mont Valérien)
Sights : iron sights dialing from 250m to 2400m.

Fusil Berthier Mle1907/1915 - German : Gewehr 302(f) -
Type : Bolt action rifle
Total length : 1306 mm (1826 mm with bayonet)
Weight (empty) : 3.81 kg
Barrel Length : 800 mm  
Caliber : 8x50R mm  
Magazine : 3 rounds clips  
$V^e$ : 701 m/s

**Fusil Berthier M\textsuperscript{le}1916 - German : Gewehr 304(f) -**  
Type : Bolt action rifle  
Total length : 1305 mm (1825 mm with bayonet)  
Weight (empty) : 4.195 kg  
Barrel Length : 800 mm  
Caliber : 8x50R mm  
Magazine : 3 rounds clips  
$V^e$ : 701 m/s

**Fusil Berthier M\textsuperscript{le}1907/15 M34 - German : Gewehr 241(f) -**  
Type : Bolt action rifle  
Total length : 1080 mm (1600 mm with bayonet)  
Weight (empty) : 3.70 kg  
Barrel Length : 580 mm  
Caliber : 7.5x54 mm  
Magazine : 5 rounds clips  
$V^e$ : 820 m/s  
The Berthier M\textsuperscript{le}1907/15 M34 had iron sights up to 900m.

**Fusil "automatique" R.S.C. M\textsuperscript{le}1917 / M\textsuperscript{le}1918 - German : Selbstlade-Gewehr 310(f) -**  
Type : Semi-automatic rifle  
Total length : 1330 mm (1850 mm with bayonet) for the 1917 and 1110 mm for the 1918  
Weight (empty) : 5.27 kg (1917) or 4.77 kg (1918)  
Barrel Length : 800 mm (1917) or 580 mm (1918)  
Caliber : 8x50R mm  
Magazine : 5 rounds clips  
$V^e$ : 701 m/s  
Principally used during the end of WW1 and the Rif war in Morocco (1921-1926) but also a few in France in 1940 and issued to sharpshooters. RSC means "Ribeyrolle Sutter Chauchat". The RSC M\textsuperscript{le}1917 was produced in a rush, without lengthy trials and quality improved as defaults were reported from the front line. The main default of the RSC M\textsuperscript{le}1917 was the chambering for the 8x50R Lebel cartridge, being too easily jammed by dirt. About 80000 were made from various subcontractors, the assembly being carried out at Saint Etienne (5000/month). The RSC M\textsuperscript{le}1918 was introduced later into the war, mainly a shorter barrel version with all the improvements implemented in the M\textsuperscript{le}1917 and with the standard Berthier 5 rounds clip system contrary to the M\textsuperscript{le}1917 dedicated clip.  
About 10000 RSC M\textsuperscript{le}1918 were built with end of production early 1919. The RSC M\textsuperscript{le}18 was well spoken of by its users. During WW1 the French semi-automatic rifles were distributed to infantry units, 16 per company, to be used by sharpshooters and platoon leaders.  
Considering French semi-automatic rifles, 6000 Meunier M\textsuperscript{le}1910 rifles in 7x59mm were built and delivered to the French army in 1916 (A6 model), giving satisfaction to the end user but ammunition supply was a nightmare, they were used during WW1.

**Fusil MAS M\textsuperscript{le}1936 - German : Gewehr 242(f) -**  
Type : Bolt action rifle  
Total length : 1020 mm (1320 mm with bayonet)  
Weight (empty) : 3.72 kg  
Barrel Length : 580 mm  
Caliber : 7.5x54 mm  
Magazine : 5 rounds clips  
$V^e$ : 820 m/s  
**Rate of fire : 12 rpm**  
The MAS36 had iron sight graduated from 200m to 1200m.

Sniper rifle  
The rifles issued to the snipers had the special mount for the scope and specially selected rifles with higher level of engineering in order to increase the accuracy. Each rifle was adjusted and fitted with a dedicated scope which had the number of the rifle marked on it. The scoped rifles were issued at the platoon level (1 for about 40 men) in 1939/1940 and several served also in the Corps Francs. The most common sniper rifle during both WW1 and 1939/1940 battles is the famous Lebel M\textsuperscript{e}1886/93 rifle but the Berthier M\textsuperscript{e}1916 is also used. They were equipped with the APX21 scope in 1940.
**APX21 scope**
- Length : 280mm
- Magnification : 3x
- Real field of view : 165mm
- Range dial : up to 1200m
- Reticule : V reticule (V)
- Marking : "A.PX21" followed by the number of the rifle to which the scope is assigned

The cartridge usually used is the M²1886D (created by the captain - later squadron commander - Désaleux) and the M³1886D a.m. (amorçage modifié = modified primer) with a V° of 701 m/s. The armor-piercing cartridge "cartouche de 8mm à belle perforante (P)" can also be used (V° = 840 m/s) and was able to penetrate 6mm at 400m. The semi-automatic R.S.C. M³1917/1918 rifle was used during WW1 and during the Rif war and several were still used in France in 1939/1940 and issued to the best sharpshooters but probably never to snipers (with a scope). This rifle like the MAS M³1936 were probably never equipped with a scope but it is very likely that various trials has been led with the MAS36 rifle. In May-June 1940 there were also trials with the experimental MAS40 rifle (semi-automatic, 7.5x54 mm, 5 rounds clips, 10 rounds magazine or an other version with a 25 rounds magazine) and a new prismatic APX M686 scope but this scope proved to be inferior to the older APX21.

For all rifles / carbines :
- Maximum range : about 3500m
- Practical range : up to 400m (rather 200m for carbines and up to 800m for scoped rifle)

**Fusil Mitrailleur M³1915 Chauchat** - German : leMG 156(f) -
- Type : Light machinegun
- Total length : 1170 mm
- Weight (empty) : 9.32 kg
- Barrel Length : 450 mm
- Caliber : 8x50R mm
- Magazine : 20 rounds half-moon magazines
- Rate of fire : 250 rpm
- V° : 637 m/s

**Fusil Mitrailleur Châtellerault M³1924/29** - German : leMG 116(f) -
- Type : Light machinegun
- Total length : 1007 mm
- Weight (empty) : 8.93 kg
- Barrel Length : 500 mm
- Caliber : 7.5x54 mm
- Magazine : 25 rounds magazines
- Rate of fire : 600 rpm or single shot selection (practical rate of fire = 200-400 rpm)
- V° : 820 m/s
- Practical range : 1200m (maximum range 3200m), 600m in AA fire
- Very accurate at short and medium range (up to 1200m), able to engage targets up to 2000m (max range is about 3000m).

**Mitrailleuse Saint-Etienne M³1907** - German : sMG 256(f) -
- Type : Medium / heavy machinegun (air cooled)
- Total length : 1180 mm
- Weight (empty) : 23.8 kg with tripod
- Barrel Length : 800 mm
- Caliber : 8x50R mm
- Magazine : 24 rounds metal trays or 251 rounds flexible belts
- Rate of fire : 500 rpm
- V° : 690 m/s (M³1932 N cartridges) or 701 m/s (M³1886 D (am) cartridges)
- Practical range : 2400m, 1000m in AA fire

**Mitrailleuse Hotchkiss M³1914** - German : sMG 257(f) -
- Type : Medium / heavy machinegun (air cooled)
- Total length : 1310 mm
- Weight (empty) : 25 kg + 24 kg with tripod (M³1916)
- Barrel Length : 785 mm (4 grooves from right to left)
- Caliber : 8x50R mm
- Magazine : 24 rounds metal trays or 251 rounds flexible belts
Rate of fire : 500 rpm (practical rate of fire = 200-400 rpm)

V° : 690 m/s (M1932 N cartridges) or 701 m/s (M1886 D (am) cartridges)

Practical range : 2400m (iron sights) to 3500m (spirit level) (maximum range 5500m)

Very accurate even at long range, able to engage targets up to 2500m in direct fire with the M1932 N bullet. Also used in indirect fire mode at a range of 1500-3500m (one MG company covers an area of 200m long and 400m wide). The MG can be used in anti-aircraft role up to 1000m.

8x50R mm cartridges :
- Cartouche M1886 D (am) (12.8 gram heavy ball) - V° = 701 m/s (3145 J)
- Cartouche M1932 N (15.05 gram heavy ball) - V° = 690 m/s (3583 J)
- Cartouche de 8mm à balle perforante (P) (9.6 gram AP ball) - V° = 840 m/s (3387 J)
  A 4.2 gram special stubs steel core and brass
  Penetration : 6mm /0° at 400m
- Cartouche de 8mm à balle traceuse (T) (11.2 gram tracer ball) - V° = 750 m/s (3150 J)
  Ball is tracing only in the first 600m. There are 2 different tracer cartridges (white and red color)

The metal trays could also be assembled to have 48, 96 etc. rounds. The 251 rounds belt is a series of 3 rounds strips connected together. The belt is 4.2m long and with the cartridges it weights about 8.5 kg. The Hotchkiss MG had an advantage over the Vickers and the Maxim HMGs in that they emitted no tell-tale plume of steam from the water cooling systems they didn't have. If the "steam cans" for the steam-water condensation were not connected to the above water-cooled MGs, there was a steam geyser after 150-200 rounds of fire.

Several of the accessories that can be used with the Hotchkiss M1914 MGs :
- Tripod (Omnibus M1915, Hotchkiss M1916) (standard)
- Iron sight M1918 (standard) (used up to 2400m)
- Spirit level M1918 (used from ranges > to 2400m and up to 3500m)
- Replacement barrels
- Case extractor M1907
- Flash hider
- Range finder (S.O.M. M1925 or older Barr and Stroud M1909M, M1909-1912 and M1912)
- Periscope (Carvallo, S.O.M., Valette-Colmont)
- Compass-goniometer M1917 (for indirect fire) on a separate tripod
- MG goniometer M1936 (for indirect fire) mounted directly on the MG
- Tripod extension (for AA fire) (Rallonge M1928)
- Specific sight for AA fire (correcteur Cazaux-Labat modifié)
- Specific stock for AA fire

A French typical infantry regiment (type "north-east") had 48 Hotchkiss M1914 MGs (16 in each battalion of the 3 battalions). There were also 3 replacement ones (1 in each battalion) for a total of 51 Hotchkiss M1914 MGs available.

A motorized infantry regiment should theoretically have 56 Hotchkiss M1914 MGs : 12 in each of the 3 battalions, 8 in a regimental motorcycle company and 12 in the regimental weapons company. In reality there was only one motorcycle platoon in the regimental staff and command company and it had only FM 24/29 LMGs. Therefore the motorized infantry regiment has also only 48 Hotchkiss M1914 MGs. Nonetheless there were 18 extra Hotchkiss M1914 MGs (6 in each battalion) that were intended for self defense if needed or replacement. There are therefore up to 66 Hotchkiss M1914 MGs available. A motorized regiment has more extra collective weapons for self-defense and/or replacement than a typical infantry regiment (there are also 6 extra 60mm M1935 mortars and 3 extra 81mm M1927/31 mortars but only 3 extra 81mm M1927/31 mortars in a typical infantry regiment). In both cases there are also extra weapons in the artillery divisional park of the division.

A MG battalion (horse drawn or motorized) has 36 Hotchkiss M1914 MGs.

For each MG the typical "north east" infantry regiment had about 6150 cartridges (2 flexible belts of 251 rounds and metal trays for each MG) :
- 5394 standard and heavy cartridges (D and N types cartridges)
- 540 armor piercing cartridges
- 216 tracer cartridges

In a motorized infantry regiment there were more than 9000 cartridges for each MG.

**Fusil anti-char Boys**

Type : AT bolt action rifle
Total length : 1620 mm
Weight (empty) : 16.3 kg
Barrel Length : 915 mm
Caliber: 13.97x99B mm (.55in Boys)
Magazine: 5 rounds magazine
Penetration: 21 mm at 100 m
\( V^* \): 884 m/s

A modest number (several dozens) was provided by the British army, which received 220 French 25mm AT guns which became the weapon of the BEF’s brigade AT companies. The Boys AT rifles equipped some reconnaissance battalions (GRDI and GRCA) as well as the two airborne units in existence.

**Mitrailleuse 7.5mm "Reibel" MAC M\(^\text{le}\)1931** - German: KpfwMG 311(f) -
Type: Medium / heavy machinegun used in fortifications (twin mounts) and vehicles, sometimes dismounted and used by the infantry.
Total length: 1030 mm
Weight (empty): 11.8 kg
Barrel Length: 600 mm
Caliber: 7.5x54 mm
Magazine: 150 rounds drum magazine
Rate of fire: 750 rpm (practical rate of fire is rather about 400-500 rpm)
\( V^* \): 840 m/s
Practical range: 1200m (maximum range 3200m)
Sight: iron sight up to 2400m (for the heavy ball) or telescopic sight (in tanks and 2.3x sight in the fortifications)

**Mitrailleuse de 13.2mm Hotchkiss M\(^\text{le}\)1930** - German: sMG 271(f) -
The Hotchkiss M\(^\text{le}\)1930 HMG was used by the army in several bunkers (96 HMGs in the Maginot Line on the Rhine River and in the Vosges fortifications), by the anti-aircraft forces (twin AAMG) and by the cavalry units (Laffly AM80 and AMR-35 ZT1). The French navy adopted it largely unlike the French army and installed them on double and quadruple AA mounts. It was exported to Japan, Italy, Japan and Romania. The Polish navy used the 13.2 mm AAMG Hotchkiss. It could be used in "anti-tank" role and heavy support by the vehicles.
Caliber: 13.2x99 mm
Telescopic sight: 2.3x (L.660 sight, field of view ?°)
Rate of fire: 450 rpm
Capacity: 30 rounds magazine
\( V^* \): 800 m/s
Practical range: 1200m - 2500m (maximum range 6500m against ground targets)

**NOTES:**

1) **RIFLES AND CARBINES AVAILABILITY:**

- The Lebel M\(^\text{le}\)1886/93 (8mm, 8 rounds) was replaced by the different Berthier rifles but it is still present in 1940. It was the rifle used by French snipers (specially selected and engineered rifles) already during WW1 and still used in 1940, equipped with APX21 (or older APX17) scope.

- The Berthier M\(^\text{le}\)07/15 (8mm, 3 rounds), replacing the Lebel rifle in 1915, still present in 1940 but few

- The Berthier M\(^\text{le}\)1916 (8mm, 5 rounds), replaced the Lebel and M\(^\text{le}\)07/15 rifle in 1916, the MOST COMMON in 1940 (most of the infantry divisions, fortress infantry etc.)

- The R.S.C. M\(^\text{le}\)1917 and M\(^\text{le}\)1918 (8mm, 5 rounds, semi-automatic) : 90,000 produced. Mostly used during the Rif war but also by several sharpshooters in France in 1940.

- The Berthier M\(^\text{le}\)1907/15 M34 (7.5mm, 5 rounds), 45,000 delivered in 1938 issued to the professional units

- The MAS M\(^\text{le}\)1936 (7.5mm, 5 rounds), 250,000 delivered in 1939/1940 (60000 before the beginning of the phoney war, and the rest during the following months but 250000 were used in the units) also issued primarily to all active units (about 250,000 men) (the professionnal ones : chasseurs portés, dragons portés, corps francs, chasseurs alpins, infanterie de l'air, légionnaires, some cavalry and infantry divisions).

- The mousqueton Berthier M\(^\text{le}\)1892 M16 (8mm, 5 rounds) was used in the cavalry and several other units like artillery units I guess ... But it was also present in the Chasseurs Alpins, in the Corps Francs beside the rifles

- The mousqueton Lebel M\(^\text{le}\)1886/93 R35 (8 mm, 6 rounds) present in 1940 and mostly used by military police, cavalry and artillery units.
Therefore on the French side there were about:
- 2,383,000 rifles in 8mm (among them 90,000 semi-auto to the best shooters among the divisions)
- 295,000 rifles in 7.5 mm issued to the best divisions

The carbines, rifles as well as MGs used standard (normal or heavy ball cartridges) as well as AP, tracer and incendiary cartridges.

2) SMGs AVAILABILITY:

ALL the SMGs used by the French Army in May/June 1940:

French origin:
- PM MAS M38 : 1,958 (19,500 ordered)
- PM STA M1924 : 1,000 (8,500 ordered)
- PM Petter M1939 : 50 (3,000 ordered)
- PM ETVS : 50 used from a total of about 100 produced

Foreign origin:
- MP 18-1 and MP 18-2 : very few
- MP 28-2 : 1,000 ordered for the police but not all delivered
- MP 34 : 200
- Erma-Vollmer MP : 3,250 but only 1,540 magazines available (only about 1,000 SMGs really used)
- Steyr : about 50
- Suomi M/31 : 300 available and 150 used on the front
- Thompson M1921 (and perhaps M1928) : 3,000 available but only several hundreds used in 1940

The PM MAS 35 is adopted as the PM MAS M38 and in January 1940 19,500 SMGs are ordered but the first batch is only delivered on 3rd May 1940. Until 23rd June 1940, only 1,958 MAS38 SMGs are delivered. The MAS38 was thus rare, with only individual weapons seeing service rather than systematic issue to particular unit types. This SMG was later used by the Germans under the name MP 722(f).

The French army has also 300 Suomi M/31 SMGs and 150 of them are directed to the north-eastern front during the 1939-1940 winter. In 1938 3,000 Thompson M1921 (and 30,000,000 .45ACP cartridges) are ordered to the USA and they are all delivered by end 1939. They are nonetheless judged too heavy, bulky and too expensive. Most of the 3,000 Thompson M1921 SMGs remained surprisingly in armories or were only tested in Morocco during 1940. They were only issued occasional in May/June 1940 or delivered to military police units (e.g. gendarmes that fought on the Loire River in June 1940). The Thompson SMGs were for example also used by the Laffly W15T CC tank destroyer crews (126 SMGs issued to the 14 self-propelled anti-tank batteries) and apparently by several AA units. They were more largely distributed among the Vichy French troops in 1941.

The EMP is the most common SMG used by the French Army in 1939-40. They actually were seized from Spanish Republican troops at the end of the Spanish Civil War. 3250 MPE were counted but due to lack of magazines only about 1,000 were issued. The most common place to find this weapon was with the Corps Francs.

3) LMGs AVAILABILITY:

In 1916, the standard squad LMG is the FM M1915 "Chauchat" : 225,000 delivered (+ 35,000 given to the USA) Before 1918 about 10,000 Browning FM BAR were also bought. In 1922, 500 FM Madsen were tested.

The Army wanted the Browning FM BAR but it was too expensive.

In 1925, Adoption of the MAC FM M1924 : 50,000 delivered (ammunition = 7.5mm model 1924)

In 1934, adoption of the MAC FM M1924/29 (ammunition = 7.5mm model 1929 = shortened cartridge) and all the FM M1924 transformed in FM M1924/29. About 150,000 delivered before 1940.

LMG from 1916 to 1934 : Chauchat, BAR, FM 1924
Since 1934 : FM M1924/29 is officially THE LMG

Note: FM M1924/29, St Etienne M1907 and Hotchkiss M1914 HMG are also used as AAMGs.
GRENADES AND EXPLOSIVES

1) Offensive (dangerous in a 8-10m range) - In German service: Eihandgranate 302(f)

Grenade OF (Mle 1915, 1918, 1930, 1937 – various fuzes)
Weight: 275g
Explosive: 150g (cheddites)

2) Defensive (dangerous in a 100m range)

Grenade F1 (Mle 1916, 1918, 1930, 1937 – various fuzes)
Weight: 660g
Explosive: 60g

Grenade DF Mle 1917 (hand and rifle grenade)
3) **Incendiary** (efficient in a 20m range)

Grenade incendiaire M<sup>e</sup>1937

![Incendiary M<sup>e</sup>1937](image)

4) **Incendiary and smoke**

Grenade incendiaire et fumigène M<sup>e</sup>1916 (efficient in a 20m range)

- Weight: 560g
- Active content: 300g

Grenade incendiaire et fumigène M<sup>e</sup>1916 and M<sup>e</sup>1916 AB (incendiary charge, usually not thrown)

- Weight: 750g
- Active content: 575g (calorite – which in fusion is piercing or welding all steel parts)

5) **Rifle grenade**

The 'Tromblon VB' (Tromblon Vivien-Bessière) grenade dischargers are fitted on Lebel M<sup>e</sup>1886/93 rifles, Lebel M<sup>e</sup>1886 R35 and sometimes MAS M<sup>e</sup>1936 rifles. Every French infantry platoon has a group of VB grenade launchers. Feared for its efficiency among German troops since WW1 and very valuable because of their ability to engage and destroy entrenched troops and MGs. The VB grenade was used during WW1 by the USA and UK and copied by the Germans.

The discharger is attached to the muzzle of the rifle and **either 1 or 2 grenades**, as desired, are inserted. The rifle is loaded with an ordinary cartridge. The bullet is fired and passes through the barrel of the rifle and the central tube of the grenade(s), forcing the striker against the primer and igniting the fuze, the VB rifle grenade will explode.
8 seconds later. The gases generated by firing the cartridge collect in the lower chamber of the discharger and exert a pressure on the base of the grenade great enough to propel the later at a distance of 170m with a rifle (800mm barrel) when only 1 grenade is fired.

These grenades were shipped in wooden boxes that held a total of 48 each. Each box was marked with a painted yellow circle that had black lettering which contained the following information in it; Top line: the type of grenade it carried ( V.B. EXP. ) and number contained, Second line: type of explosive, who manufactured the explosive, the Lot number along with the month and year it was manufactured in, Third line: the manufacturer who filled the grenade, the Lot number along with the month and year it was done.

There is a minimum range because the grenade would have to be fired close to the vertical and would explode in the air, before reaching the ground. That can nevertheless be used to create dangerous air bursts. The range is 80m with an angle of 85° and 175m with an angle of 50° when using a rifle with a 800mm barrel.

The Tromblon was carried in a special shaped leather holster called an Etui, which was normally worn on the waist belt of the grenadier. A special sight called the "appareil de pointage et de repérage Mle1917" and Mle1917M (modified) was developed for use with the tromblon that could used to help verify the angle at which the weapon was fired and aided in determining the approximate range the grenade was to go. The difference between the two different sights was in the range calibrations. These sights were affixed to the rear sight of the weapon by means of a hand-tightened screw.

**Grenade explosive Mle1915 (VB de guerre) (explosive and fragmentation, dangerous in a 100m range)**

- Caliber : 50 mm
- Weight : 490g
- Explosive : 60g
- Range : 80-170 m (800mm barrel rifle) or 145-215m (450mm barrel carbine)
- The sighting device Mle1917 M is graduated from 10m to 10m until 170m
- Rate of fire : 4-9 rpm (therefore usually a group of 3-4 VB launchers are firing together)

There were about 16 tromblons VB issued per company, which could cover a 200m wide front and fire together at up to 150 rpm.

Ranges of VB grenades : the grenades range was determined by the angle of fire that the trombon was pointed when the grenade fired.

**Angle of Fire and Range (with the Balle "D" service bullet loaded with BN3F powder and 800mm barrel ) :**

- 45° : 190 meters
- 50° : 175 meters
- 55° : 170 meters
- 60° : 160 meters
- 65° : 140 to 150 meters
- 75° : 110 to 120 meters
- 80° : 85 to 100 meters
- 85° : 80 meters
VB illuminating/flare grenade

(Had to be fired with a cartridge without bullet, which is also shown on the photo)

VB message grenade

The message grenade, called grenade "lance-messages" or "grenade porte-messages", was used to send messages from one trench section to another over heavily engaged areas. These grenades contained a fuze, which at the end of the fuses cycle would detonate a small smoke packet so that it could be found. Range of 350m.

Note: At the end of 1939 Brandt developed also a 50mm HEAT rifle grenade. It had a range of about 100m and an armor penetration of 40mm. It entered in production during May 1940 and was successfully tested at the Satory test range on 10th June 1940 but they could not be issued to the combat units before the armistice. The documents related to these works were sent to the USA in June 1940 and were used as basis to develop the M9 AT rifle grenade and the HEAT rocket of the Bazookas.

6) Anti-tank

Grenade anti-char M1918 (probably not in use anymore in 1940)

7) Bouteilles incendiaires (Molotov cocktails) were also used by the French troops
8) Explosive charges – generally with melenite

There are various explosive charges in brass boxes / tubes.

- **Pétard de 20kg M°1929**
  Explosive : 20kg
  Size : 475mm x 170mm x 170mm

- **Pétard de 10kg M°1929**
  Explosive : 10kg
  Size : 270mm x 170mm x 170mm

- **Pétard de 1kg M°1929**
  Explosive : 1kg
  Size : 38mm x 73mm x 273mm

- **Pétard de 135g M°1928**
  Total weight : 200g
  Explosive : 135g
  Size : 148.5mm x 33.5mm x 21.2mm

  Used alone or in multiple charges : concentrated (2 to 20 charges) or juxtaposed (7 charges for 1 meter) for various destruction tasks (walls, barbed wire networks, trees, railroads, equipments etc.).

  In a typical infantry regiment there are 108 of these 135g explosive charges and 46 detonators.

  In the cavalry units all armoured cars had 4 such explosive charges and most horse mounted men, motorcyclists or dragons portés (motorized infantry : on side-cars, trucks or halftracks) carry one explosive charge. One dragons portés regiment in a DLM had for example a total of 1200 explosive charges and 800 detonators.

- **Cartouche de 100g M°1929**
  Total weight : 125g
  Explosive : 100g
  Size : dimeter of 29mm and length of 129mm

- **Pétard de 60g M°1929**
  Explosive : 60g
  Size : 73mm x 33.5mm x 21mm
  This charge is used as relaying / joining / igniting charge

The standard dotation of an engineer platoon / company is following :

- **Engineer platoon**
  10kg charge : 1
  1kg charge : 12
  135g charge : 475
  100g charge : 192
  60g charge : 50
  → total : about 108 kg explosives

- **Engineer company**
  10kg charge : 4
  1kg charge : 48
  135g charge : 1900
  100g charge : 768
  60g charge : 200
  → total : about 434 kg explosives
Each tank or armored car crew was armed with miscellaneous small arms, mainly pistols and revolvers. But according to a French cavalry officer manual from 1939 there were also hand grenades and explosives. In the AMR-33 and AMR-35 armored cars and in the Hotchkiss H35 tanks, the crew had 5 F1 hand grenades (defensive). In the Laffly 50AM, Laffly 80AM, Panhard TOE, Panhard 178, Schneider-Kégresse P16 M1929, Renault AMC-34, Renault AMC-35 etc. each crew had 10 F1 hand grenades (defensive) and 2 incendiary grenades. In each cavalry vehicle (including armored cars and tanks) there were also 4x 200g explosive charges (150g explosive) = "pétard de cavalerie", for various destruction tasks.

9) Smoke dispenser B5 M1935

This smoke dispenser used by the infantry is a steel box of 120x120x495 mm. It weights 15 kg and produces smoke during 10-15 minutes on an area of 10x600 meters and 20 meters high.
MINE WARFARE EQUIPMENT

1) Anti-tank mines

- Anti-tank stakes or "piquet Ollivier"
  This was an improvised AT mine using a 3.5kg explosive charge, a 120mm artillery shell (4.2kg explosive) or a 150mm artillery shell dug vertically in the ground, with a 1 meter long stake attached to the rupture igniter (52 kg firing pressure, 0.75 second delay). A tank hitting it would detonate the charge or shell. The "piquet Ollivier" was directed against the wheels, tracks and bottom armor of the tanks when they rolled over it. This device was mainly used in the Maginot Line; it was often hidden in bushes and hedges but mainly deployed around the fortifications and camouflaged as a fence post among the rails of AT obstacles or among the pickets in wire obstacles. The French snap fuze, Ollivier is of the instantaneous, mechanical type and contains a spring-loaded striker with a snap release. Lateral pressure, applied near the top of the extension tube, snaps the fuze case and fires the detonator.

- Improvised anti-tank shell mines
  The French improvised AT shell mine consists of a single 120mm shell in a wooden case. This case is fitted with a loose wooden pressure board, one end of which rests on the pressure head of the pressure fuze for the shell mine, which is connected to the shell by a flash tube and an L-shaped adapter. It is used in mine fields and road blocks.
  - Length: 559 mm
  - Width: 127 mm
  - Height: 254 mm
  - Firing pressure: ~295 kg
**Mine à charge allongée M1935 (steel) / M1936 (aluminium) - German: sPzMi 420(f)**

The French heavy anti-tank mine M1935 uses the M1935 or M1936 pressure fuzes. This mine was designed for employment in permanent defensive installations. The first order of 55,200 AT mines has been delivered between July 1936 and May 1938. On 1st September 1939, it was evaluated that 90,000 of these AT mines were needed in the fortifications of the Maginot Line. This explains probably why improvised AT mines and Ollivier AT stakes were also largely used in the permanent defensive positions

- Length: 406 mm
- Width: 254 mm
- Height: 120 mm
- Weight: 11.5 kg
- Filling: 1.5 kg melenite (picric acid)
- Firing pressure: 360 kg

**Mine légère M1936 - German: lePzMi 407(f)**

The French light anti-tank mine M1936 uses the M1935 or M1936 pressure fuzes. This mine was designed for employment in AT mine fields (used by infantry and cavalry units) and in permanent defensive positions. The flanged base plate has a hole in each corner for hold-down bolts when the mine is laid in permanent defensive positions. There is a cavity under the mine for eventual traps against enemy troops trying to remove the mine. The French army should have had 400,000 of these AT mines for its motorized units plus 100,000 mines in reserve but only about 50,000 had been delivered in 1939. The production rate reached 100,000 mines/month end 1939 and 200,000 mines/month in January 1940. On 10th May 1940, the French army had only 440,000 light AT mines instead of the 500,000 planned.

- Length: 241 mm (base plate = 324 mm)
- Width: 140 mm (base plate = 222 mm)
- Height: 114 mm
- Weight: 6.6 kg (7.3 kg indicated by an other source)
- Filling: 2.7-2.8 kg melenite (picric acid) (3.1 kg indicated by an other source)
- Firing pressure: 190-225 kg

**Heavier AT mine developed in 1940**

In 1940, a heavier AT mine weighting 12-13 kg for an explosive content of 6-7 kg was developed and a first order of 10,000 mines was placed to test them.

**Foreign AT mines**

End 1939 France ordered 1,200,000 3-4kg AT mines to Italy. They were to be delivered in 6 months and were bought for 75 millions francs. There are no information about the delivery but in October 1939 the Engineer corps was asked to “prepare the stockpiling of the AT mines ordered in Italy, likely to be delivered quickly”.
**NOTE:** This is a temporary table of regulation issue of AT mines for cavalry units, dated 3rd February 1939.

<table>
<thead>
<tr>
<th>Unit</th>
<th>Parent Unit</th>
<th>Number of mines</th>
<th>Transport</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cavalry or spahis regiment</strong></td>
<td>DLC</td>
<td>448</td>
<td>3.5 tons truck</td>
</tr>
<tr>
<td>HQ support squadron</td>
<td>Spahis brigade (BS)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Armored Car Regiment (RAM)</strong></td>
<td>DLC</td>
<td>232</td>
<td>3.5 tons truck</td>
</tr>
<tr>
<td>HQ support squadron</td>
<td></td>
<td>55</td>
<td>1 per sidecar</td>
</tr>
<tr>
<td>1st motorcycle squadron</td>
<td></td>
<td>55</td>
<td>1 per sidecar</td>
</tr>
<tr>
<td>2nd motorcycle squadron</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Motorised Infantry Battalion (BDP)</strong></td>
<td>DLC</td>
<td>200</td>
<td>1.2 to 2 tons light truck</td>
</tr>
<tr>
<td>Headquarters support squadron</td>
<td></td>
<td>55</td>
<td>1 per sidecar</td>
</tr>
<tr>
<td>One motorcycle squadron</td>
<td></td>
<td>62</td>
<td>2/half track or 4/truck</td>
</tr>
<tr>
<td>1st motorized infantry squadron</td>
<td></td>
<td>62</td>
<td>2/half track or 4/truck</td>
</tr>
<tr>
<td>2nd motorized infantry squadron</td>
<td></td>
<td>25</td>
<td>1 per cross-country tractor</td>
</tr>
<tr>
<td>Support weapons squadron</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Divisional 25mm AT gun squadron</strong></td>
<td>DLC, DLM</td>
<td>248</td>
<td>2 tons light truck</td>
</tr>
<tr>
<td><strong>Reconnaissance regiment</strong></td>
<td>DLM</td>
<td>216</td>
<td>3.5 tons truck</td>
</tr>
<tr>
<td>Headquarters Support Squadron</td>
<td></td>
<td>55</td>
<td>1 per sidecar</td>
</tr>
<tr>
<td>1st motorcycle squadron</td>
<td></td>
<td>55</td>
<td>1 per sidecar</td>
</tr>
<tr>
<td>2nd motorcycle squadron</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Tank regiment</strong></td>
<td>DLM</td>
<td>140</td>
<td>3.5 tons truck</td>
</tr>
<tr>
<td>HQ support squadron</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Motorised infantry regiment (RDP)</strong></td>
<td>DLM</td>
<td>248</td>
<td>5 tons truck</td>
</tr>
<tr>
<td>HQ support Squadron</td>
<td></td>
<td>55</td>
<td>1 per sidecar</td>
</tr>
<tr>
<td>1st battalion</td>
<td></td>
<td>80</td>
<td>4 per 6x6 truck (up to 80)</td>
</tr>
<tr>
<td>o One Motorcycle Squadron</td>
<td></td>
<td>80</td>
<td>4 per 6x6 truck (up to 80)</td>
</tr>
<tr>
<td>o 1st motorised infantry squadron</td>
<td></td>
<td>34</td>
<td>2 per cross-country tractor</td>
</tr>
<tr>
<td>o 2nd motorised infantry squadron</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>o Support weapons squadron</td>
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</tr>
<tr>
<td>2nd Battalion</td>
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</tr>
<tr>
<td>3rd Battalion</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>GRDI</strong></td>
<td>DI</td>
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<td>3.5 tons truck</td>
</tr>
<tr>
<td>Headquarters Support Squadron</td>
<td></td>
<td>55</td>
<td>1 per sidecar</td>
</tr>
<tr>
<td>1st motorcycle squadron</td>
<td></td>
<td>55</td>
<td>1 per sidecar</td>
</tr>
<tr>
<td>2nd motorcycle squadron</td>
<td></td>
<td>20</td>
<td>2 per cross-country truck</td>
</tr>
<tr>
<td>Support weapons motorcycle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>squadron</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
(1) Based on this, and provided no later table was issued, the regulation issue for a DLC's Motorised Infantry Regiment (RDP) would be as follows:

<table>
<thead>
<tr>
<th>Motorised infantry regiment (RDP)</th>
<th>DLM</th>
</tr>
</thead>
<tbody>
<tr>
<td>• HQ support Squadron</td>
<td>200</td>
</tr>
<tr>
<td>• 1st battalion</td>
<td></td>
</tr>
<tr>
<td>o One Motorcycle Squadron</td>
<td>55</td>
</tr>
<tr>
<td>o One motorised infantry squad</td>
<td>62</td>
</tr>
<tr>
<td>o Support weapons squadron</td>
<td>25</td>
</tr>
<tr>
<td>• 2nd Battalion</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Battalion</th>
<th>142</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTAL</td>
<td>484</td>
</tr>
</tbody>
</table>

French had AT mines, despite the popular misconception, and these were quite commonly issued and used during the campaign and not only by engineer units but for example all cavalry, reconnaissance, mechanized or motorized infantry battalions were equipped with AT-mines.

They were used extensively at Gembloux where they formed an integrated part of the overwhelmingly successful AT defense and at this defensive area the German never break through the French lines. Numerous mines were laid before the battle. One account by Louis Brindejonc, commanding a 25mm SA34 AT gun mentions a Renault UE chenillette coming up to resupply them during a pause in the battle. As well as ammunition it brought 20 Mle 1935 light AT mines. The mines are deployed 100m in front of their position.

At Sedan thousands of AT mines had been laid months before the campaign. Unfortunately they were reported to have been adversely affected by damp and so were dug up to be fixed. Sadly time did not permit them to be laid again, which was kind of unfortunate. The Germans also later extensively used French captured AT mines, especially during the battles in North Africa.

In "Denkschrift über die französische Landesbefestigung" (OKH, 1.10.1941, Berlin) there is a very long study of all the components of the Maginot line. Concerning the mines the Germans mention the light and heavy AT mines, the "piquet Ollivier", the AP bouncing mine Mle 1939, fragmentation mines (F1 defensive grenades) and derivating naval mines in the Rhine

A typical 'north-east' type motorized infantry division had at least about 9,280 AT mines: about 4,500 AT mines in the infantry regiments, the BDAC has 700 AT mines (2 lorries transporting 350 AT mines each), the GRDI has about 580 AT mines and the CDAC has about 3,500 AT mines (transported in 10 light trucks). The engineer battalion has also probably a number of AT mines available.

A typical 'north-east' type infantry division had at least about 2,080 AT mines: about 1,500 AT mines in the infantry regiments, the GRDI has about 580 AT mines and the engineer battalion has also probably a number of AT mines available.

The French doctrine planned the deployment of 1,370 mines/km on 1 row or 2,740 mines/km on 2 staggered rows. The mines were placed in linear groups of 5 on a length of 2.50m, the groups being separated by 1.40m gaps. Such a minefield was usually prepared in 8 hours.
2) Anti-personnel mines

- Anti-personnel bounding mine M₁939

The French AP bounding mine M₁939 consists of a 60mm mortar shell (prefragmented, 0.16 kg melenite) enclosed in a steel tube closed at the top by a cover. One end of an L-shaped flash tube is screwed to the base of the projectile tube. The other end of the flash tube is threaded to receive a fuze adapter. A rectangular metal support plate surrounds the flash tube and the steel tube. The mortar shell is fitted with a delay pellet and a detonator. A propelling charge (0.8 g black powder) is located in the flash tube. This mine uses the pull fuze M₁939 or the pressure-pull fuze SEMG (firing pressure of 40-45 kg or firing pull of 4 kg). The mine is about 184 mm high and 83 mm wide.

The propelling charge propels the mortar shell from the projectile tube and at the same time ignites the delay pellet (0.2 second), which burns through and fires the detonator. The detonator fires the main charge of the prefragmented shell at the height of 0.5-2.0 meters above the ground. The French AP bounding mine M₁939 has an effective casualty radius of 9-10 meters.
A report from the French HQ on 28th May 1940 about the production facilities and several equipments indicates among other things that the production of the bounding mines goes on but at reduced rate (500 mines/day) at this date. On 28th May, there are 10,000 stockpiled mines available for the Armies. This kind of mine was already produced and used in 1939. This note gives neither the total number of produced AP bounding mine nor the available number in the units but only the number of AP mines which are in reserve/in stock.

The earliest forerunner to the modern bounding antipersonnel mine appears in Baron Minno van Coehorn’s “Nouvelle Fortification,” dated 1706, which includes an illustration of a “boîte à grenade” (an early form of a command detonated shell fougasse). This type was discussed in a US military engineering manual dated 1859 by General Halleck. In fact, Colonel Marzocchi, an Italian military engineer, first proposed a design similar to the modern bounding antipersonnel mine in May 1891. His design called for a coupled (pressure-activated Jacobi) fuze linked by detonating cord to a device that launched a 22cm shell (filled with 100 to 150 grams of black powder) to a height of about four meters where it detonated. However, there is no indication that anyone ever fabricated this device. In the accounts of the siege of Port Arthur in 1904, there was a reference to a bounding anti-personnel mine. “These “shrapnel” mines had a small charge which propelled a “shell” ten to twenty feet into the air. Upon reaching the end of a tethering wire, the mines exploded as an air burst.”

On the Eastern Front during the WW1, “Bounding mines, either automatic or wire-controlled, appeared in the Russian Army in 1916. The bottom part of the metal housing of the mine contained a powder ejection charge with an electric primer, and the upper part was a shrapnel (fragmentation) shell armed with a large number of fragmentation elements. A so-called friction fuse was inserted in the shell. The mine was placed in the ground, and the fuse of the shell was connected by a chain to its case. When the powder was ignited, the shell projected upward, and the chain pulled out the fuse scratcher. The shell detonated above the ground, scattering fragments over a large area.” Just before the beginning of WW1, Niels Waltersen Aasen of Copenhagen patented a bounding mine as did American John Steel in 1917. However, modern manufactured examples this type would not make their combat debut until the early days of WWII. The introduction of the German S-Mine was supposed to take place at the beginning of 1936. However, the first 1000 S-Mine 35s were not distributed until August 1938. In the following months their production experienced significant fluctuations (December 1938: 70,660 pieces, January 1939: 26,465 pieces). The total quantity of S-Mines delivered through February 1939 was 388,070 (according to plant letter No. 715/39 K (arms statistics)). The 171st Pioneer Battalion reported using S-mines during the Polish campaign. Nevertheless, the western powers only began to learn of this development when French patrols of the German West Wall (Siegfried Line) began to take unexplained casualties. These casualties were attributed to a new “secret weapon,” the famous German “S” mine. This mine was introduced in 1935, with an inventory of 706,000 by the beginning of WW2. Indeed, the S-Mine 35 with a lethal radius of 25 meters was reported to have played a critical role in defeating the French attack into the Saarland in 1939. This attack had failed because of the inability of the French Army to advance through extensive, densely laid antipersonnel minefields which contained thousands of S-mine 35s, many of which had been emplaced by the 252nd Pioneer Battalion of the 252nd Infantry Division.

The French soldiers were stunned by this new device and promptly dubbed it “the Silent Soldier.” The S-mine 35 apparently made quite an impression on the French and British who rapidly developed their own versions, the M*1939 and the Shrapnel Mine No. 2 respectively. This type is still widely used and is more commonly referred to as a “Bouncing Betty.” During WW2, French material was used to produce 4 models of anti-personnel mines for the German army. These mines were the pot mine A 200, the pot mine S 150, the anti-personnel mine W-1 and the grenade mine E-5.

The US Army began their belated development of modern antipersonnel mines like the “Bouncing Betty” only as a direct result of the dismal failure of the French offensive into Germany’s Saar region (mentioned above). US antipersonnel mine development finally began in the summer of 1940; almost a year after WW2 had begun in Europe. At this point, Major Pierre Delalande (a former member of the French Corps of Engineers who had escaped from France following the German conquests in 1940) had reached the US with the designs for the French M*1939 bounding antipersonnel mine (which was based on the German S-mine). This eventually led to the fielding of the US M2 series of antipersonnel mines beginning in April 1942, which used a 60mm mortar shell. The US M2A4 anti-personnel mine (standard issue for the US Army during the early 50’s) is almost an exact twin of the French M*1939. However, the M2 proved deficient in combat, consequently, the US developed also their M16 directly fire the German S-mine after the war. The French also appear to have later based their new M*1951/55 AP bounding mine on the German S-mine.

● **Improvised anti-personnel mine with F1 grenades**

F1 defensive grenades (fragmentation) were used in barbed wire networks of defensive positions (or in bushes) as traps. The pull fuze M*1939 used on the AP bounding mine can also be used with improvised grenade and shell mines, or with standard demolition charges.

● **Nonstandard anti-personnel shell mine**

Although the French anti-personnel shell mine is non-standard, it is not a field-improvised mine. It consists of a wooden case which contains a main charge of 2 HE shells and a booster charge of 4 sticks of gelinite. A sheet-metal pressure cover fits over the case and is held on by 2 lid-retaining wires which are fastened to pegs on the side the case. A built-in pressure fuze is centrally located. This mine was employed as an AP mine in hasty mine fields and road blocks. It was also used in AT mine fields to hinder the passage of reconnaissance and breaching parties.
3) French SFR-441 mine detector

The SFR-441 mine detector was produced before WW2 and is of regenerative type in which a continual audible signal increases in pitch as the detector approaches a metallic body. This mine detector consists of three main parts: search coil and handle, amplifier and oscillator and headset. This mine detector is not highly sensitive to small bodies of metal. It will detect German Tellerminen buried to depths of about 40 cm and S-mine buried to depths of about 20 cm. Smaller bodies of metal cannot be detected.

FLAMETHROWERS

The French used flamethrowers extensively during WW1 and there are mentions of flamethrowers being held in the engineer park of one or two of the armies in 1940. Otherwise there is no specific information about their use in or characteristics in 1939/1940. New infantry flamethrower models had been designed during the inter-war period and several models had been developed and were available for the use on tanks (Renault D2 and Renault R35 were intended to be transformed) but I could not find technical data about them. It is also possible that the French saw the flamethrower as a very specialised weapon, only of use in prepared attacks on fortified or heavily entrenched positions. As they had not the slightest intention of doing anything like that before 1941, the French Army might have seen no call to encumber combat formations with them.

MORTARS

Mortier de 50mm Mlé1937 (Brandt)

The 50mm Mlé1937 mortar was issued in 1939 to replace the French rifle grenade (VB launcher) in use at the platoon level. Few saw action in the infantry in 1940. They were only really issued to the Vichy army. This mortar The Germans used this exceedingly light weapon as the 5cm Granatenwerfer 203(f).

Type: Light mortar
Caliber: 50 mm
Barrel length: 415 mm
Weight in action: 3.65 kg
Elevation: 45° (fixed)
 Traverse: 8°
Rate of fire: 20-25 rpm
Ammunitions:

HE shell
Shell weight: 0.435 kg
Maximum range: 695 m
V°: 70 m/s
**Mortier de 60mm Mlé 1935 (Brandt)**
The 60mm Mlé 1935 was one of the many products of the Edgar Brandt design bureau and it entered in French service in 1937. It became in the USA the 60mm M1 mortar (and from that the M2 and M19). The French had 4940 60mm Mlé 1935 mortars in service in 1940. Usually there were 96 shells immediately at disposal in the mortar trailer (the crew could carry 42 shells), 54 more in the accompanying trailer/truck at the company level and 50 more shells at the regimental level for a total of 200 HE shells per mortar in a French 1940 infantry regiment. The Chinese copied it as the Type 31 with a slightly shorter barrel. The Germans used it under the name 6cm Granatenwerfer 225(f).

- **Type**: Light mortar
- **Crew**: 1 NCO + 4 men (+ 1 driver)
- **Caliber**: 60 mm
- **Barrel length**: 725 mm
- **Weight in action**: 19.7 kg
- **Elevation**: 45° - 83°
- **Traverse**: depending from the elevation (11° at 45° elevation, 13.5° at 60° elevation and 20.5° at 75° elevation)
- **Rate of fire**: 20-25 rpm

**Ammunitions**:
- **FA Mlé 1935 HE/fragmentation (with V8-I or 21/28B Mlé 1935 fuze)**
  - **Shell weight**: 1.33 kg (160 g explosive)
  - **Maximum range**: 1000 m (the army manual mention the use up to 1000m but some sources indicate 1700 m.
  - **The minimum range is 100 m)**
  - **V°**: 158 m/s
  - Unlike most of the mortar shells during WW2, which were the simplest possible iron castings, this shell has internal fragmentation grooves in the core to increase the fragmentation and the AP efficiency.

**Mortier de 81mm Mlé 1927/1931 (Brandt)**
The 81mm mortar produced by the French Brandt firm became a 'classic' design of its era and was copied or licence-built by almost every army in Europe and elsewhere (Austria, Czechoslovakia, Denmark, Finland, Romania –built under license by Voina -, Germany - 8.14cm GrW 278(f) and 278/1(f) -, Italy - 81/14 modello 35 -, Japan - 81mm Type 3 -, Yugoslavia - 8.1cm MWM 31/38 Kragjewac -, Netherlands (built by HIH-Siderius in Rotterdam), Poland - wz.31 -, USA - 81mm mortar M1 -, USSR - 82mm model 1936 -). It remains to this day the epitome of conventional mortar design. In 1940, the French had over 8000 in service in two main versions (L/15.6 and L/13.7). Usually there were 48 HE shells immediately at disposal in the mortar trailer, 68 HE + 12 smoke shells in the accompanying ammunition trailer and 12 HE + 10 smoke at the company level and each regiment had also 30 'GC' shell (GC = grande capacité = higher explosive content). Therefore each 81mm mortar in a French 1940 infantry regiment had a total of 134 HE, 3-4 'GC' HE, 36 smoke shells and a number of illuminating shells.

- **Type**: Medium mortar
- **Crew**: 1 NCO + 5 men (+ 1 driver)
- **Caliber**: 81.4 mm
- **Barrel length**: 1267.5mm
- **Weight in action**: 58.5kg (18.5kg barrel, 18kg bipod, 1.5kg sight, 20.5kg base plate)
- **Elevation**: 45° - 85°
- **Traverse**: depending from the elevation (8° - 12°)
- **Rate of fire**: 20 rpm (up to 30 rpm in intense fire with a trained crew)

**Ammunitions**:
- **FA Mlé 1924/27 HE shell**
  - **Shell weight**: 3.310 kg (400g explosive)
  - **Maximum range**: 2850m
  - **V°**: 174 m/s

- **FA Mlé 1932 HE shell**
  - **Shell weight**: 3.345 kg (530g explosive)
  - **Maximum range**: 2850m
  - **V°**: 174 m/s

- **FA Mlé 1935 'GC' (GC = grande capacité = high capacity) heavy HE shell**
  - **Shell weight**: 6.845 kg (2.400kg explosive)
  - **Maximum range**: 1200 m
  - **V°**: 158 m/s

- **FA Mlé 1924/27 or Mlé 1932 smoke shell**
  - **Shell weight**: 3.310-3.345 kg (225g smoke component)
  - **Maximum range**: 2850m
  - **V°**: 174 m/s
FA M*l924/27 or M*l932 illuminating shell
Shell weight : 0.850-1.000 kg (with or without parachute)

<table>
<thead>
<tr>
<th>Accuracy of the 81mm M*l927/31 mortar :</th>
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<tbody>
<tr>
<td>• 8m x 17m square at 460m range</td>
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<tr>
<td>• 9m x 32m square at 995m range</td>
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<tr>
<td>• 17m x 35m square at 1730m range</td>
</tr>
<tr>
<td>• 32m x 42m square at 2060m range</td>
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Mortier de 120mm M*l1935 (Brandt)
The French Army had adopted this heavy mortar and a squad of 2 mortars should have been issued in each regiment in 1940 but very few had been delivered before the armistice and the weapon was not really issued.

Type : Heavy mortar
Crew : 1 NCO + 6 men (+ 1 driver)
Caliber : 120mm
ROF : 10-12 rpm
Ammunitions :
HE shell (a heavy HE shell 'GC' was also available)
Shell weight : 16.4 kg
Maximum range : 7000 m

Heavier mortars or mortars used by artillery units (75mm, 150mm, 220mm, 240mm, 280mm) are detailed in the artillery section.

INFANTRY GUNS

Canon de 37mm L/21 M*l1916 TR
This infantry gun was first used during WW1, TR means "Tir Rapide" or "rapid fire". The USA adopted it and it was designated 37mm M1916. However, by 1941 most of them had been put into storage but it was used against the Japanese. The Japanese Type 11 gun was based on this French design. For transport this weapon could be broken down into 3 sections. In addition, wheels could be attached for towing. These guns were sometimes equipped with an armored shield. In German service it was known as the 3.7cm IG 152(f).

1036 of these guns are still in service in 1940 in the French army (mostly in second line infantry divisions) to fulfill the infantry gun and AT gun tasks since there are not enough of the new 25mm AT guns in service in the infantry units. It was very accurate (in "Précis de tir & armement de l'infanterie" - March 1939 - the gun is said to be very accurate, with a very small dispersion) and had a high rate of fire. Each 37mm infantry gun had 120 M*l1916 HE and 80 AP shells available in a French 1940 infantry regiment.

Caliber : 37mm
Crew : 1 NCO + 6 men
Length : 3.50m
Width : 1.05m
Barrel length : 790 mm
Weight in action : 108 kg
Weight in travel : 160 kg (with the wheels)
Protection : the shield is 6.5mm thick
Rate of fire : 15-30 rpm
Traverse : 35°
Elevation : -8° to +17°
Telescopic sight : 2x (L.698 sight, field of view 7.88°, + reticle, adjustable drum up to 1800m)
Muzzle velocity : 367-600 m/s (HE and AP shell)
Max Range : 2400m
Practical range : 400m against light armored vehicles and 1500m against soft targets
Penetration : 18mm /35° at 400m

ANTITANK GUNS

In a classical French infantry division there are theoretically 52-56 25mm AT guns and 8 47mm AT guns for a total of 60-64 AT guns :

- 12x 25mm SA34/SA37 AT guns in each of the 3 infantry regiments :
  - 2 in each of the 3 infantry battalions
  - 6 in the regimental heavy company
- 12x 25mm SA34/SA37 AT guns in the divisional AT company (CDAC)
- 2x 25mm SA34/SA37 AT guns in the divisional training centre (CID)
• 3-6x 25mm SA34/SA37 AT guns in the reconnaissance battalion (GRDI)
• 8x 47mm M°1937 or 75mm M°1897/33 AT guns in the BDAC (AT divisional battery)

Many divisions had no CDAC or CID and many had not the theoretical numbers of AT guns, some had only a
dozen. Several divisions had also no 25mm AT guns but used instead the 37mm TR16 infantry gun in AT role.

**Canon de 25mm SA M°1934 (Hotchkiss) and SA-L M°1937 (Puteaux) L/72**

Caliber : 25x194R mm  
Crew : 1 NCO + 5 men (commander, gunner, assistant gunner, 3 ammunition bearers) + 1 driver  
Weight : 480kg (SA34 carriage) or 300kg (SA37 carriage, L = light)  
Length : 3.71m  
Width : 1.05m  
Height : 1.10m (at the shield)  
Protection : the shield is 7mm thick  
Barrel length : 1.80m  
Rate of fire : 25 rpm against fixed target and 15 rpm against moving target  
 Traverse : 60°  
Elevation : -5° to +15°  
Telescopic sight : 4x (L.711 telescopic sight, with a 3450m range drum, field of view 10.13°, V reticle)  
V° : 920 m/s  
Practical range : 800m (heavy armored vehicles), 1000m (medium armored vehicles) and 1500m (light armoured vehicles and softskins)  
Penetration : 40mm/0° at 500m; 32mm/35° at 200m  
Accuracy : at 800m HxL = 80cm x 80cm

The French 25mm AT guns were very modern in 1934. About 4500 of these guns were in service in May 1940. They were especially known as being very discreet, the flash hider used on them made them difficult to spot according to both French and German AARs. They proved to be very accurate guns, and able to destroy all the German tanks up to 800m if the impact angle was good enough. Only the PzIV Ausf.D at long range was tricky to be engaged by the 25mm AT gun in May/June 1940 if not at close range. In the first 500m the penetration efficiency was at least equal to the penetration of the 3.7cm L/45 PaK and at longer range the KE felt slightly more rapidly due to the lightweight projectile. The Germans captured such guns in large numbers in 1940 and used them in secondary roles as coastal defence and in some garrisons. Finland used also about 240 of these AT guns. There were theoretically 12 of these AT guns in each French infantry regiment in 1940 but several regiments had only 4 or no AT gun at all. For example the 55° DI, a reserve division at Sedan, had no AT guns in its infantry regiments, 12 AT guns in divisional AT company, a total of 12 AT guns for the whole division (20-25% of the number of the paper). For the 71° DI the situation was even worse with only 8 AT guns in the same conditions. These units were also deployed on an overstretched front of 20-30 km whereas a division should defend a 5-7 km wide front. The 37mm TR infantry gun was often still in service even in AT role. The 25mm AT gun was lacking HE shells to neutralize human/soft targets and therefore the 37mm TR infantry gun was still liked since it could fire HE shells. About 220 25mm AT guns were also given to the British Expeditionary Force (BEF) to increase its firepower, in exchange the British gave the French some Boys AT rifles which were not efficient and had a weaker penetrating power than the Hotchkiss 13.2mm HMG. The two ‘infanterie de l’air’ (airborne infantry) companies and several reconnaissance groups used some of these AT rifles. Each 25mm AT gun crew had 72 AP/APT shells immediately available and a total of 156 AP/APT shells per AT gun in a French 1940 infantry regiment. In typical infantry or cavalry units the 25mm AT guns were generally towed behind a M°1937 infantry or cavalry trailer with horses. On the front the Renault UE tractor generally towed them. In motorized infantry regiments the towing vehicle was also often the Renault UE tractor and for long-range movements various halftracks and trucks were used. The AT guns could also be directly transported on a truck or towed on additional "wheels" (train rouleur FAR). In the divisional AT company/squadron of motorized units the official towing vehicle could be the Laffly V15T in cavalry units or the Latil M7 T1 in infantry units. The Unic TU1 was also used for that task. One single 25mm AT gun from 18° GRCA destroyed quickly 7 German tanks of the 1.PzD in Gravelines on 24th May. During the battle of Gembloux, the 25mm SA34 AT gun commanded by Louis Brindejonc (2° RTM) destroyed 7 German tanks. In front of Stonne a Panzer IV from 10.PzD was knocked out by the 25mm AT gun of sergent Durand (67° RI), there are many photos of the same Panzer 35(t) destroyed in Lille by a 25mm AT gun from 46° GRDI (the hole in the front hull armor can clearly be seen) etc. There are many such examples of German tanks being knocked out by the French 25mm AT guns. **According to colonel Kühne (3.Panzerbrigade, 3.PzD)**: "the accuracy of the French 25mm AT gun is very good. The front hull armor of the Panzer III has been easily penetrated by the excellent French 25mm AT gun. Trials with booty guns proved that the French 25mm AT gun is superior to the German 3.7cm PaK. This 25mm AT gun is very hard to spot because the flash is invisible (flash hider)."

**Canon de 47mm L/53 M°1937 (SA37)**

Caliber : 47x380R mm  
Crew : 1 NCO + 5 men  
Weight : 1070kg  
Length : 4.10m
This AT gun was the best AT gun on the battlefield in 1940, after the 8.8cm Flak18 used in AT role and perhaps the best one before the arrival of the 5.0cm Pak38. It exceeded widely the German 3.7cm Pak in terms of penetration and was also superior to the Czech made 4.7cm AT gun. The French army had about 1200 of them in service in May 1940, they were depending from the artillery regiments and not all came into service. Initially a BDAC should have included 12 47mm AT guns but due to the lack of guns this number was reduced to 8. The Laffly S15T or Laffly W15T (and sometimes Citroën-Kégresse P17 and Unic P107) generally towed the 47mm Mle1937 AT gun if the battery was not horse drawn. An example of report concerning the 47mm Mle1937 AT gun : the French 36th infantry division on the Aisne river on 9-10th June 1940 faced the 10.ID, 26.ID, the SS-Polizei and elements of the 6.PzD. First they stopped all the German assaults in part thanks to their good supporting artillery and took about 800 German POWs, then they had to pull back because of the collapse of the 2nd infantry division facing 2 Panzerdivisionen more west. During the retreat, one 47mm SA37 gun (battery of sous-lieutenant Nayme) destroyed successively 3 moving German tanks at 1500m.

About 823 4.7cm Pak181/182(f) (captured on the front or in factories / repaired / newly built) were used after the campaign of France by the Germans. The Germans produced also a dedicated 4.7cm APCR shell for this gun. But already in May/June 1940 some of the captured guns were immediately used against French tanks, especially the dreaded Renault B1bis. The German reports indicate that 1226 shells were fired with these booty guns during the battle of France. General Heinz Guderian himself in his memories ("Achtung Panzer!") indicates that he led the fire of a captured French 47mm AT gun against a Renault B1bis.

ORGANIZATION OF A MOTORIZED BDAC (Batterie Divisionnaire Anti-Char = AT divisional battery)

Command platoon
- 1x commander (captain), 1 NCO, 2 brigadiers, 6 gunners, 7 drivers = 17 men
- 1x liaison vehicle
- 1 all terrain liaison vehicle
- 1x truck
- 4x motorcycles

Guns sections (4 sections)
- 4 officer (lieutenants), 12 NCOs, 12 brigadiers, 8 master gunners, 60 gunners, 32 drivers = 128 men
- 8x 47mm Mle1937 AT guns and 8x FM Mle1924/29 LMGs
- 6x truck (4 trucks transporting the signal equipment [8 telephone sets, 4 four-way switchboards, 8 km of cable and 4 radio sets], the observation equipment and the 8 LMGs)
- 8x all-terrain light tractors towing the guns (and carrying 40 shells)
- 2x all-terrain light tractors transporting ammunition + 2 ammunition trailers
- 4x all terrain liaison vehicle
- 4x motorcycles (for the messengers)
- 4x lorries (2 lorries transporting 350 AT mines each = 700 AT mines)

General services
- 5 NCOs, 2 brigadiers, 15 gunners, 6 drivers = 28 men
- 2x all-terrain heavy recovery tractors
- 1 truck
- 3 lorries
- 1 trailer (field kitchen)

The armament is composed of 8 AT guns (each with 200 shells), 8 LMGs, 700 AT mines and small arms (carbines, pistols etc.).
ORGANIZATION OF A HORSE-DRAWN BDAC (Batterie Divisionaire Anti-Char = AT divisional battery)

Command platoon
- 1x commander (captain), 1 NCO, 2 brigadiers, 6 gunners, 1 horse driver, 9 driver = 20 men
- 4x horses
- 2x liaison vehicles
- 1x truck
- 2x all terrain tractors (used for emergency purposes to tow the guns)
- 4x motorcycles

Guns sections (4 sections)
- 4 officer (lieutenants), 12 NCOs, 12 brigadiers, 8 master gunners, 60 gunners, 52 horse drivers, 4 drivers = 152 men (16 observers / LMG gunners)
- 120x horses
- 8x 47mm Mle 1937 AT guns and 8 caissons, 8x FM Mle1924/29 LMGs
- 2x truck and 2x lorries (transporting ammunition, the signal equipment [8 telephone sets, 4 four-way switchboards, 8 km of cable and 4 radio sets], the observation equipment and the 8 LMGs

General services
- 5 NCOs, 3 brigadiers, 9 gunners, 16 horse drivers = 33 men
- 24x horses
- 4x wagons (including one field kitchen)
- 1x bicycle (transported on a truck during movements)

The armament is composed of 8 AT guns (24 shells in the limber, 72 shells in the caisson and each section has a truck with 80 shells per gun = 176 shells per gun), 8 LMGs and small arms (carbines, pistols etc.).

Canon de 47mm L/53 TAZ Mle1939 (SA39)
The 47mm Mle1939 TAZ (TAZ = triflèche tous azimuts) had a new 3-trails carriage for a 360° traverse (instead of 68° for the Mle1937), pneumatics to be towed at 60 km/h (instead of 25 km/h for the Mle1937 in a motorized battery or 8 km/h for a horse-drawn battery, which had wheels with rubber tyre) and a flash hider to make the gun more discreet. This gun should have replaced the 47mm Mle1937 for September 1939. A few 47mm Mle1939 guns were probably used during June 1940.

Canon de 75mm L/36.3 Mle1897/33
Caliber : 75x350R mm
Length : 4.98m
Barrel length : 2721 mm (2229 mm rifling)
Width : 1.51m
Weight in action : 1500 kg
Weight in travel : 1550 kg
Elevation : -6° to +50°
Traverse : 58°
Practical AT range : 800m (maximum range 11100m)
Rate of fire : up to 28 rpm (10-12 rpm in sustained fire)
Crew : 1 NCO + 6 men
Penetration : 50mm /30° at 400m with obus de rupture Mle1910M (APHE) (V° = 580 m/s)

The 75mm Mle1897/33 had a new split-trail carriage and entered in service around 1935. It was present in the BDAC (= Batterie Divisionaire anti-char = AT divisional battery) for the protection of the light artillery regiment. Initially there should have been 12 guns in the BDAC but only batteries with 8 guns were constituted. All the 75mm Mle1897/33 guns were intended to be replaced by the better 47mm Mle1937 gun but not enough were available and in May / June 1940 several BDAC were still equipped with 75mm Mle1897/33 AT guns. The BDAC could also be mixed with 2 75mm Mle1897/33 and 6 47mm Mle1937 AT guns. Standard 75mm Mle1897 field guns were also used in AT tank role, either when integrated in defensive positions or simply to defend the artillery battery being overrun. Large numbers were sold from Army stocks to Brazil but enough remained for the Germans to take over in 1940. From 1935 on these guns had DS Michelin low-pressure tyres. The standard 75mm Mle1897 guns were also used in AT role, sometimes on Arbel Mle1935 platforms to have a 360° traverse.

Canon de 75mm L/53 TAZ Mle1939 (Schneider) (TAZ = triflèche tous azimuts)
Caliber : 75x518R mm
Barrel length : 4000 mm (3250 mm rifling)
Battle-station weight : 2090 kg
Rate of fire : 20 rpm
Muzzle velocity : 700 m/s
Traverse : 360°
Elevation : 40°
Maximum range : 13000 m (3000m in AA role)
Penetration : 80mm at 1000m

The 75mm Mle1939 had a 3-trails carriage for a 360° traverse and should have replaced all the 75mm AT guns (75mm Mle1897 and Mle1897/33 used in AT role, 75x350R mm) (and part of the 47mm Mle1937 AT guns probably) at the divisional level but it did not enter in service before the armistice. This gun could have used the Brandt sub-calibrated 75/57mm shells and Brandt HEAT projectiles which are tested in 1940 to even increase a lot the AT capacity.

**MOUNTAIN ARTILLERY**

**Canon de 65M Mle1906**
Caliber : 65x167R mm
Barrel length : 1313 mm (1032 mm rifling)
Weight in action : 400kg
Elevation : -10° to +35°
Traverse : 6°
Rate of fire : 18 rpm
Max Range : 6500 m (4.5kg schrapnel / cannister shell and 3.8kg HE shell)
V° : 330 m/s
100 of these guns were in service in the French alpine troops. Also used by Greece and Poland. In German service it was known as the 6.5cm GebK 221(f) and issued to mountain troops.

**Canon de 75M Mle1928 Schneider**
Caliber : 75x190R mm
Barrel length : 1480 mm (1060 mm rifling)
Weight in action : 660kg
Elevation : -11° to +40°
Traverse : 10°
Rate of fire : up to 28 rpm
Max Range : 9000 m
Crew : 1 NCO + 6 men
156 of these guns were in service in the French alpine troops. Also used by Greeks, Poles and in German hands it became the 7.5cm GebK 237(f).

**Canon de 105M Mle1928 Schneider**
Barrel length : 1260 mm (988 mm rifling)
Weight in action : 745kg
Elevation : 0° to +40°
Traverse : 10°
Rate of fire : 8 rpm
Max Range : 8000 m
Crew : 1 NCO + 6 men
24 of these guns were in service in the French alpine troops.

**AA ARTILLERY**

**AA Machineguns**
Many FM 24/29 LMGs, Saint-Etienne Mle1907, Hotchkiss Mle1914 and MAC Mle1931 were used as AAMGs in single and twin mounts on the battlefield. They were often the single AA protection for motorized columns. The 25mm SPAA guns were not very common.

**Bitube de 13.2mm Mle1930 (13.2mm twin AA gun)**
Caliber : 13.2x99 mm
Barrel length : 1670 mm (1000 mm rifling)
Battle-station weight : 375 kg
Rate of fire : 900 rpm (450 rpm for the single mount)
Muzzle velocity : 800 m/s
Magazine : 2x 30 rounds magazines
Traverse : 360°
Elevation: 0°, +90°
Practical range : 2500m against ground targets, 1500m - 3500m against aircrafts at 400 km/h - 300 km/h
Penetration : 20mm /0° at 500m, 15mm /0° at 1000m, 12mm /0° at 2000m
Could also be found also on quadruple mounts (navy)
Crew of 1 NCO and 8 men.
The aiming device (correcteur L.P.R. Le Prieur-Ricordel 1933) consists in a 12x magnification range finder and a 1x magnification sight with big a field of view.

**Canon de 20mm HS404 (Hispano Suiza)**
Caliber : 20x110 mm
Battle-station weight : 280 kg
Rate of fire : 600 rpm
Muzzle velocity : 850-880 m/s
Magazine : 60 rounds magazine
Traverse : 360°
Elevation: -10°, +75°
Practical range : 1200 m in AA fire (maximum range about 5500 m)
This AA gun is most commonly found in the French aircrafts (MS.406, D.520, MB.152) but also used on wheeled ground mounts for the defence of the airfields.

**Canon de 20mm Mlé 1939 Oerlikon**
Caliber : 20x100RB mm
Barrel length : 140 cm
Battle-station weight : 300 kg
Rate of fire : 460 rpm
Muzzle velocity : 840 m/s
Magazine : 20 rounds magazine
Traverse : 360°
Elevation: -10°, +75°
Practical range : 1200 m (maximum range about 5500 m)
In theory, each infantry regiment was to have 12x 20mm CA Mlé 39 (Oerlikon), in 3 platoons of 4 guns. In a normal infantry support companies, one AA platoon with four 20mm CA Mlé 39 (Oerlikon) AA guns was part of each of the 3 battalion support companies, as one of its 4x MG platoons, normally armed with 8mm Hotchkiss M1914 MGs, but specialized in AA protection was armed with the 20mm AA guns. In a motorized infantry regiment, all three 20mm AA platoons were INSTEAD assigned to the regimental MG and weapons company.
But even this moderate level of weapons allocation was far from achieved by May 1940. Ferrard reports a total delivery of only 237x 20mm CA Mlé 39 by 10th May 1940.
The numbers of 20mm Mlé 1939 guns assigned to the infantry divisions in France on 1st April 1940 were:

- 1ᵉ, 9ᵉ, 12ᵉ, 15ᵉ and 25ᵉ DIM : 12 AA guns each
- 3ᵉ DIM : 11 AA guns each
- 5ᵉ DIM : 13 AA guns
- 10ᵉ, 11ᵉ, 13ᵉ, 14ᵉ, 19ᵉ, 21ᵉ, 42ᵉ and 43ᵉ DI : 12 AA guns each
- 23ᵉ and 36ᵉ DI : 3 AA guns each
- 1ᵉ DINA : 3 AA guns
- 2ᵉ and 3ᵉ DINA : 2 AA guns each
- 4ᵉ DINA : 4 AA guns
- 5ᵉ and 6ᵉ DINA : 1 AA gun each
- 1ᵉ and 3ᵉ DIC : 3 AA guns each
- 4ᵉ DIC : 2 AA guns
- 1ᵉ DM : 6 AA guns
- 82ᵉ DIA : 2 AA guns
- 87ᵉ DIA : 6 AA guns
- 7 unidentified divisions with only a partial allocation, equipments in schools/training units etc. (apparently 9 in Corsica)

The 237 guns in Ferrard were apparently for Metropolitan France only. In his book (Servir, I, p. 176), Gamelin states that a total of 357x 20mm Mlé 1939 AA guns existed on 1st May 1940. This is 120 more than the 237 of Ferrard, and they can be accounted for by including 20mm guns outside France with perhaps about 100 guns in North Africa.

In French North Africa the figures for 6th October 1939 were :
- 81ᵉ, 83ᵉ, 84ᵉ, 85ᵉ and 88ᵉ DIA : 12 AA guns each
- (82ᵉ DIA : 3 AA guns)
3° DM : was waiting for 3 AA guns
Rabat guarding Sultan's palace : 4 AA guns
3° and 4° BCA : 4 AA guns each
1° REC : 2 AA guns
Bataillon d'Infanterie Légère : 2 AA guns
8 were in the compagnies and batteries Saharienne Portées
12 were in the Postes deTerritoire du Sud
3 were on the Mareth Line
2 were in the Goum Motorisé de Tunisie
But some more were sent to France from North Africa before 1st May 1940. The 82° DIA is a division already largely transported to France by 6th October 1939.
With perhaps about 16 AA guns in Indochina and 4 AA guns in the Levant we can easily find about 120 guns outside France.

### Canon de 25mm Mle1938 Hotchkiss - 2.5 cm Flak Hotchkiss 38 (f)
Caliber : 25x163 mm
Barrel length : 3000 mm (1500 mm rifling)
Battle-station weight : 900 kg
Weight traveling : 1100 kg
Rate of fire : 250 rpm
Muzzle velocity : 900 m/s (HE and HET) and 875 m/s (AP)
Magazine : 15 rounds magazine
Traverse : 360°
Elevation: -7°, +90°
Maximum range : 7500 m, vertical effective range 2500 m
Ammunition types : HE (250g projectile), AP (300g projectile), Phosphorous (rare)
Penetration : 35mm/0° at 500m
Crew of 1 NCO and 8 men.

During the 1930s Hotchkiss developed a 25mm AA gun that was adopted by France, Japan (25mm type 96 and mainly in the navy), Russia and Romania. 574 in service in the French Army in May 1940 (+147 Mle1940 mainly in the French air force for the protection of the airfields, fixed mounts). In single and/or twin barrel versions. This weapon was intended to have a dual purpose role and AP rounds for anti-tank use were issued (penetration of about 35mm at 500m). Captured guns were used by the Germans as 2.5cm FlaK Hotchkiss 38 and 39. The shell is 25x163mm it is not the same that the shell used in the 25 mm AT guns, which is 25x194R and used for 2.5 cm L/72 Puteaux PaK 112 (f) and Hotchkiss PaK 113 (f). Very stable and accurate, the 25mm Hotchkiss AA guns remained in service until the beginning of the 50's in France.

### Canon de 25mm Mle1939 Hotchkiss - 2.5 cm Flak Hotchkiss 39 (f)
Caliber : 25x163 mm
Barrel length : 3000 mm (1500 mm rifling)
Battle-station weight : 850 kg
Weight traveling : 1150 kg
Rate of fire : 250-300 rpm
Muzzle velocity : 900 m/s (HE and HET) and 875 m/s (AP)
Magazine : 15 rounds magazine
Traverse : 360°
Elevation: -3°, +110°
Maximum range : 7500 m, vertical effective range 2500 m
Ammunition types : HE (250g projectile), AP (300g projectile), Phosphorous (rare)
Penetration : 35mm/0° at 500m
Crew of 1 NCO and 8 men.

### Canon de 25mm Mle1940 Hotchkiss (fixed mounts on airfields)
Caliber : 25x163 mm
Barrel length : 2220 mm (1500 mm rifling)
Battle-station weight : 699 kg
Rate of fire : 350-400 rpm
Muzzle velocity : 900 m/s (HE and HET) and 875 m/s (AP)
Magazine : 15 rounds magazine
Traverse : 360°
Elevation: -5°, +90°
Maximum range : 7500 m, vertical effective range 2500 m
Ammunition types : HE (250g projectile), AP (300g projectile), Phosphorous (rare)
Penetration : 35mm/0° at 500m
Canon de 25mm Mle 1940J Hotchkiss (25mm twin AA gun)
Caliber : 25x163 mm
Barrel length : 2 barrels of 2200 mm (1500 mm rifling)
Battle-station weight : 1400 kg
Weight traveling : 1800 kg
Rate of fire : 560-600 rpm
Muzzle velocity : 900 m/s (HE and HET) and 875 m/s (AP)
Magazine : 2x 15 rounds magazines
Traverse : 360°
Elevation: -5°, +100°
Maximum range : 7500 m, vertical effective range 2500 m
Ammunition types : HE (250g projectile), AP (300g projectile), Phosphorus (rare)
Penetration : 35mm/0° at 500m

Canon de 37mm L/50 Mle 1925 (single) and Mle 1933 (twin) (Hotchkiss)
Caliber : 37x278R mm
Rate of fire : 30-42 rpm per gun (only semi-automatic and manually loaded, therefore inadequate)
Muzzle velocity : 850 m/s (HE projectile of 725g or HET projectile of 738g, with about 230g explosive)
Traverse : 360°
Only used by the French navy.

Canon de 37mm L/48 Mle 1935 (twin or quadruple) (Hotchkiss)
Caliber : 37x219R mm
Rate of fire : 330 rpm (twin) or 660 rpm (quadruple)
Muzzle velocity : 825 m/s (HE/HET projectile of 831g with 210g explosive)
Magazine : 6 rounds clip
Traverse : 360° (mounting electrically powered for training but not for elevation)
Elevation: +10° to 85°
Range : 8000m
Only used by the French navy.

Canon de 37mm Mle 1930 (twin or single) (Schneider)
Caliber : 37x278R mm or perhaps 37x300R prototype ammunition
Battle-station weight : 1340 kg (single ground mount)
Rate of fire : 175 rpm (350 rpm for the twin version)
Muzzle velocity : 800-850 m/s
Magazine : 8 rounds clip
Traverse : 360°
Elevation: 0° to +80° (single ground mount)
Range : vertical effective range 3000 m
Only 20 delivered on 10th May 1940. These guns were all used by the army and deployed in 5 batteries of 4 guns to defend the area of Paris in May/June 1940.

Canon de 40mm Bofors Mle 1938/1939
Victor Hammar and Emanuel Jansson designed this excellent AA-gun for Bofors factory and T. Wennerstrom designed ammunition for it. Story of this legendary weapon started from request made by Swedish Navy at 1925 for Bofors to develop 20-mm automatic-cannon for shipboard use. At 1928 doubts about sufficiency of 20-mm caliber surfaced (The basic idea was that single hit had to be capable reliably destroying aircraft), so development goal changed as 40-mm automatic gun. Its first prototypes were finished at 1930 and first gun was delivered to Swedish Navy at 1932 (and called M/32). That same year developing country based towed version started, that version named M/34 had two-axle carriage with 4 wheels. The weapon was recoil-action cannon with vertical breech combined to loading done with 4-round clips. As clips could be feed in one after another constant fire low firing-rate could be maintained. The gun could fire both single-shots and semiautomatic fire, in automatic-mode the gun kept firing as long as foot-pedal was hold down and ammunition was fed in. M/32 already had been sold to four navies and M/34 to three armies, but it was slightly improvised version of M/34 called M/36 that really hit the jackpot. Bofors M/36 buying countries of 1930’s included: Argentina, Belgium, China, Denmark, Egypt, Estonia, Finland, France, Greece, Norway, Latvia, Netherlands, Portugal, Sweden, UK, Thailand and Yugoslavia. As production line of Bofors factory clearly was unable to satisfy such demand the company made deals for license production with Belgium, Finland, France, Hungary, Norway, Poland, UK and USA. During WW2 both Germany and Japan used captured 40-mm Bofors AA-guns and Soviet 37-mm AA-gun M/39 was clearly based to Bofors design. Over 100,000 40-mm Bofors AA-guns were manufactured world- wide by end of WW2. During it Bofors M/36 and its versions become the legendary classic weapon from which the company is internationally known. The gun was not only ahead of its time in some areas, but it appeared in right place at the right time – there was a gap between effective range and firepower of 20-mm automatic guns and heavy AA-guns
in 1930’s. 40-mm Bofors was just the weapon needed for filling that gap. The guns (especially M/36 variations) have remained in use at many countries to this day and variations of newer L/70 gun are still produced today.

Caliber : 40x311R mm
Length of weapon : Traveling 625 cm - In firing position 518 cm
Barrel length : 2500 mm (1930 mm rifling)
Battle-station weight : 1920 kg
Rate of fire : 140 rpm
Muzzle velocity : 850 m/s
Magazine : 4 or 8 rounds clip
Traverse : 360°
Elevation : -5°, +90°
Maximum range : Horizontal range 9000 m, Vertical range 5000 m
Sight system : Various sight arrangements
Ammunition types : HE-tracer, AP, AP-tracer (projectile 0.995 kg)

Canon CA 75mm PF M\textsuperscript{le}1915 (fixed on plateform) - 7.5 cm Flak M15(f) -
Calibre : 75x350R mm
Barrel length : 2720 mm (2230 mm rifling)
Battle-station weight : 2219 kg
Rate of fire : 12 rpm
Muzzle velocity : 580 m/s (projectile of 6 kg)
Traverse : 360°
Elevation : 0° to +75°
Maximum range : 6500 m

Autocanon de 75mm M\textsuperscript{le}1913/34 (self-propelled)
Calibre : 75x350R mm
Barrel length : 2720 mm (2230 mm rifling)
Weight : 5880 kg
Rate of fire : 12 rpm
Muzzle velocity : 580 m/s (projectile of 6 kg)
Traverse : 237°
Elevation : 0° to +70°
Maximum range : 6500 m

In 1940 57 AA batteries were using the Autocanon de 75mm M\textsuperscript{le}1913/1934 ... A total of 236 of these SPAAs were used on 10\textsuperscript{th} May 1940. The Germans captured many and still used 45 of them in May 1944. Several of these SPAA guns were even sometimes used in direct AT role. There is an exemple on the Aa canal between Gravelines and Watten : 2 of these 75mm SPAA guns (402e RADCA) were defending the Saint-Folquin bridge on 24\textsuperscript{th} May 1940. They were supporting the 2\textsuperscript{nd} battalion of the 137\textsuperscript{e} RI against an assaillt of the “Grossdeutschland” regiment supported by elements of the 1.PzD. They managed to destroy 3 German AFVs (Sturmgeschütze III from the Sturmgeschütz-Batterie 640, tanks and/or armored cars from the 1.PzD).

Canon CA 75mm M\textsuperscript{le}1917/34 (Schneider) - 7.5 cm Flak M17/34(f) -
Caliber : 75x518R mm
Barrel length : 4000 mm (3250 mm rifling)
Battle-station weight : 4800 kg
Weight traveling : 4940 kg
Rate of fire : 20 rpm
Muzzle velocity : 700 m/s
Traverse : 360°
Elevation : 0° to +70°
Maximum range : 8000 m

Canon CA 75mm M\textsuperscript{le}1930 - 7.5 cm Flak M30(f) -
Calibre : 75x518R mm
Barrel length : 4000 mm (3250 mm rifling)
Battle-station weight : 3800 kg
Weight traveling : 4200 kg
Rate of fire : 20 rpm
Muzzle velocity : 700 m/s
Traverse : 360°
Elevation : -1° to +70°
Maximum range : 8000 m
**Canon CA 75mm Mle 1932** - 7.5 cm Flak M32(f) -  
Caliber : 75x518R mm  
Barrel length : 4050 mm (3250 mm rifling)  
Battle-station weight : 3800 kg  
Weight traveling : 5300 kg  
Rate of fire : 25 rpm  
Muzzle velocity : 700 m/s  
Traverse : 360°  
Elevation : -5° to +70°  
Maximum range : 8000 m  
Also adopted by Belgium under the name "75 mm ABS/FRC modèle 1936"

**Canon CA 75mm Mle 1933** - 7.5 cm Flak M33(f) -  
Caliber : 75x518R mm  
Barrel length : 4000 mm (3250 mm rifling)  
Battle-station weight : 3730 kg  
Weight traveling : 4200 kg  
Rate of fire : 20 rpm  
Muzzle velocity : 700 m/s  
Traverse : 360°  
Elevation : 0° to +75°  
Maximum range : 8000 m

**Canon CA 75mm Mle 1939 (Schneider)**  
Caliber : 75x518R mm  
Barrel length : 4000 mm (3250 mm rifling)  
Battle-station weight : 3250 kg  
Rate of fire : 20 rpm  
Muzzle velocity : 700 m/s  
Traverse : 360°  
Elevation : 0° to +90°  
Maximum range : 8000 m

**Canon CA 90 mm Mle 1939 (Schneider)** – 9.0 cm Flak M39(f) -  
Caliber : 90x673R mm  
Barrel length : 4500 mm (3780 mm rifling)  
Battle-station weight : 5760 kg  
Rate of fire : 15 rpm  
Muzzle velocity : 810 m/s (projectile of 9.5kg)  
Traverse : 360°  
Elevation : -4° to 80°  
Maximum range : 11000 m  
Used on the ground but mainly by the French navy, in single and twin mount. Five mobile batteries were deployed around Paris and had shells enabling them to be used in direct AT fire. Some were used in direct AT fire in North Africa initially against the landing US troops in November 1942.

**Canon de 94 mm Vickers**  
Caliber : 94x672 mm  
Barrel length : 4960 mm (4690 mm rifling)  
Battle-station weight : 8900 kg  
Rate of fire : 10 rpm  
Muzzle velocity : 792 m/s  
Traverse : 360°  
Elevation : -5° to 80°  
Maximum range : 9500 m

**Canon de 105 mm CA Mle 1917 and Mle 1917/34 PF (fixed on plateform)**  
Caliber : 105 mm  
Barrel length : 2980 mm (2350 mm rifling)  
Battle-station weight : 5000 kg  
Rate of fire : 8 rpm  
Muzzle velocity : 555 m/s  
Traverse : 360°  
Elevation : 15° to 84°
Maximum range : 12500 m (6000m vertical)

**Canon de 130 mm Mlé1935**
Caliber : 130 mm  
Barrel length : 5850 mm  
Rate of fire : 14 rpm  
Muzzle velocity : 800 m/s (projectile of 32 kg)  
Maximum range : 12000 m  
Only used on the ships of the French navy, intended to be developed for ground units but it could not be done before the armistice.

**Canon de 152 mm Mlé1930/1936**
Caliber : 152 mm  
Barrel length : 8250 mm  
Rate of fire : 4 rpm (8-12 rpm because 2-3 guns are installed in each turret)  
Muzzle velocity : 870 m/s (projectile of 55 kg)  
Maximum range : 21000 m (vertical range of 7000 m)  
Only used on the ships of the French navy, could fire on ships but it was also intended for AA fire with an elevation up to 60°.

**Number of French AA guns available for the army in 1939/1940 in metropolitan France**  
(According to Stéphane Ferrard)

<table>
<thead>
<tr>
<th>AA gun</th>
<th>Available on 30th April 1940</th>
<th>Mobilized on 10th May 1940</th>
<th>Delivered in May/June 1940</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.2mm x2</td>
<td>270</td>
<td>270</td>
<td>-</td>
</tr>
<tr>
<td>20mm Oerlikon</td>
<td>237</td>
<td>244 (a few former Spanish seized guns)</td>
<td>65</td>
</tr>
<tr>
<td>20mm HS404</td>
<td>150</td>
<td>3</td>
<td>-</td>
</tr>
<tr>
<td>25mm x2</td>
<td>127</td>
<td>327</td>
<td>65</td>
</tr>
<tr>
<td>25mm guns</td>
<td>721</td>
<td></td>
<td>421 (including 12 multiple mounts self-propelled AA guns)</td>
</tr>
<tr>
<td>37mm Schneider</td>
<td>20</td>
<td>20</td>
<td>-</td>
</tr>
<tr>
<td>40mm Bofors</td>
<td>42</td>
<td>28</td>
<td>-</td>
</tr>
<tr>
<td>75mm guns</td>
<td>1695</td>
<td>1607</td>
<td>60</td>
</tr>
<tr>
<td>90mm guns</td>
<td></td>
<td>About 35</td>
<td>20 Mlé1939 guns</td>
</tr>
<tr>
<td>● About 35 Mlé1926/30 guns</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>● 5 Mlé1939 guns</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>→ ground based</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>94mm Vickers</td>
<td>20</td>
<td>20</td>
<td>-</td>
</tr>
<tr>
<td>105mm guns</td>
<td>149</td>
<td>135</td>
<td>-</td>
</tr>
<tr>
<td>TOTAL</td>
<td>3471</td>
<td>2689</td>
<td>631</td>
</tr>
</tbody>
</table>

In 1940, the French army France had 20x 94mm Vickers AA guns beside about 40x Schneider 90mm AA guns (Mlé1926/1930 and 1939) and about 135x 105mm Mlé1915/1934 AA guns. From the 1695x 75mm AA guns listed, 876x are based on the 75mm Mlé1897 gun and fire the 75x350R shell (75mm Mlé1913/34, Mlé1915/34 and Mlé1915). The other 819x 75mm AA guns are based on the 75mm Mlé1928 Schneider gun and fire the 75x837R shell (75mm Mlé1917/34, Mlé1930, Mlé1932, Mlé1933 and Mlé1928/39). That makes a total of 1890 potentially available heavy AA guns. In comparison at the same time, the Germans had more than 2500 8.8cm and 10.5cm AA guns.

The French army had only about 270 light AA guns (13.2mm) and 1331 medium AA guns (20-40mm) available in May 1940. Further deliveries led to about 1900 medium AA guns available. In comparison, the Wehrmacht on 10th
May 1940 had about 6500 2.0cm and 3.7cm AA guns covering the troops advancing in France. These AA guns caused the main losses in the French air force while the Luftwaffe encountered much less AA fire.

FIELD ARTILLERY

In 1940 the French had about 10,000 field artillery pieces in combat units.

- Divisional artillery regiments (75, 105 and 155mm) : 40 (13 motorized)
- Mountain artillery regiments (75 and 105 mm) : 3
- Non-divisional artillery regiments (75, 105, 155, 194, 220, 240, 280mm) : 21 (13 motorized)
- Independent artillery companies : 2
- Rail guns heavy artillery regiment : 1

Here is an approximate listing of all kinds of artillery pieces available in the French army in 1940:

Field artillery (75mm, 105mm C and 105mm L and 155mm C) mobilized in May 1940:

- 75mm M 1897 : 4500
- 105mm C (various models) : 376
- 105mm L (various models) : 1002
- 155mm C (various models) : 1827
- 65mm M Mle 1906 (mountain gun) : 70
- 75mm M Mle 1928 (mountain gun) : 156
- 105mm M Mle 1928 (mountain gun) : 24
- 75mm T Mle 1915 (trench mortar) : probably 21 (294 available)

**TOTAL 1 : 7,976 guns mobilized**

Heavy field artillery mobilized in May 1940:

- 120mm L Mle 1878 and 1916 : only few mobilized to reinforce fortified areas (600 available)
- 145/155mm L Mle 1916 : 68 (168 available)
- 150mm T Mle 1917 Fabry (tranch mortar) : about 866, at least 360 during the Phoney War (1159 available)
- 155mm L Mle 1877 : 743
- 155mm L Mle 1877/14 : 480
- 155mm L Mle 1918 : 120
- 155mm L Mle 1917 : 407 (535 available)
- 155mm GPF : 352 (449 available)
- 155mm GPFT : 24
- 194mm GPF (tracked SPA) : 26 (49 available)
- 220mm C Mle 1916 (heavy mortar) : 376 (462 available)
- 220mm L Mle 1917 : 56 (68 available)
- 240mm LT Mle 1916 (heavy trench mortar) : 12 (410 available)
- 270mm M (coastal heavy mortar) : 24 available, probably none mobilized
- 280mm C PF (heavy mortar) : 100 (PF = plateforme = plateform) (109 available)
- 280mm C Ch (tracked SPA) : 26 (Ch = chenille = tracked)
- 370mm M Fillioux : 4 (12 available)

**TOTAL 2 : 3,684 guns mobilized**

Rail road artillery mobilized in May 1940:

- 164mm : 4 (8 available)
- 194mm : 24 (32 available)
- 240mm : 16
- 274mm : 16
- 293mm : 5 available but not mobilized
- 305mm : 6
- 320mm : 16
- 340mm : 8 (10 available)
- 370mm : 13 available, none mobilized
- 400mm : 10
- 520mm : 1 available, not mobilized

**TOTAL 3 : 100 guns**

**TOTAL 1+2+3 : 11,760 guns mobilized**
1) NON DIVISIONAL ARTILLERY:

- Artillery battery (75, 105, 155, 194, 220, 240, 280mm)
  4x howitzers or guns

- Light artillery battalion
  3x artillery battery (12) (75mm)

- Medium artillery battalion
  3x artillery battery (12) (105mm)

- Heavy artillery battalion
  3x artillery battery (12) (155mm and >)

- Light artillery regiment
  3x light artillery battalion (75mm) (36)

- Medium artillery regiment
  2x medium artillery battalion (105mm) (24)

- Heavy artillery regiment
  2x heavy artillery battalion (155mm and >) (24)

- Independent Artillery Battalion
  3x artillery battery (12)

2) DIVISIONAL ARTILLERY: different divisional artillery regiments

- Infantry Division (DI) (2 regiments):
  
  Artillery regiment (= "RAD" for régiment d'artillerie divisionnaire)
  3x Light Artillery Battalion (75mm)
  1x BDAC
  1x BDAA

  Heavy artillery regiment (= "RALD" for régiment d'artillerie lourde divisionnaire)
  2x Heavy Artillery Battalion (155mm)
  1x BDAC
  1x BDAA

  BDAA = Batterie Divisionaire Anti-Aérienne = AA divisional battery with 6x 25mm AA guns
  BDAC = Batterie Divisionaire Anti-Char = AT divisional battery with 8x 47mm Mle 1937 or 75mm Mle 1897/33 AT guns.

- Motorized Infantry Division (DIM) (2 regiments):
  
  Light Artillery Regiment (= "RADm" for régiment d'artillerie divisionnaire motorisé)
  3x Light artillery battalion (75mm)
  1x BDAC
  1x BDAA

  Heavy Artillery Regiment (= "RALD" for régiment d'artillerie divisionnaire motorisé)
  1x Light artillery battalion (105mm)
  1x Heavy artillery battalion (155mm)
  1x BDAC
  1x BDAA

- Light Cavalry Division (DLC) (1 regiment):
  
  1x Light artillery battalion (75mm)
1x medium artillery battalion (105mm)
1x BDAC
1x BDAA

• **Light Mechanized Division (DLM) (1 regiment)** :

  2x Light artillery battalion (75mm)
  1x medium artillery battalion (105mm)
  1x BDAC
  1x BDAA

• **Armored Division (DCR) (1 brigade)** :

  3x Light artillery battalion (75mm)
  2x Medium artillery battalion (105mm)
  1x BDAC
  1x BDAA

**Characteristics of several guns** :

**Canon de 75mm (L/36.3) Model 1897**

*Type*: field gun  
*Crew*: 1 NCO + 6 men  
*Caliber*: 75x350R mm  
*Length*: 4.45m  
*Barrel length*: 2721 mm (2229 mm rifling)  
*Width*: 1.51m  
*Weight in action*: 1140 kg  
*Weight in travel*: 1970 kg  
*Elevation*: -11° to +18°  
*Traverse*: 6°  
*Ready to fire in*: 5 minutes  
*Rate of fire*: up to 28 rpm (10-12 rpm in sustained fire)

**HE Shell**

- *Maximum range*: 11100 m  
- *Projectile weight*: 5.550 to 6.500 kg depending from different HE shells  
- *V°*: 575 m/s

This is the famous "75". This French gun developed for WW1 was the first field gun equipped with modern recoil system and first field gun fitting to quick-fire concept. Used by 18 countries including the US (until 1941), UK (1939-40 in small numbers), Poland (75mm armata polowa wz. 97), Portugal, Ireland, Greece, Romania, Finland (48, 12 of which arrived in time for the Winter War), Lithuania and Spain. France had 4500 in service in June 1940, most of which ended in German hands as FK97(f), 231(f) and 232(f) used for 2nd line troops and fortifications. The FK 97(f) has wheels and is the basic model. The modernized version (with pneumatics) is called FK 231(f) in German service. The FK 232(f) is the 75mm Mle 97/33 AT gun version with a new split-trail carriage. Large numbers of Mle 97/33 guns were sold from Army stocks to Brazil but enough remained for the Germans to take over in 1940.

In 1941, the Germans facing the T34 tanks in Russia converted in hurry about 800 75mm Mle 1897 guns for anti-tank use (on the Pak38 carriage and with a muzzle break). It was called 7.5cm Pak 97/38. Later there were also several 7.5cm Pak 97/40 (Pak40 carriage) but they are much more rare guns. At first, ammunitions captured from France and Poland was used. With the German Gr 38/97 HL/B (f) and Gr 38/97 HL/C (f) HEAT shells, 96mm and 128mm thick armor could be penetrated at any distance. The Germans converted also some T26 in tank-destroyers armed with the Pak 97/38. These vehicles were called 7.5cm Pak 97/38 (f) auf Fahrgestel Panzerkampfwagen T26 (r). Only 10 of these vehicles were built during 1943 and issued to the 3rd company of the Pz. Jäg. Abt. 563. They were still all operational on 1st March 1944 when Marders replaced them.

Finland used also 46 Pak 97/38 AT guns. Compared to other Finnish AT guns these were very good so they were issued to units located all over the frontline. During the battles of summer 1944 seven guns of this type were lost. After WW2 the remaining 39 guns were kept warehoused until being sold to museums and collectors in 1986. During WW2 Rumania used also the 7.5cm PaK 97/38, probably equipments given by Germany when they replaced their guns.

When the USA had to make a choice of field gun to equip its army in view of its participation in WW1, they took the best candidate available at the time: the French 75mm Model 1897. Pressed into service by the thousands, there were still many of them in 1941 and, like their French colleagues, their career continued during WW2.
There is some confusion among the US models of the 75. You must distinguish the gun itself from its carriage. In US designation system, the carriage had designation independent from the gun fitted upon it. The same carriage may be used for several guns and one gun be fitted on several different carriages. Basically, there were four type of 75mm field guns, according to the US terminology: the 75 modèle 1897 was the French gun, built in France and given to the US Army. The M1897 was the US exact copy, built in the USA, while the 75mm M1897A2 and the 75mm M1897 A4 were US redesigns, both built solely in the USA.

The carriages were initially designated with a name starting with "M1897" followed by a letter and a digit. Later, it became "M2A1", "M2A2", ... The carriages changed more than the gun itself in the inter-war period, the most conspicuous change being the replacement of wooden spoke wheels by pneumatic ones.

In 1940, the British bought a batch of those guns and assigned them to their home defense units. They were renamed "Ordnance QF 75mm Mark I" and declared obsolete on March 8, 1945.

The M1897A4 is almost the only variant still extant when the USA entered the war in 1941. Since the appearance of the 105mm howitzer, the 75mm field gun had become obsolete but the needs were such that it was sent overseas in the Pacific as well as in North Africa, where it fought until late 1942. They were used as field guns but also for example on the 75mm Gun Motor Carriage M3 and 75mm Gun Motor Carriage M3A1 halftracks.

**Mortier de 75mm T M1915**
- Type: trench mortar
- Crew: 1 NCO + 4 men
- Caliber: 75mm
- Barrel length: 770mm
- Weight in action: 234 kg
- Weight in travel: 304 kg
- Elevation: 0° to +80°
- Traverse: 40°
- Rate of fire: 4 rpm
  - HE Shell
    - Maximum range: 1700 m
    - Projectile weight: 5.3 kg
    - V°: 130 m/s

**Canon de 105mm C (L/17) M1935 Bourges**
- Type: howitzer
- Crew: 1 NCO + 6 men
- Caliber: 105mm
- Barrel length: 1760 mm
- Weight in action: 1627 kg
- Elevation: -5° to +45°
- Traverse: 52°
- Ready to fire in 5 minutes
- Rate of fire: 15 rpm
  - HE Shell
    - Maximum range: 10500 m
    - Projectile weight: 15.6 kg
    - V°: 465 m/s

Used by Germans under the name 10.5cm leFH 325 (f)

**Canon de 105mm C (L/20) M1934 Schneider**
- Type: howitzer
- Crew: 1 NCO + 6 men
- Caliber: 105mm
- Barrel length: 2090 mm
- Weight in action: 1722 kg
- Elevation: -7° to +38.7°
- Traverse: 39.6°
- Ready to fire in 5 minutes
- Rate of fire: 15 rpm
  - HE Shell
    - Maximum range: 10500 m
    - Projectile weight: 15.6 kg
    - V°: 465 m/s

Used by Germans under the name 10.5cm leFH324 (f)

**Canon de 105mm L (L/28) M1913 Schneider**
- Type: field gun
Crew : 1 NCO + 6 men
Caliber : 105 mm
Barrel length : 2980 mm (2350 mm rifling)
Weight in action : 2300 kg
Elevation : -5° to +37°
 Traverse : 6°
Ready to fire in 5 minutes
Rate of fire : 6-8 rpm

Ammunition
Maximum range : 11800 m (Mle 1914 HE) - 12100 m (Mle 1916 canister)
Projectile weight : 15.4kg (Mle 1914 HE) - 16.9 kg (Mle 1916 canister)
V° : 570 m/s (Mle 1914 HE) - 553 m/s (Mle 1916 canister)

About 857 guns are in service in France in 1940. Also used by the Germans under the name 10.5 cm FK331 (f) (for example as coastal defense in Norway or France). Other countries using this gun included Belgium, Czechoslovakia, Estonia and a dozen of these guns were used in Finland during WW2 (105 K/13). The gun was also manufactured under license in Italy, Poland and Yugoslavia.

Canon de 105mm L (L/41.5) Mle 1936 Schneider
Type : field gun
Crew : 1 NCO + 6 men
Caliber : 105mm
Barrel length : 4369 mm (3087 mm rifling)
Weight in action : 4110 kg
Elevation : 0° to +43°
 Traverse : 49°
Ready to fire in 3-5 minutes
Rate of fire : 5 rpm

HE Shell
Maximum range : 16400 m
Projectile weight : 15.7 kg
V° : 725 m/s

Used by Germans under the name 10.5cm FK332 (f) (primarily as a coastal gun in Norway and the Channel Islands).

Mortier de 150mm T Mle 1917 Fabry
Type : trench mortar
Caliber : 150mm
Length : 2100mm
Barrel length : 1240mm
Weight in action : 615 kg
Elevation : +42° to +72°
 Traverse : 30°
Rate of fire : 2 rpm

HE Shell
Maximum range : 2000 m
Projectile weight : 17 kg (5.4 kg explosive)
V° : 156 m/s

Canon de 155mm C (L/15) Mle 1917 Schneider
Type : howitzer
Crew : 1 NCO + 7 men
Caliber : 155mm
Barrel length : 2332 mm (1737 mm rifling)
Weight in action : 3300 kg
Elevation : 0° to +42°20'
 Traverse : 6°
Ready to fire in 5 minutes
Rate of fire : 2 rpm during 10 minutes or 0.7 rpm in sustained fire

HE Shell
Maximum range : 11900 m
Projectile weight : 43 – 43.5 kg
V° : 450 m/s

It was a good gun, pretty light, firing a 43kg shell at a maximum range of some 11900m - there were five different types of shells for this gun, including HE, shrapnel and smoke shells. The soundness of the design was soon proved by the fact the Americans adapted it, to equip it's Expeditionary Army in Europe - their copies were called
M1917 and M1918. It was still in both French and American service at the outset of the Second World War. It was also used by a number of other countries, including Finland (which employed the piece with good effect during the Winter War) and Poland. The last US M1918A3 version like the last French version of 1940 (only several of them in 1940) used a modernized carriage with pneumatics.

**Canon de 155 mm C (L/16) Mle 1915 Saint-Chamond**

Type: howitzer  
Crew: 1 NCO + 9 men  
Caliber: 155mm  
Barrel length: 2510 mm (2250 mm rifling)  
Weight in action: 2860 kg  
Elevation: 0° to +40°  
Traverse: 6°  
Ready to fire in 20 minutes  
Rate of fire: 2 rpm during 10 minutes or 0.7 rpm in sustained fire

**HE Shell**  
Maximum range: 9800 m  
Projectile weight: 43 kg  
V°: 335 m/s

**Canon de 145/155mm (L/42) Mle 1916 Saint-Chamond**

Type: field gun  
Caliber: 145mm or 155mm  
Weight in action: 12500 kg  
Elevation: 0° to +38°  
Traverse: 6°  
Ready to fire in 3 hours  
Rate of fire: 1-2 rpm

**HE Shell**  
Maximum range: 18000 m  
Projectile weight: 43 kg  
V°: 790 m/s

This gun was used by the Germans under the name 15.5cm K420(f).

**Canon de 155mm L (L/26) Mle 1918 Schneider**

Type: field gun  
Caliber: 155mm  
Weight in action: 5050 kg  
Elevation: 1°15’ to +43°35’  
Traverse: 6°  
Ready to fire in 20 minutes  
Rate of fire: 2 rpm

**HE Shell**  
Maximum range: 13600 m  
Projectile weight: 43.7 kg  
V°: 561 m/s

The 155mm L Mle 1877 and Mle 1877/1914 were seen as the best counter-battery guns during WW1 but they were getting old and had to be changed. The 155mm GPF would have been good but was mostly produced for the US troops. The 155mm L Mle 1917 were too heavy and lacked mobility. The 155mm L Mle 1918 was therefore made as an emergency solution by the French army late in WW1, only 4 produced for WW1 and 120 in service in 1940. It was the last developed gun still using the Mle 1877/1914 De Bange barrel and it was mounted on the Schneider Mle 1917 C carriage. This gun was used by the Germans under the name 15.5cm K425(f).

**Canon de 155mm L (L/32) Mle 1917 Schneider**

Type: field gun  
Crew: 10 men  
Caliber: 155mm  
Weight in action: 8800 kg  
Elevation: -5° to +40°  
Traverse: 4°30  
Ready to fire in 30 minutes  
Rate of fire: 2-3 rpm

**HE Shell**  
Maximum range: 17000 m
Projectile weight : 43.7 kg
V° : 665 m/s

The first guns were available beginning 1917 and became the most common French heavy gun of WW1. The French army had 535 of these guns in 1940. This gun was used by the Germans under the name 15.5cm K416(f).

**Canon de 155 mm GPF (L/38) (Grande Puissance FILLIOUX)**

Type : field gun  
Crew : 10 men  
Caliber : 155mm  
Weight in action : 11200 kg  
Elevation : 0° to +36°  
Traverse : 60°  
Ready to fire in 30 minutes  
Rate of fire : 2-3 rpm

**HE Shell**  
- Maximum range : 18600-19300 m  
- Projectile weight : 43 kg  
- V° : 735 m/s

**Canon de 155 mm GPFT (L/38) (Grande Puissance FILLIOUX – Touzard carriage)**

Type : field gun  
Crew : 10 men  
Caliber : 155mm  
Weight in action : 12200 kg  
Elevation : 0° to +39°  
Traverse : 60°  
Rate of fire : 2-3 rpm

**HE Shell**  
- Maximum range : 21000 m  
- Projectile weight : 43 - 45 kg  
- V° : 735 m/s

The 155mm GPF was adopted by the US Army as the 155mm M1917/1918 and it is the direct ancestor of the 155mm gun M1 'Long Tom'. It was also the gun used to design the 155mm GMC M12 self-propelled gun. The Germans used it under the name 15.5cm K418/419(f).

The Original 155mm GPF was rather slow to move generally about 8 km/h using Latil TAR or Latil TARH2 trucks in France in 1940. These guns were mostly present in the ALCA (artillerie lourde de corps d'armée = army corps heavy artillery) and in the general reserves with 352 guns mobilised in May 1940.

The 155mm GPFT (Touzard carriage = version with 4 pneumatics) was one of the most modern French guns in 1940 with the 105mm L Schneider M1936, but only 24 of them were in service in 1940. This gun was towed at 25-30 km/h by the Laffly S35T truck. The Germans used the 155mm GPFT in the Deutsche Afrika Korps. In March 1944 there were still 22 15.5 cm K419(f) in service in the German army.

**Canon de 155mm L (L/55) M1932 Schneider**

Type : field gun / coastal gun  
Caliber : 155mm  
Weight in action : 16600 kg  
Elevation : -8° to +45°  
Traverse : 360° with the plateform  
Rate of fire : 4-5 rpm (elevation up to 25°) and 3-4 rpm (elevation 25° - 45°) thanks to a mechanical loading system

**HE Shell**  
- Maximum range : 26000 - 27500 m  
- Projectile weight : 50 kg (5.5kg explosive)  
- V° : 900 m/s

The M1932 155mm L Schneider gun was mainly used by the French Navy for its mobile batteries. When emplaced on the plateform (which needed no peculiar preparation of the ground) it had a full 360° traverse. The strange shape of the wheels is to allow the easy 360° traverse, which would not have been possible with pneumatics. Only 16 guns (4 batteries of 4 guns) were in service in 1939/1940.

- Battery n°1 was mobilized in Gabès (Tunisia), moved to Gabès (Tunisia) in February 1940 and was sent back to Sfax (Tunisia) on 8th June 1940. It is transfered to Bône on 25th June 1940 and Nemours on 22nd August 1940 (Algeria) where it was still deployed on 8th November 1942. This battery never left North-Africa.
- Battery n°2 (Capitaine de Corvette Hamelin and later Lieutenant de Vaisseau Brenot) was first in Toulon.
- Battery n°3 (Lieutenant de Vaisseau Jabet) was first in Bizerte (Tunisia).
- A 4th battery was in Senegal but no battery number is mentioned. This battery in Western Africa was in fact not mobile; it was a fixed coastal artillery battery with 4x 155mm M1932 Schneider emplaced at Yof, near Dakar. Another difference is that it belonged to the Army, not the Navy, and was manned by colonial artillery.
personnel. The Yof 155mm battery was replaced by one with 138mm Mle1924 guns (September 1941), and the 155mm guns relocated to Cap Manuel (also in the Dakar area), at which point the battery passed under Navy control.

Batteries n°2 and n°3 took part in the campaign of France. They were at Montebourg (France) in August 1939 and served together during the campaign. Only these two batteries got the Somua MCG 4 halftracks, 3 per gun for a total of 24 MCG4 halftracks (3 packs : 8600 kg with the barrel, 8000 kg with the carriage and 6000 kg with the plateform), and were really mobile batteries. They were sent in Belgium in May 1940 and battery n°3 was also used in the Netherlands to support the French troops landed in Walcheren against the Waffen-SS "Deutschland" regiment. The batteries n°2 and n°3 ended up at Dunkirk, where they proved to be very efficient in defending the allied pocket at 360°. Concerning the battery n°2 : 2 guns were destroyed at Gravelines on 24th May, 1 gun was destroyed on the road between Grande-Synthe and Petite-Synthe, the last gun is still firing on 2nd June and is finally scuttled. Concerning the battery n°3 : 2 guns were detached to the 2nd battery and were scuttled beginning June. The 2 other guns were near Vallières and were scuttled on 3rd June.

This gun was used by the Germans under the name 15.5cm K424(f).

**Canon de 194 mm GPF (L/33.5) (Grande Puissance FILLIOUX)**

Type : Tracked field gun (can easily fire at 360°)

- Speed : 8-10 km/h (Panhard SUK4 M2 engine, 120 hp)
- Crew : - men
- Caliber : 194mm
- Weight in action : 29600 kg
- Elevation : 0° to +37°
- Traverse : 360°
- Rate of fire : 1-2 rpm

**HE Shell**

- Maximum range : 20800 - 22500 m
- Projectile weight : 44.9 kg
- V° : 725 m/s

The companion ammunition tractor carried 60 shells. Only 50 pieces of this tracked SPA were in service in the French army in 1940. Several of these self-propelled guns were captured and used by German forces as the 19.4cm Kanone 485 (f) auf Selbstfahrlafette. There were for example 3 such guns in the Heer Artillerie Regiment 84 in 1942 (Army Group North in Russia).

**Mortier de 220mm C (L/10.3) Mle1916**

Type : heavy mortar/howitzer

- Caliber : 220mm
- Weight in action : 5800 kg
- Elevation : 10° to +65°
- Traverse : 6°6'
- Ready to fire in 6 hours
- Rate of fire : 1 rpm

**HE Shell**

- Maximum range : 10800 m
- Projectile weight : 100.5 kg
- V° : 415 m/s

**Canon de 220mm L (L/35) Mle1917 Schneider**

Type : field gun

- Caliber : 220mm
- Weight in action : 23000 kg
- Elevation : 0° to +37°
- Traverse : 20°
- Ready to fire in 6 hours
- Rate of fire : 1 rpm

**HE Shell**

- Maximum range : 22800 m
- Projectile weight : 105.5 kg
- V° : 770 m/s

**Canon de 240mm (L/22.3) Mle1884/1917 Saint-Chamond**

Type : field gun

- Caliber : 240mm
- Weight in action : 31000 kg
- Elevation : 0° to +38°
- Traverse : 10°
Ready to fire in 24 hours
Rate of fire : 1-2 shell every 2 minutes

HE Shell
Maximum range : 18000 m
Projectile weight : 164 kg
V° : 640 m/s

**Mortier de 240mm LT M°1916**
Type : heavy trench mortar/siege mortar
Caliber : 240mm
Barrel length : 2450mm
Weight in action : 3500 kg
Elevation : +45° to +75°
Traverse : 36°
Rate of fire : 1 shell every 6 minutes

HE Shell
Maximum range : 2150 m
Projectile weight : 83-89 kg (42.4 - 45 kg explosive)
V° : 145 m/s

**Mortier de 280mm C (L/12) M°1914 Schneider PF (on plateform)**
Type : heavy mortar/howitzer
Caliber : 280mm
Barrel length : 3352mm (2642mm rifling)
Weight in action : 16220 kg
Elevation : +10° to +60°
Traverse : 44°60'
Rate of fire : 4 shell every 5 minutes

HE Shell
Maximum range : 10950 m
Projectile weight : 205 kg (275 kg)
V° : 418 m/s

Used by the 6th battery of the 154e RAP (Régiment d'Artillerie de Position) against the Italian fort of Chaberton in the Alps.

**Mortier de 280mm C (L/12) M°1914 Schneider Ch (tracked SPA)**
Type : heavy mortar/howitzer
Caliber : 280mm
Barrel length : 3352mm (2642mm rifling)
Weight in action : 26000 kg with 30 shells (+ 29000 kg for the companion ammunition tractor)
Elevation : +10° to +60°
Traverse : 360°
Rate of fire : 4 shell every 5 minutes

HE Shell
Maximum range : 10950 m
Projectile weight : 205 kg (275 kg)
V° : 418 m/s

**Mortier de 370mm (L/8) Fillioux**
Type : heavy mortar/siege howitzer
Caliber : 370mm
Weight in action : 28615 kg
Elevation : -8° to +60°
Traverse : 44°60'
Ready to fire in 36 hours
Rate of fire : 1-2 shell every 5 minutes

HE Shell
Maximum range : 10500 m (7800 m)
Projectile weight : 375 kg (540 kg)
V° : 375 m/s

**NOTE : Length of the barrel in caliber (L/xx)**
Such a value can vary from one country to another, which explains sometimes the discrepancies from one source to another. The USA and the UK measure the length of the gun barrel from the mouth of the chamber to the end of the barrel (without the muzzle brake). That is the bore length = the rifling + the length of the chamber. Most...
continental European countries (France, Germany, Italy etc.) measure the length of the barre from the rear of the breech to the muzzle, in that case the considered length is bigger and close to the overall length.
NOTES:

1) TECHNICAL DEVELOPMENTS

In 1937/1940 several French companies initiated interesting technical developments in the armament field:

- **Brandt 120 mm mortar Mle 1935**
  The French Army had adopted this heavy mortar and a squad of 2 mortars should have been issued in each regiment in 1940 but very few had been delivered before the armistice. This mortar was also manufactured in Russia under the name "120mm Polkovoy Minomyot Obr. 1938g". The Russians also modified it and later produced their own mortars (that's why it is often thought that this 120mm mortar is a Soviet conception) and it has later been copied by the Germans for their "120 mm Granatwerfer 1942". The KNIL, the Dutch East Indies Army, ordered 30 120 mm mortars but it seems none were delivered before the fall of France.
  Brandt sold the Kuomintang regime two 120mm Mle 1935 mortars and 275 rounds of ammunition in 1938, and these were delivered in March 1939 via Rangoon and the Burma Road. With the fall of France further purchases became impossible and the weapons were turned over to the 21st Arsenal for reverse engineering. In the meantime, the 50th Arsenal was working on their own design and a competition between the two was held in 1943/44. The 21st Arsenal (Brandt-derived) mortar was chosen in 1944 (hence the designation 33 = 33rd year of the Republic). In any event, none were actually built until 1945. Production appears to have ceased around 1946, with probably about a hundred built. The main differences between the Brandt version delivered to China and the Type 33 was that the 21st Arsenal shorted the tube slightly to reduce weight and replaced the spring-carried pneumatic tires with simple wooden spoke wheels.

- **Larsen 29/20mm taper-bore AT gun**
  The 25×194R shell used in the 25mm Puteaux Mle 1937 and 25mm Hotchkiss Mle 1934 AT guns was taken as the basis for the taper-bore experiments conducted in 1939/1940 by the Danish Larsen company for the French Army, utilizing also the first German trials of Gerlich. Larsen developed a 29/20 mm AT gun that should have replaced the French 25mm AT guns at first in the mountain infantry units and give a could AT capacity to the French airborne companies. The French army had tested different prototypes and the French company Manhurin manufactured the 29/20mm shell. In May 1940, about 50 Larsen 29/20mm AT guns on Puteaux Mle 1937 carriage were delivered and tested. The 90g tungsten projectile (V° = 1400 m/s) was able to penetrate 56mm/30° at 400m. Perhaps very few of them even saw combat in May/June 1940.
  These studies were then followed up by the Germans to create different taper-bore AT guns: the Gerlich 28/20mm is a copy of the French gun based on the Larsen patent, the 2.8cm sPzB 41 (which used a projectile based on the French 25mm AT round), the 4.2cm lePak 41 and the 7.5cm Pak 41. They worked very well, but suffered from a shortage of tungsten needed in the projectile.

- **Brandt new generation shells**
  The studies led by Brandt in the 30's aimed to increase the initial velocity of the shells (without increasing of the chamber pressure) and also more generally to increase the penetration power of the shells. The French company Brandt developed series of sub-calibrated HVAP/APCR/APHC shells: 37/25mm, 75/57mm and also sub-calibrated projectiles for the 155mm and 203mm guns of the French navy. The other nations did not develop similar or equivalent systems before 1941/1942.
  The 37/25mm subcalibrated shell with a 20mm core was tested but could not enter in service before the armistice. The V° was 850 m/s and it had the same penetration capacity than the 25mm SA34/37 AT gun. The same 37/25mm subcalibrated shell was also planned to be used in the 25mm SA34/37 AT gun, reaching in that case a V° of 1150 m/s, but the barrels had to be modified. The most outstanding realization is probably the 75/57mm shell with a muzzle velocity of 900 m/s and a penetration of 90mm/35° at 1000m ... The 75mm Mle 1897 and Mle 1897/33 guns could have engaged and destroyed the German Panzer IVs at 2500m in May/June if such shells would have been available!
  Beside the sub-calibrated shells, Brandt also developed a 75mm HEAT shell at this time, using the patent of the Swiss Mohaupt. The tests took place in Bourges in 1940 and the results were that impressive that they were put in the secret immediately in order to avoid German capture.
  On 14th June 1940, the French war ministry authorized Brandt to give all these info to the USA and the United Kingdom, including the exploitation licence for the Mohaupt patent. The inventor, Henry Mohaupt, by the intermediary of the Brandt company filed for US patent on 10th February 1941 and it is kept secret on 7th March 1941. The sub-calibrated shells were used in the UK as basis to develop the APDS shells (armored piercing discarded sabot) issued from 1942/1943. The first AT guns using them were the 6 Pdr and 17 Pdr AT guns.

- **French Brandt HEAT AT rifle grenade developpments**
  At the end of 1939 Brandt developed also a 50mm HEAT rifle grenade. It had a range of about 100m and an armor penetration of 40mm. It entered in production during May 1940 and was successfully tested at the Satory test range on 10th June 1940 but they could not be issued to the combat units before the armistice. The documents related to these works were sent to the USA in June 1940 and were in some extend used as basis to develop the
Bazookas. The Brandt HEAT rifle grenade was also secretly produced in France at 300,000 pieces in the free zone and issued to Vichy forces. Several partisans groups used them in 1944.

- **Remote-controlled breaching vehicles**
The French army developed radio-guided or wire-guided vehicles transporting a destruction charge before the Germans had their Goliath, Springer or Borgward B.IV dedicated to that function.

In 1937-1940 the French army developed:

- The "véhicule P" (P for Pommellet, the captain who invented it) : constructed by Lorraine, 2000 ordered but only 11 constructed before the armistice
- The "engin K" (K for Alphonse Kégresse, the constructor) : 12000 vehicles ordered (6000 in April 1940, 6000 in May 1940), precursor of the Goliath which was built later based on this French vehicle.
- In April 1940, 300 FT-17 tanks are also destined to be transformed in guided demolition tanks (guided from a ground post or from a R-35 command tank, like later the Borgward and the StuG(FkI) for example)

The very first prototypes, remote-controlled breaching vehicles for cutting wire obstacles were developed in Germany and France during World War I. The Germans were the first to produce and deploy remote-controlled minefield breaching vehicles by using both an expendable charge-carrying vehicle (the "Goliath") and a nonexpendable vehicle (the B-IV) that was intended to drop its charge and withdraw before the charge detonated. Although these vehicles were used with some success at Sevastopol in 1942 and Kursk in 1943, they were generally considered failures.

- **Tank construction technology and Somua S35 tank**
The Somua S35 was intended to be produced in the USA but due to WW2 that never happened. All what the French learned about casting technology was transferred to the USA and that inspired more or less the turret of the Lee, the hull of the M3A1 and the Sherman general design. The conception/design of the future M4 Sherman is in fact partly inspired by these studies and French engineers were present in the US "Ordnance" during debriefing meetings in Washington beginning July 1940. But what is sometimes heard about the Sherman being directly linked to the Somua S35 is an urban myth.

- **Renault G1 tank**
In 1936 a new program is launched to develop a "G" tank for the infantry. Somua, SEAM and Renault will propose prototypes or models. The initial requirement are a weight of about 20 tons, an armor of 50mm, a top speed of 50 km/h, a range of about 200 km and an armament consisting in a 47mm (75mm) gun mounted in a turret and 2 MGs. In fact the infantry wanted a kind of Somua S35 like the cavalry. The G1 tank would be lighter than the B1bis, easier to produce and cheaper to produce. At the same time, Germany started to study the Panzer III and the Panzer IV, armed respectively with a 37mm and a 75mm gun mounted in a turret.

- For Somua the chassis is the one of the future Somua S40 with a dual armament, an APX4 turret with a 47mm SA35 gun and a 75mm hull gun. It is a kind of B1bis but weighting about 25 tons instead of 32 tons. The armor would reach 60mm, there is a 300hp engine (12 cylinders) allowing to reach 40 km/h and the hull gun as a traverse of 12°. These projects are not followed but will lead to the development of the Somua SAu40.
- The second prototype is the G1P (P for Poniatowski) developed by SEAM. This project is also a dual tank, it will be stopped. The Germans will capture at least one prototype in 1940 according to photographic evidences.
- Renault develops a different tank, with a modern chassis and all the armament in a new kind of turret. The turret will be equipped with a 47mm L/53 gun (V° = 840 m/s) and/or a 75mm gun (shortened 75mm M°1897 barrel with a semi-automatic breech M°1935 - V° = 555 m/s). The studies from Renault are more similar to the Panzer IV in Germany, the T34 in Russia or the future M4 Sherman in 1942, which will be partly inspired by French engineers detached in Washington in July 1940. The G1R would have been produced in September 1940 (the effective war against Germany was not expected before 1941) but the development was stopped in June 1940. The French in 1937/1939 also preferred a dual armament at this time, like the British for the first developments of the Churchill and the USA with the later M3 Grant for the USA. In May 1940, the combats proved that Renault was right with its 75mm gun mounted in the turret and such a tank would have been really useful. The USA will nonetheless develop the M3 Grant, arguing that it was too intricate to handle 75mm shells in a small turret. The British will cancel the planned mounting of a 3 inches (76.2mm) gun in the Chassis of the Churchill after Saint-Nazaire in 1941 and the first combats in North-Africa. The Renault G1R is armed with a 47mm SA37 L/53 gun or a 75mm gun based on the barrel of the 75mm M°1897 field gun, both can be seen on the wooden models made by Renault. The anti-tank capacity is far better with the 47mm gun but the HE shells are more powerful for the 75mm guns. It is therefore planned to arm platoons of 3-5 tanks with 47mm and 75mm armed tanks. The 75mm gun would also have been able to fire the new Brandt 75/57mm sub-calibrated shells and Brandt HEAT shells.

After visiting Germany in late 1929/early 1930, members of the Soviet Mission invited the German engineer Edward Grote to the USSR. After his arrival, Grote began work at the AVO-5 Design Office, within the Aviation Engine Department of the 'Bolshevik' Factory. He led a team that was engaged on designing on a heavily armored, medium-weight tank as an alternative to the maneuverable T-24. In 1930, prototypes of the experimental, TG Tank (Tank Grote) were subjected to trials and found to have some faults. Despite rectifying the faults that were found
during testing, it was decided that the TG Tank would not be placed in production. Further work on the TG Tank was suspended and the services of Edward Grote were no longer required and in August 1933, Grote was requested to leave the USSR. He was then thought to have gone to France and worked for Renault on the development of the experimental G1R tank. On the declaration of war he may have moved to the USA and been involved in the design of the Sherman tank. He is barely mentioned anywhere except for the US immigration records for that period that recorded an Edward Grote as taking up employment with the US Government in mid 1940.

● The MAS40 semi-automatic rifle
The MAS40 should have been delivered in 1941, it was a modern semi-automatic rifle, equivalent to the M1 Garand but even with 10 and 25 rounds magazines.

<table>
<thead>
<tr>
<th>Type</th>
<th>semi-automatic rifle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total length</td>
<td>1065 mm</td>
</tr>
<tr>
<td>Weight (empty)</td>
<td>3.94kg</td>
</tr>
<tr>
<td>Barrel Length</td>
<td>580 mm</td>
</tr>
<tr>
<td>Caliber</td>
<td>7.5x54 mm</td>
</tr>
<tr>
<td>Magazine</td>
<td>5 rounds clips, 10 rounds magazine or an other version with a 25 rounds magazine</td>
</tr>
<tr>
<td>V°</td>
<td>840 m/s</td>
</tr>
</tbody>
</table>

● Mine Plows, Rakes, and Detectors
In 1918, the French developed the first plow-equipped tank, which was based on a Renault FT-17 tank. In 1939 and February/March 1940, the French army tested also various plows and other advanced mine-clearing system on the Renault R35 but they were only few at the testing level and they saw no operational use. The Germans and the British armies later used these prototypes. After WW2, the former mine-clearing systems were tested again on a B1bis tank. However, plow tanks were not really used in combat until D-Day in 1944, when the British 79th Armored Division employed a "Bullshorn" plow on a Churchill tank at Sword Beach.
The Germans, French, Russians, and Italians entered WWII with metallic mine detectors, but information on the details of their origin is lacking. During the interwar years, the French seem to have developed the first vehicle-mounted electronic mine detector on an Renault R35 tank.

● Bridge layers
Already in 1917 and in the 20's, crossing systems and engineer vehicles based on the FT-17 were tested. In 1938 a bridge layer vehicle is studied and the manufacturer FCM produced 4 "tracteur de franchissement M1" (M1 crossing tractors) but they were too heavy (25.5t) and intricate to use. In 1937 Somua and Coder began to work together to produce a bridge layer vehicle. The first prototype is based on the Somua MCL5 halftracked vehicle with additional armor. The equipment was tested in September and October 1939: a 100km road stage and a 50km cross country stage are realized followed by 15 bridge laying tests with 20 crossings of Renault D2 tanks. The tests are rather satisfying and after slight modifications, the prototype is again tested in February/March 1940 with the successful crossing of Somua S-35 and Renault B1bis tanks (32 t). The experiments are cancelled by the defeat of 1940.

● Instantaneous radio-goniometry
Before WW2 one of the leader in the field of the telecommunications was ITT (International Telegraph & Telephone), a US company whose leader was colonel Sosthène Bell. The man was very francophile and ITT had built one of the first automated telephone central in Paris.

From 1937 to 1945, ITT developed the numeric transmission mode for the telephone communications (the system that is still used today). ITT had founded in Paris a big R&D laboratory, directed by Maurice Deloraine. Henri Busignies worked at this lab and was specialized in radio-goniometry (it consists in 2 radio listening stations (at 2 different locations), which determine the bearing of an emission. The crossing of the 2 lines determines the position of the enemy emitter). He has created the automatic radio-goniometer mounted in the aircrafts.

Before WW2, the French Navy stated that the German submarines communicated by messages whose length did not exceed 1 second (the encoded morse code message was recorded and emitted at high speed). The classical radio-goniometry required about 30 seconds to locate the bearing of the emission. The message of course could be intercepted and eventually deciphered but the position of the sub remained unknown. This was confirmed in 1939 during the Italian landing in Albania where German subs were also deployed. The engineer in chief Champsaur, commander of the signals service of the French Navy, asked then Maurice Deloraine to develop an instantaneous radio-goniometer. The lab managed to produce such equipment; the bearing could be red immediately.

One prototype was produced and tested with success in France in 1940, before the armistice. After the armistice, these results were hidden to the Germans. Maurice Deloraine, Emile Labin, Georges Chevigny, Henri Busignies and their families went to New York with the plans. The possibility of localizing the German submarines was
indicated to the US Navy which was not convinced at first. The US Navy asked then ITT to build and test the device conceived by the French engineers and it was done in less than 3 months. It allowed the localization of the German submarines in the Atlantic thanks to their radio emissions. 4,000 of the radio-goniometers were then produced. They were deployed on the US and British coasts and a large part of these devices were mounted on ships escorting the convoys.

2) IF FRANCE HAD NOT FALLEN?

France expected not to have to fight the decisive battles before 1941. At this time you would have had many improvements in the French equipments, including all the developments detailed previously.

**Anti-tank guns :**

Much more 47mm SA39 TAZ L/53 AT guns (360° traverse) would have been in service in the infantry units and at the divisional level the 75mm L/53 M°1939 AT/AA gun would have replaced all the 75mm AT guns and part of the older 47mm M°1937 AT guns. New HEAT and subcalibrated would have been introduced for many guns.

**Fighters :**

- Dewoitine D.520. It was already operational in 1940. This aircraft was slower than the Messerschmitt Bf.109E but clearly superior in maneuverability. A comparison was made on April 21, 1940, with an intact captured Bf.109E-3 that had been brought down in French territory. This comparison highlighted the fine qualities of the best French fighter of WW2. Had France not surrendered in June 1940, the Dewoitine D.520’s career might have been comparable to that of British and German fighters.

- The Dewoitine D.550 was a racing aircraft version of the D.520 designed in 1939, with an upgraded engine and shorter wings. The D.551 and D.552 were military derivatives, powered by the 12Y51 (1,100 hp) or 12Z engines, respectively. About 18 aircrafts were at different stages of completion on 25th June 1940 but none of them could fly. The D.553 and D.554 were projects with supercharged 12Z engines. The D.551 prototype could reach 662 km/h at 6000m. The weight of the armed and ready aircraft was 2,200 kg but during its development the prototype was apparently only armed with two MGs. Once delivered to the fighter units, the Dewoitine 551 would have been a kind of French "Mustang". The Dewoitine D.551 was expected to reach 650 km/h with full armament and fuel supply. Armament would have been 1x 20mm cannon in the nose and 6x 7.5mm MGs in the wings or 1x 20mm cannon in the nose and 2x 20mm cannons + 4x 7.5mm MGs in the wings.

- Arsenal VG30 series. The original specification that led to the VG series was offered in 1936 in order to quickly raise the number of modern aircraft in French service, by supplying a "light fighter" of wooden construction that could be built rapidly in large numbers.

  Named for engineer Vernisse (V) and designer Jean Gaultier (G), the VG30 was all wooden in construction, using plywood (the first type of engineered wood to be invented. It is made from thin sheets of wood veneer, called plies, which are stacked together with the direction of each ply's grain differing from its neighbors by 90° (cross-banding). The plies are bonded under heat and pressure with strong adhesives, usually phenol formaldehyde resin, making plywood a type of composite material) over stringers in a semi-monocoque (French for "single shell" or unibody). The layout was conventional, a low-wing monoplane that bore a striking resemblance to the later Italian Macchi C.202. The armament consisted of a 20mm Hispano-Suiza 404 cannon (60 rounds) firing through the propeller hub, and four 7.5mm MAC 1934 M39 drum-fed machine guns (500 rounds each), two in each wing. The prototype was equipped with a Hispano-Suiza engine and flew in October 1938. The VG31 was to use the 860 hp Hispano-Suiza 12Y-31 and the VG32 the Allison V-1710C-15. The VG31 flew in 1939 and proved to have excellent performance. The prototype VG32 was completed in 1940 and awaiting its test flight when it was captured by the advancing German forces at Villacoublay.

  The VG33 was a modified version of the VG31 using the same 12Y-31, and first flew on 25th April 1939. It had surprisingly good performance of 560 km/h, and was ordered into production with a contract for 220 aircrafts in September, later raised to 1,000. Production didn't take long to start, but most of the airframes never received engines and sat at the factory when it was overrun. It was faster than the Dewoitine D.520 but with an older engine, it could therefore have achieved much more.

  Further developments continued while the VG33 production started. The VG34 mounted the newer 935 hp 12Y-45, the VG36 used the 1,000 hp 12Y-51 originally intended for the VG35, and introduced a new streamlined radiator bath that looked very similar to the one on the P-51 Mustang. The VG36 reached 590 km/h. Single prototypes of all three were built and flown in early 1940. The VG37 was an extended range version of the VG36, while the VG38 was to have used the 12Y-77, but neither were built.

  The last in the series was the VG39, originally powered by the new 1,200 hp 12Y-89 using an extension shaft on the propeller to streamline the nose profile, giving the plane an excellent speed of 625 km/h even when loaded down with two more machine guns. The actual production version was to have been the
VG39bis, powered by the new 1,600 hp Hispano-Suiza 12Z-17, using the streamlined radiator intake design from the VG36.

Two more designs were projected, both based on the VG39bis airframe. The VG40 mounted the Rolls-Royce Merlin III and the VG50 the newer Allison V-1710-39. Neither was built. The VG33 matched the Bf.109E in speed and maneuverability (but was slightly underarmed compared to the latest Bf.109E versions) and was somewhat faster than the Dewoitine D.520. In larger quantities, this plane could have shown the Luftwaffe a rough time, but as was the case for most French planes, production problems plagued the VG33 such that only 160 aircraft were close to completion before the Armistice, with probably just 19 (?) of the produced aircrafts were actually taken on by the Armée de l'Air. Probably only 2 machines ever flew in an active fighter group, which was formed on 18th June 1940 and conducted missions for just a week. After the fall of France 12 VG33s were confiscated by the Luftwaffe, perhaps for fighter training.

- Bloch 157 (close to a Fw190). The MB.157 was the last development of the MB.150 series (Bloch 152 and 155 issued to the French 1940 air force). The MB.157 had a speed of 710 km/h at 7850m with its Gnôme & Rhône 14R of 1700 hp!

Note: In 1940 the Bf-109E reached 556 km/h and the Spitfire MkI 580 km/h.

**Armored fighting vehicles:**
- B1ter heavy tank
- Somua S40 medium tank
- SAu40 self propelled gun (for heavy support and also as self-propelled AT gun)
- ARL40 self propelled gun
- Renault G1 tank
- Lots of tank destroyers like the Laffly W15TCC (already used in 1940) in its armored version and the Lorraine 37L tractor armed with the 47mm L/53 AT gun.

**Aircraft carriers:**

In 1939/1940 there were already the "Bearn" aircraft carrier and the "Commandant Teste" seaplane carrier but they were obsolete. Concerning the carrier capable aircrafts, the Loire Nieuport LN.411 and the Vought V156F (dive bombers and torpedo aircrafts) from the French fleet air arm were available.

Two new aircraft carriers for the navy should have been available in 1941-1942 ("Joffre" and "Painlevé"):
- 18,000t
- 236m long
- 34m wide
- Speed 33 knots
- Embarking 40 aircrafts (15 fighters and 25 attack aircrafts)
- Armament: 8x 130mm AA guns, 8x 37mm AA guns, 28x 13.2mm AAMGs
- Crew: 70 officers, 1180 NCOs and men

The "Joffre" construction started in March 1940 but reached only 20% before the armistice. The "Painlevé" was never started.

The aircrafts intended for these new aircraft carriers were:

- Fighters:
  - Dewoitine D.790 (navalized version of the Dewoitine D.520)
  - Several twin-engined attack aircrafts (which is new on an aircraft carrier at the moment):
    - CAO 600 (Constructions Aéronautiques de l'Ouest) (380 km/h)
    - Dewoitine D.750 (360 km/h)
    - Bréguet 810 (derived from the Bréguet 693 attack aircraft)
- Other single engined attack aircrafts:
  - Latécoère 299 (350 km/h) (derived from the Latécoère 298 seaplane)

**Radar:**

Here is some information on French radar development, taken from Louis Brown's "A radar history of World War Two: technical and military imperatives", Institute of Physics Pub., 1999. His account draws heavily on papers presented at a IEE Conference and expanded for publication in Robert Burns' "Radar development to 1945", London, Peter Peregrinus, 1988 as well as some articles in French Magazines.

The pioneers were:
- Pierre David, at the Laboratoire National de Radioélectricité, who, by 1934, had created a radio "barrier" ("barrage" in French), consisting of a transmitter and a widely separated receiver, which sensed a disturbance when a plane passed between them. These barriers were soon installed at the ports of
Cherbourg, Brest, Toulon and Bizerte, on a ship- and aircraft-detection role, but observations were difficult to interpret.

- Camille Gutton, at the Société Française Radio-Electrique (SFR), who created a very low-powered continuous-wave 16-cm set (less than 1W), tried unsuccessfully on aircraft in 1934 and installed aboard a French liner in 1935, also not very successfully.

As a second step, David devised a method of using multiple stations to determine direction and speed, by using observed Doppler shift on each station. The system could easily be confused by multiple aircraft or formations in the observed area. Nevertheless, both the Army and the Navy ordered sets (12 stations (fixed) along two lines around Reims and in the Argonne and 20 mobile for the Army, at least two stations built and 4 more planned for the Navy). In October 1938, he proposed, without much of a favourable reception, a pulse-echo system, which would in theory allow for direct ranging. Gutton, on his turn, developed a 16 cm pulsed set, installed at Brest, but the lack of a suitably-powered transmitter at such small wavelengths did not enable aircraft detection, only short range ship detection and ranging.

Finally, on April 1939, the British disclosed their work on radar, which led to orders for pulse radars with a 6 meters, 12 kW transmitter produced by SADIR in October 1939, with a detection range of 60 km. The British air-defence radar grew out of a public debate in the British Parliament in 1935 about protection from bombers in case of a war. The RAF believed that the air war would be a strategic bombing duel. As a result, its performance was poor when it was fighting in France, and of course as a strategic bombing force it was hopeless, but when as a result of entirely unplanned circumstances (i.e. utter defeat resulting in the fall of France) it found itself in the situation that it had planned for, i.e. fighting a strategic bombing offensive, then it performed well.

As an aside regarding Gutton's work, virtually every country started research using cm-wave, but gave up after a while, because of low power. Only the discovery of the magnetron enabled functional cm-wave sets to be created. As can be seen, initial interest was naval, a pattern repeated in Germany and, IIRC, in the USA, perfectly reasonable considering the huge advantages accruing to the possession of radar. The Air Force, apparently, never got involved with radar at the beginning. This is probably an important clue as to why the British had a better system: they developed radar from the outset to be part of an air defence command structure, and not as a technological tool that had to be integrated afterwards in the existing system. Having discovered early the advantages of integration [considering weapons as a system, to put it another way] they remained in the lead throughout the war, even when their equipment was technically inferior (something true as regards Germany until the introduction of cm-wave radar, in 1942-1943).

If the French have had fully operational radar systems in June 1940. German losses could have been higher, true, but the range were shorter than at the English Channel (less warning time). Nevertheless the British planned to deploy radars on French ground during 1940 which could have played a key role during a German attack launched in 1941 rather than in May 1940.

**Atomic bomb:**

Several French scientists were already working on the basis of the development of an atomic bomb in 1939-1940. At the time of the German invasion, France did not just own the biggest amount of uranium oxide than any other country on earth, but also all heavy water available in Europe: 185 kg was what the French special envoy Jacques Allier (French military intelligence service) did buy in March 1940 from the Norwegian company Nosk Hydro and had sent in 12 sealed aluminum containers to France. During the 16-17th June night, the heavy water was shipped to Great Britain on the order of the ministry of armament (order signed by Bichelonne) to continue the researches.

On May 16th 1940 did the telephone ring in Henri Moreut's office, the deputy director of the laboratory of nuclear chemistry at the "Collège de France". Joliot-Curie was calling and ordered his subordinate to him. Visibly agitated he told him: "The front at Sedan has collapsed. Dautry just rang me. We have to secure the heavy water!". During the same night the containers containing the valuable "Product Z" (as it was called) were moved to central France, to prevent the Germans, who were already close to Paris, from getting any knowledge about his research. This was completely in vain, because a few days later German troops captured a copy of this file, together with lots of other documents of the French Ministry of Defense.

Joliot stayed alone in Paris, because he didn’t want to leave his valuable laboratory equipment, among it the just completed first Cyclotron in western and central Europe. He ordered his subordinates Hans-Heinrich Halban and Lew Kowarski, who were running a temporary branch of the Centre of nuclear chemistry and nuclear physics in the villa "Clair Logis" to bring the heavy water to England via Bordeaux. Halban explains:" During one night we left our valuable cargo in the jail of Riom which was the most secure place. The heavy water was finally loaded on the British transport ship "Broompark" in Bordeaux. Lord Suffolk and Berkshire, the scientific attache of the British embassy in Paris accompanied the valuable freight. This adventurous British aristocrat had once in his youth run away from home and joined a ship's crew. During his time as a sailor he learned some carpentry, which was now very useful. In hurry he built a seaworthy raft on which the aluminium jerry cans containing the "Product Z" and industrial diamonds with the value of 2 1/2 million Sterling pounds were sored. Halban and Kowarski had to swear to
the Earl of Suffolk that in case of the ship getting damaged, e.g. through being torpedoed or striking a mine, they would help getting the raft out of the cargo compartment and would stay with it. These precautions proved to be unnecessary. The ship with the strategically important cargo reached England safely. A ship, which left Bordeaux at the same time was sunk by the Germany and Joliot managed to pass the wrong information to the Germans that the heavy water was on this ship.
Main sources:

- "1940 L'infanterie" (collection armes et uniformes, François Vauvillier)
- "Chars B au combat - Hommes et matériels du 15e BCC" (Stéphane Bonnaud)
- "Cours des officiers spécialistes artificiers - conférence sur les munitions" (Parc régional de réparation et d'entretien du matériau de Bourges, mars 1940)
- "Denkschrift über die französische Landesbefestigung" (Berlin 1941)
- "France 1940 – l'armement terrestre" (Stéphane Ferrard)
- "Hommes et ouvrages de la Ligne Maginot" (3 volumes, Jean-Yves Mary et Alain Hohnadel)
- "Il était une fois la Ligne Maginot" (Jean-Bernard Wahl)
- "Kennblätter fremden Geräts" (Heft 8a und Heft 8b) (Berlin 1941)
- "L'armement de l'infanterie française 1918-1940" (Gazette des armes, special edition)
- "L'automobile sous l'uniforme" (François Vauvillier)
- "Les automitrailleuses de reconnaissance – tome 1 : l'AMR 33 Renault" (François Vauvillier)
- "Les automitrailleuses de reconnaissance – tome 2 : l'AMR 35 Renault" (François Vauvillier)
- "Les engins blindés français 1920-1945" (Pierre Touzin)
- "Les matériels de l'armée de terre française 1940" (2 volumes, Stéphane Ferrard)
- "Les véhicules blindés français 1900-1940" (Pierre Touzin)
- "The French army 1939-1940 – organisation, order of battle, operational history" (4 volumes, Lee Sharp)
- Direction Générale de l'Armement, various official technical documents from 1939-1940
- Service Historique de l'Armée de Terre
- Trackstory n°1 : Somua S35
- Trackstory n°2 : Panhard 178
- Trackstory n°3 : Renault B1bis
- Trackstory n°4 : Renault R35/40
- Various 1936-1940 French military manuals including:
  - "Aide-mémoire de l'officier de cavalerie en campagne" (Ministère de la Guerre, 1939)
  - "Aide-mémoire de l'officier de réserve d'infanterie" (Lieutenant-Colonel Arendt, 1940)
  - "Aide-mémoire d'instruction pour les unités de chars légers – instruction tactique du chef de char" (1936)
  - "Aide-mémoire du mitrailleur" (Capitaine Vidal, 1939)
  - "Aide-mémoire pour les travaux d'état-major" (École Supérieure de Guerre, 1939)
  - "Connaissance et emploi des armes et engins de l'infanterie" (Lieutenant-Colonel G. Paillé, 1937)
  - "Description et entretien du matériel et des munitions de 155 C. Mle 1917" (Ministère de la Guerre, 1932)
  - "Instruction générale sur le tir de l'artillerie" (Ministère de la Guerre, 1940)
  - "Instruction générale sur le tir de l'infanterie" (Ministère de la Guerre, 1940)
  - "Instruction pour les unités dotées d'armes lourdes" (Ministère de la Guerre, 1940)
  - "Instruction provisoire pour la pièce de mortier de 60mm modèle 1935" (Ministère de la Guerre, 1938)
  - "Instruction provisoire pour les sections d'éclaireurs motocyclistes d'infanterie" (Ministère de la Guerre, 1940)
  - "Instruction sur le matériel automobile, la conduite des véhicules et les colonnes automobiles" (Ministère de la Guerre, 1939)
  - "Instruction sur l'emploi tactique des grandes unités" (Ministère de la Guerre, 1937)
  - "La recherche des renseignements dans les corps de troupe et les unités subordonnées – annexe 1 au règlement de l'infanterie" (Ministère de la Guerre, 1939)
  - "L'enseignement du combat" (2 volumes, Commandant Bouron, 1936)
  - "Manuel du gradé de l'armée de l'air" (Ministère de la Guerre, 1938)
  - "Manuel du gradé d'infanterie" (Ministère de la Guerre, 1940)
  - "Manuel du gradé du génie" (Ministère de la Guerre, 1936)
  - "Manuel du mitrailleur de terre contre avions – instruction provisoire pour les sections de mitrailleuses de D.A.T. modèle 1930" (Ministère de la Guerre, 1937)
  - "Manuel du service en campagne de cavalerie" (Lieutenant-colonel A. Dalmay de la Garenne, 1938)
  - "Notice d'emploi des chenillettes d'infanterie" (Ministère de la Guerre, 1940)
  - "Notice provisoire de la tourelle APX.1" (Atelier de Construction de Puteaux, 1936)
  - "Notice provisoire de la tourelle APX.4" (Atelier de Construction de Puteaux, 1937)
  - "Notice provisoire de la tourelle APX.R" (Atelier de Construction de Puteaux, octobre 1936)
  - "Notice d'instruction sur le canon de 75mm SA Mle 1935 - figures" (Lieutenant Courtier, 1939)
  - "Notice de canon de 47 SA 1935" (Ministère de la Guerre, Septembre 1939)
  - "Précis de tir et arment de l'infanterie" (Lieutenant-Colonel G. Paillé, 1939)
  - "Règlement de l'infanterie – Première partie – instruction" (Ministère de la Guerre, 1940)
  - "Tables de tir du matériel de 47mm Mle 1937 – projectile perforant modèle 1936" (Ministère de la Guerre, 24 septembre 1939)
Other sources :

- "1939-1940, batailles pour la France" (Patrick de Gmeline)
- "1939-40 Combats sur la ligne Maginot" (Société d'Histoire et d'archéologie du Ried Nord, 1991)
- "39-45" magazines
- "Abbeville 1940 - avec la division cuirassée de Gaulle" (Jean Marot)
- "Ardennes 1940 – tenir l" (Gérald Dardart)
- "Avec la 3° DLM et le corps de cavalerie" (G. Delater)
- "Avec le 15° BCA – notes de guerre" (Edouard Vincent)
- "Avec les héros de 40" (Marc-André Fabre)
- "Batailles & Blindés" magazines
- "Blitzkrieg à l'Ouest, Mai-Juin 40" (Jean-Paul Pallud)
- "Boulogne 1940 – mourir en chantant" (André-Georges Vasseur)
- Bulletin de liaison de l'association des amis du musée du canon et des artilleurs :
  - N°15 : L'artillerie dans la bataille des Alpes en 1940 (partie 1)
  - N°17 : L'artillerie dans la bataille des Alpes en 1940 (partie 2)
  - N°18 : L'artillerie en mai 1940 dans la bataille de Gembloux et le repli vers Dunkerque
  - N°20 : L'artillerie en mai et juin 1940 dans la Ligne Maginot
  - N°23 : L'artillerie de la 3° DLM du 14 mai au 7 juin 1940 - sud de Sedan - bataille de Stonne
  - N°25 : L'artillerie lourde hippomobile dans la Blitzkrieg de 1940
- "Ceux de la cavalerie 1939-1940" (Francis Rico)
- "Ceux de l'artillerie 1939-1940" (Etienne Dubuisson)
- "Ceux des chars – 45 jours, 45 nuits" (Pierre Voisin)
- "Ceux de l'infanterie 1939-1940" (Jean Tournassus)
- "Combats par -30°" (Henri Chenavas)
- "Comme des lions – mai/juin 1940 – le sacrifice de l'armée française" (Dominique Lormier)
- "Corps à corps avec les blindés" (Henri Lespès)
- "De Gaulle sous le casque – Abbeville 1940" (Henri de Wailly)
- "Des forêts d'Alsace aux chemins de Normandie – La 43° division d'infanterie dans la guerre, 3 septembre 1939 – 26 juin 1940" (Thibault Richard)
- "Divided and Conquered : The French High Command and the Defeat of the West, 1940." (Jeffery A. Gunsburg, 1979)
- "En auto-mitrailleuse à travers les batailles de mai" (Guy de Chézal)
- "Fallait-il sauver le char Bayard ?" (René Boly)
- "Franc tirreur en uniforme" (André Sernin)
- "Gembloux 1940 … Echec à la 4° Panzer" (Marcel Pieret)
- "Gembloux" (Henri Aymes)
- "Groupe Franc" (Albert Merglen)
- "Guderian's XIXth Panzer Corps and the Battle of France : Breakthrough in the Ardennes, May 1940." (Florian K. Rothbrust)
- "Histoire de la ligne Maginot" (Roger Bruge)
  - volume 1 : "Faites sauter la ligne Maginot"
  - volume 2 : "Offensive sur le Rhin"
  - volume 3 : "On a livré la ligne Maginot"
- "Histoires de Guerre" magazines
- "Historica" magazines
- "Historique des 2° et 202° régiments d'artillerie – campagne de 1939-1940"
- "Historique du 7° bataillon de chars légers F.C.M"
- "J'étais médecin avec les chars" (André Soubiran)
- "Juin 1940 – combats sur le Rhin et dans les Vosges" (J.-Martin Busser)
- "Juin 40 le mois maudit" (Roger Bruge)
- "Koh Chang, the unknown battle – Franco-Thai war of 1940-1941" (Jurg Meisler, World War II Investigator, XIV, 1989, 26-34)
- "La 2° division d'infanterie pendant la campagne de 1939-1940 – Le lion des Flandres à la guerre" (Robert Villate)
- "La 3° division d'infanterie motorisée 1939-1940" (General Bertin-Boussu)
- "La 36° division d'infanterie à l'honneur, 1939-1940" (F. Soulet)
- "La bataille de France, mai-juin 1940" (Pierre Lyet, 1947)
- "La bataille de Metz (42° DI) pendant la bataille de France" (Général Pierre Keller)
- "La bataille de Rethel 16 mai – 10 juin 1940" (Robert Marcy)
- "La bataille au sud d'Amiens, 20 mai – 8 juin 1940" (P. Vasselle)
- "La campagne de 1940" (Christine Levisse-Touzé)
- "La division de fer dans la bataille de France, 10 mai - 25 juin 1940" (Pierre-Georges Arlabosse)
- "La division de Metz (42° DI) pendant la bataille de France" (Général Pierre Keller)
- "La division de Savoie (28° DIA) pendant la guerre 1939-1940" (Revue de Savoie 1941/1942)
• "La Ligne Maginot Aquatique" (Paul Marque)
• "La randonnée du 9e Zouaves 1939-1940" (Lieutenant-colonel Tasse)
• "La victoire évaporée – Abbeville 1940" (Henri de Wailly)
• "L'Armée Blindée Française (volume 1) : Mai-juin 1940 ! Les blindés français dans la tourmente" (Gérard Saint-Martin)
• "L'arrière garde meurt mais ne se rend pas ! La tragédie des Flandres, 1940" (Pierre Porthault)
• "Le 1er Régiment de Chasseurs Parachutistes" (Pierre Dufour)
• "Le 19e Groupe de Reconnaissance Divisionnaire (1939-1940)"
• "Le 7e GRDI dans les combats du 10 mai au 4 juin 1940" (Laurent Soyer)
• "Le 9-9 dans la tourmente 1939-1945" (André Mudler and Yves Lacaze)
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• "Les Cadets de Saumur" (Antoine Redier)
• "Les cinq jours de Toul" (Pierre Ordioni)
• "Les combats du Mont-Dieu – Mai 1940" (Gérard Giuliano)
• "Les combattants du 18 juin" (Roger Bruge)
  o volume 1 : "Le sang versé"
  o volume 2 : "Les derniers feux"
  o volume 3 : "L'armée broyée"
  o volume 4 : "Le cessez le feu"
  o volume 5 : "La fin des généraux"
• "Les Corps Francs 39/40" (Patrick de Gmeline)
• "Les mille victoires de la chasse française, mai-juin 1940." (Jean Gisclon)
• "Les Panzers passent la Meuse" (Paul Berben and Bernard Iselin)
• "Les soldats de 40 dans la première bataille de Normandie – de la Bresle au Cotentin" (R.G. Nobécourt)
• "Les soldats de la drôle de Guerre" (François Cochet)
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• "Mai - Juin 1940, les blindés français" (Ronald McNair)
• "Military" magazines (especially special issues n°4, 8, 17, 21, 31, 34)
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• "Les Panzers passent la Meuse" (Paul Berben and Bernard Iselin)
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• "Les soldats de la drôle de Guerre" (François Cochet)
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• "L'escadron de Segonzac" (Olivier d'Ormesson)
• "Mai - Juin 1940 : défaite française, victoire allemande, sous l'œil des historiens étrangers" (Maurice Vaïsse)
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• "Les Panzers passent la Meuse" (Paul Berben and Bernard Iselin)
• "Orage in Champagne, l'ultime bataille – 12 juin 1940" (Claude Antoine)
Websites:

- [http://france1940.free.fr/](http://france1940.free.fr/) (Nowfel Leulliot's website) and its discussion group with skilled and gentle people
- [http://enpointe.chez.tiscali.fr/oobs.html](http://enpointe.chez.tiscali.fr/oobs.html) (Stéphane Commans's website)
- [http://www.lignemaginot.com/index10.htm](http://www.lignemaginot.com/index10.htm)

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