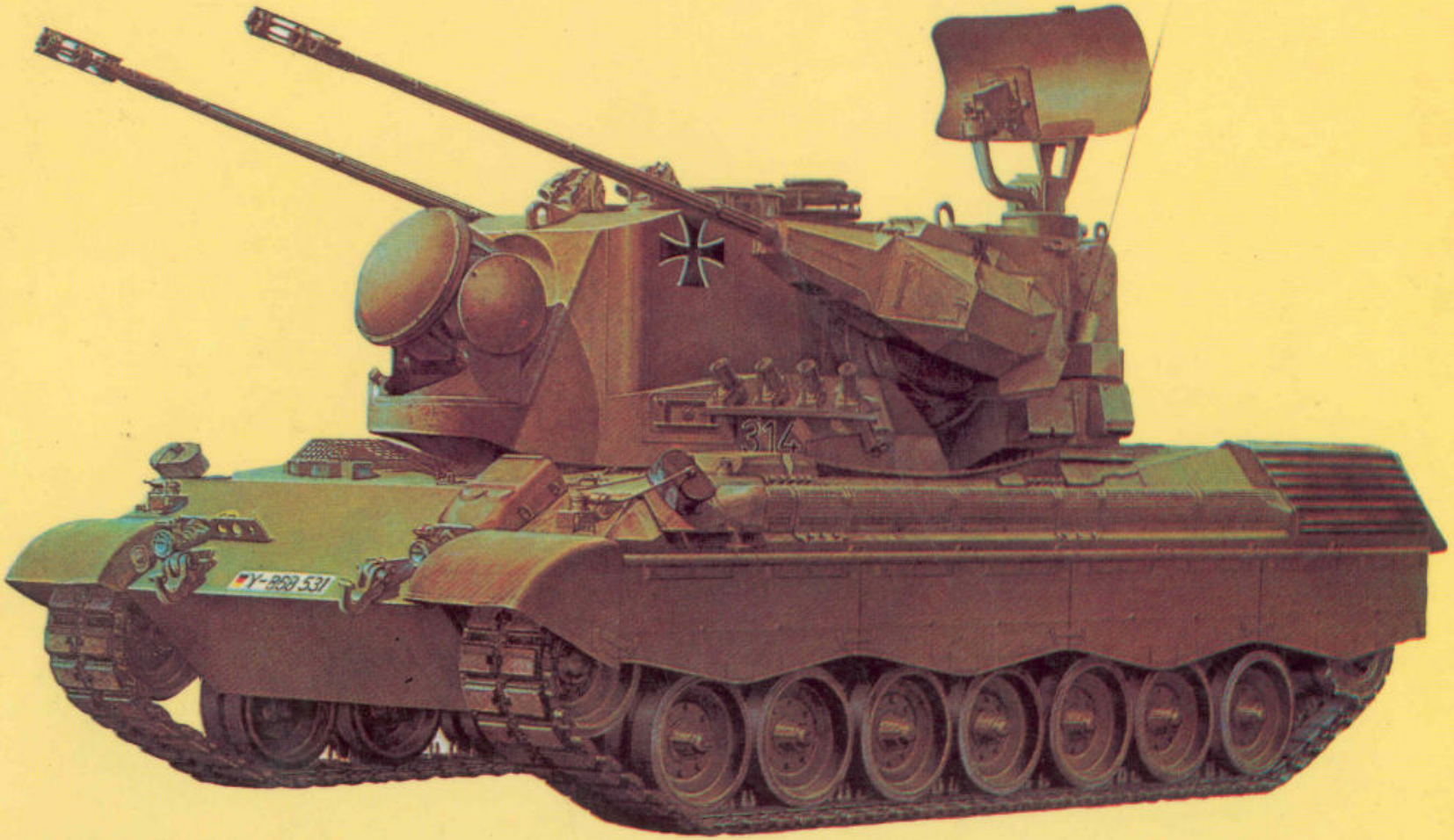
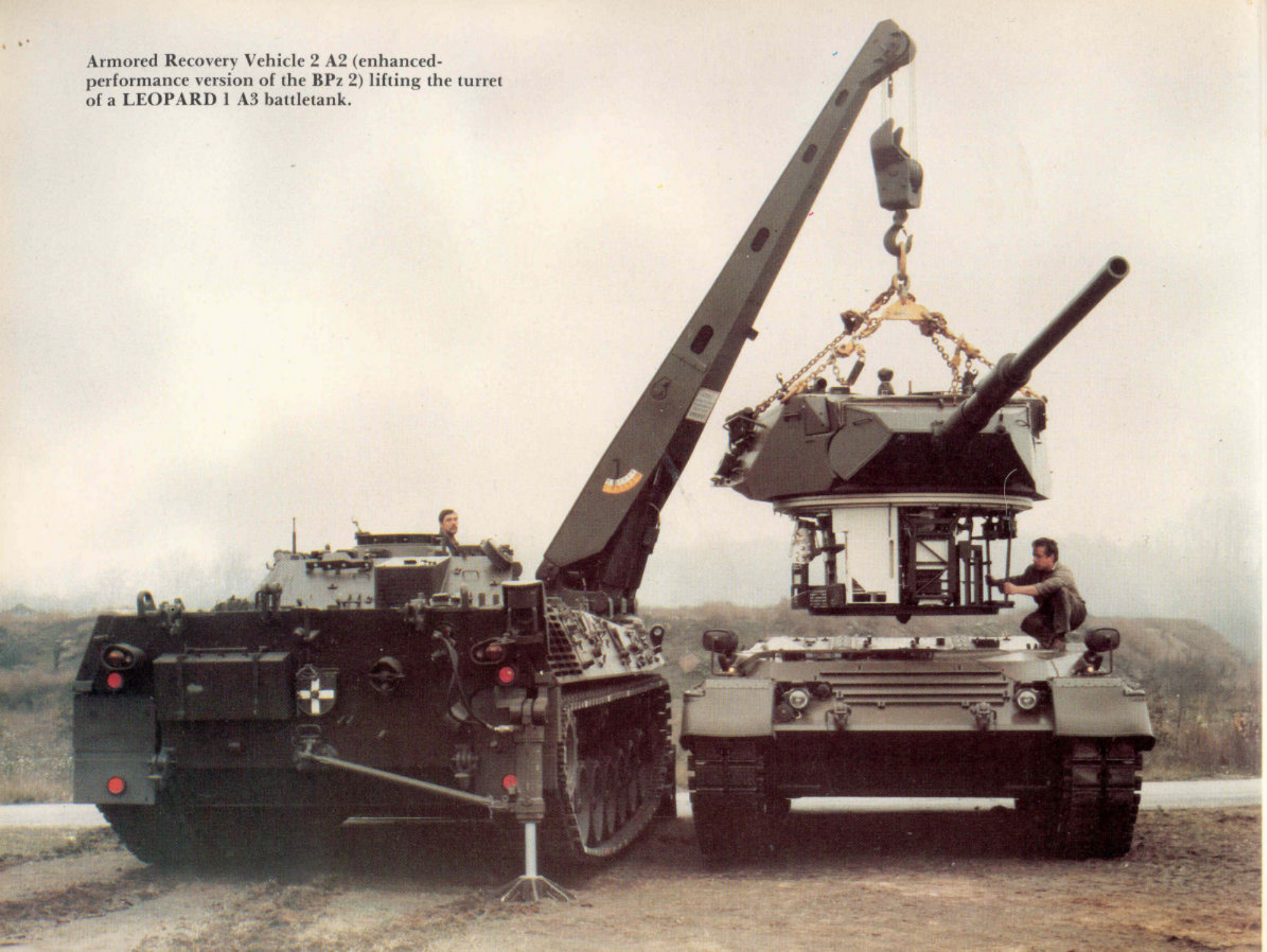
THE LEOPARD-FAMILY

Leopard 1 and 2 - Gepard - Biber -Engineer Tanks - etc.



Michael Scheibert



Armored Recovery Vehicle 2 A2 (enhanced-performance version of the BPz 2) lifting the turret of a LEOPARD 1 A3 battletank.

THE LEOPARD-FAMILY

An Example of Good Family Planning

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ACKNOWLEDGEMENTS AND SOURCES:

For their help in obtaining photographic material I particularly want to thank Messrs. Thiemo Fokjar, W. J. Spielberger, and Major Wolfgang Schneider, as well as the Royal Belgian and Norwegian Embassies.
Additional photos came from the periodicals:
— Soldat und Technik
— Truppenpraxis
— Kampftruppen
— Osterreichische Militärische Zeitschrift
— Schweizer Soldat
— Erkennungsblätter

Firms:
— Krauss-Maffe
— MaK
— Wegman
— Wieger
— Rheinmetall

Archives:
— Battle Troop School 2 of the Federal German Army
— Michael Scheibert

Gothscans ltd

Cover photo:
GEPARD Anti-Aircraft Tank

Library of Congress Catalog Number: 88-63995.

Translated from German by Dr. Edward Force.
Printed in the United States of America.
ISBN: 0-88740-167-8
Published by Schiffer Publishing, Ltd.
1469 Morstein Road, West Chester, Pennsylvania 19380

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The founder of the family, battle tank LEOPARD 1 of the first construction batch, climbing over a barrier. The LEOPARD 1 had a climbing ability of 110 cm and crossed ditches up to 2.90 meters wide.

The LEOPARD 1 battle tanks of the original series production are not yet equipped with side track aprons; likewise the D 130 E2 end-collector-track is not yet equipped with replaceable track pads. The absence of lifting eyes for sea transport on both sides of the hull, as well as the boarding steps at the same height on the sides of the turret, indicate that these are vehicles of the first construction batch. In the background is another family member, the Armored Recovery Vehicle 2.

OVERVIEW

The LEOPARD 1 Battle Tank (see also Volume 84) was delivered to the army as of September 1965. This first German battle tank developed since World War II, along with the related support vehicles, has become one of the greatest export hits of the German armaments industry. In all, some 6000 related vehicles were produced on the basis of the LEOPARD 1 Battle Tank and exported to many countries. These include the Armored Recovery Vehicle 2, the Engineer Tank (PiPz), the BIBER (Beaver) Bridgelaying Tank and the GEPARD (Cheetah) or CA 1 Anti-Aircraft Tank. All the family vehicles, including the founding father, the LEOPARD 1 Battle Tank, have been and are being constantly up-rated in performance and battle value, in order to keep up with the levels of military threat and technical progress.

In addition to the series-production vehicles there are a number of Leopard 1-oriented export versions being produced outside Germany, as well as a large number of experimental developments.

The LEOPARD 2 Battle Tank, delivered as of 1979 (see also Volumes 69 and 98), is not a further development of the LEOPARD 1, but a ground-breaking new development, which has also experienced a series of battle-value enhancements. Aside from several experimental developments, there is at this time only the driving school cab version, similar to that of the LEOPARD 1.

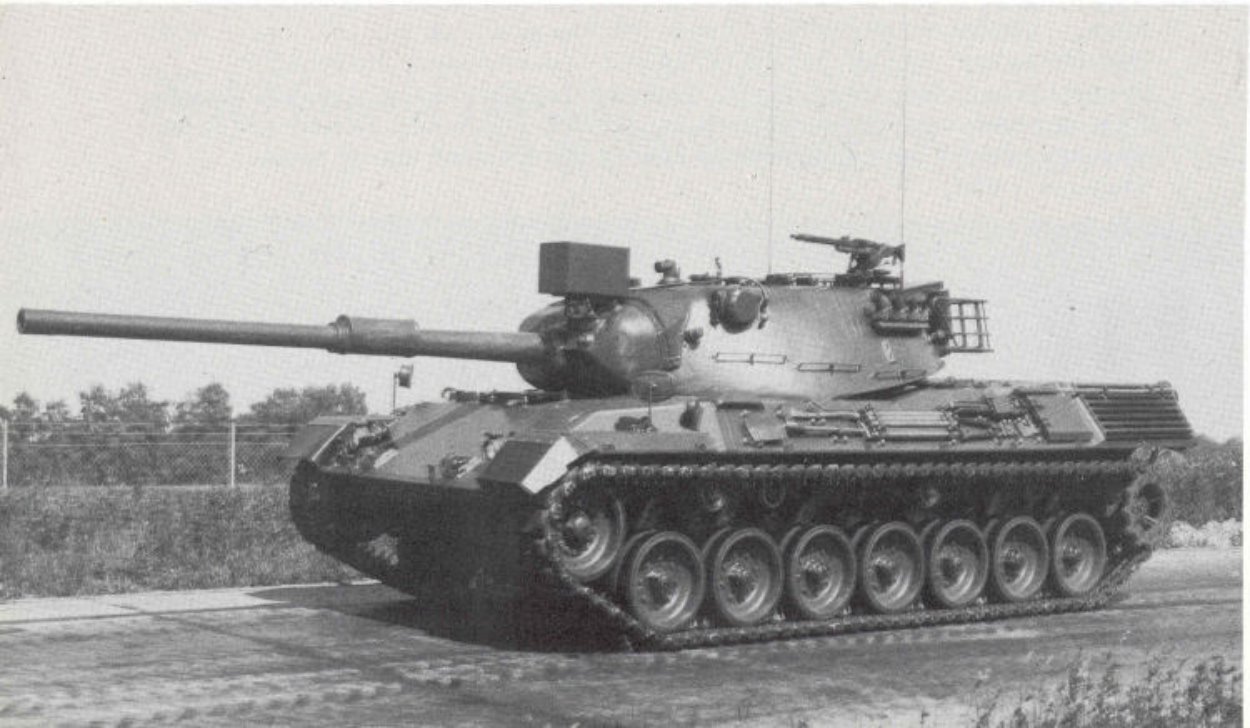
It is to be expected that the LEOPARD 1 will remain in use until the end of the Nineties, the LEOPARD 2 until into the next century, for which the necessary battle-value enhancements are being designed now or are already in production.

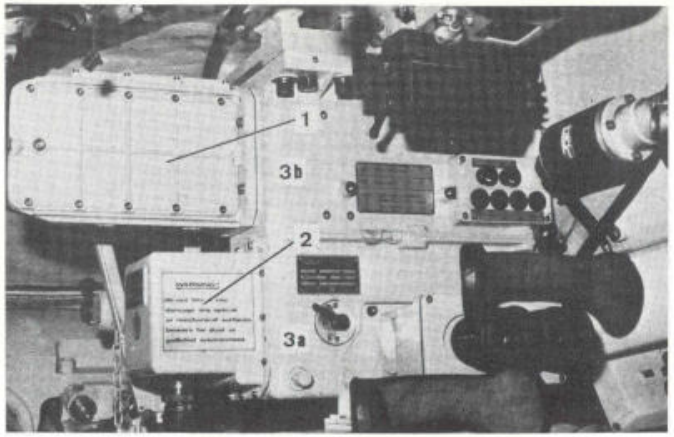
Three vehicles of the LEOPARD family, from right to left: LEOPARD 1 A4 Battle Tank (large observation bulge of the PERI R12 panoramic periscope on top of the turret), Armored Recovery Vehicle 2 (differing from Engineer Tank 1 by having, among other things, no ladder on the crane boom), and the BIBER Bridgelaying Tank. The use of the same production units has great logistic advantages; along with the performance capability of the vehicles, it is one of the reasons for the great success of the LEOPARD family. (MaK)

Below: Although both battle tanks bear the name of LEOPARD, these are two completely different vehicles. At left is a LEOPARD 1 A3 with welded turret, customary fire-control system, 105 mm gun with a rifled cannon and 830-HP motor. At right is a LEOPARD 2 with computer-directed fire-control system, laser range finder, primary stabilized optics, 120 mm smooth-bore gun, new-type armor protection and 1500-HP motor. Strictly speaking, the two vehicles form their own families with the same family name. (Krauss-Maffei)

LEOPARD 1 BATTLE TANK

The developmental history of the "Standard Tank", as the LEOPARD 1 was first called, goes back to 1955, when the concept and definition phase began. In connection with the results of the standing Armaments Commission of the WEU, a military pact was made between the Federal Republic of Germany and France with the goal of developing a common battle tank. In 1958, Italy also joined this pact. According to the trilateral military and technical requirements established in the same year, the German Industrial Groups A (Porsche, Jung, MaK, and Luther & Jordan) and B (Warneke Engineering Bureau of the Ruhrstahl firm, Henschel and Hanomag), as well as the French Atelier de Construction Moulineaux (AMX) each produced two prototypes. The first trilateral comparison test of the German and French prototypes took place during March of 1961 in France (Bourges and Satory) and the Federal Republic of Germany (Meppen). The tank development of the German Industrial Group C (Borgward), which held unusual ideas for those times, had to be abolished because of the firm's financial collapse in 1961. At the beginning of 1959 the development of the Standard Tank Prototypes II began: their preparation was taken up in September of 1960. Since the hydropneumatic suspension, the new-type steer-shift transmission as well as the two-stroke diesel tank motor of Industrial Group B gave trouble and were not satisfactory, the preparation of Industrial Group B's Standard Tank was discontinued in 1960. Within the framework of the trilateral tank development, Prototype II of Industrial Group A was compared with the improved French AMX development in a comparison test in September of 1962. As early as October of 1961 the manufacture of fifty zero-series tanks began. The delivery of





LEOPARD 1 battle tank of the Belgian army. These vehicles are equipped with the Cobelda computer-directed fire control system of the SABCA firm, a laser range finder, and the Cadillac-Gage weapons stabilization system. This interior photo shows part of the gunner's position with the gunner's periscope in the upper right, the laser range finder including power source and binocular viewer under it; in the center at the lower edge of the picture is the forehead brace of the turret-aiming telescope. In addition, the LEOPARD 1 (BE) differs from the German version in having the DOM 410 radiation detection device built in, as well as in the secondary armaments (anti-aircraft and hatch-mounted machine guns made by the FN firm) and the gun mantlets that go with them.

Left: LEOPARD 1 battle tank (original series production) of the 4th production batch); vehicles with this armament were also exported to Belgium, Italy, The Netherlands and Norway. At first they were still equipped with the old linking-bar tracks with vulcanized track pads, but now have changed exhaust covers without vertical steps and welded rings like the vehicles of the third production batch.

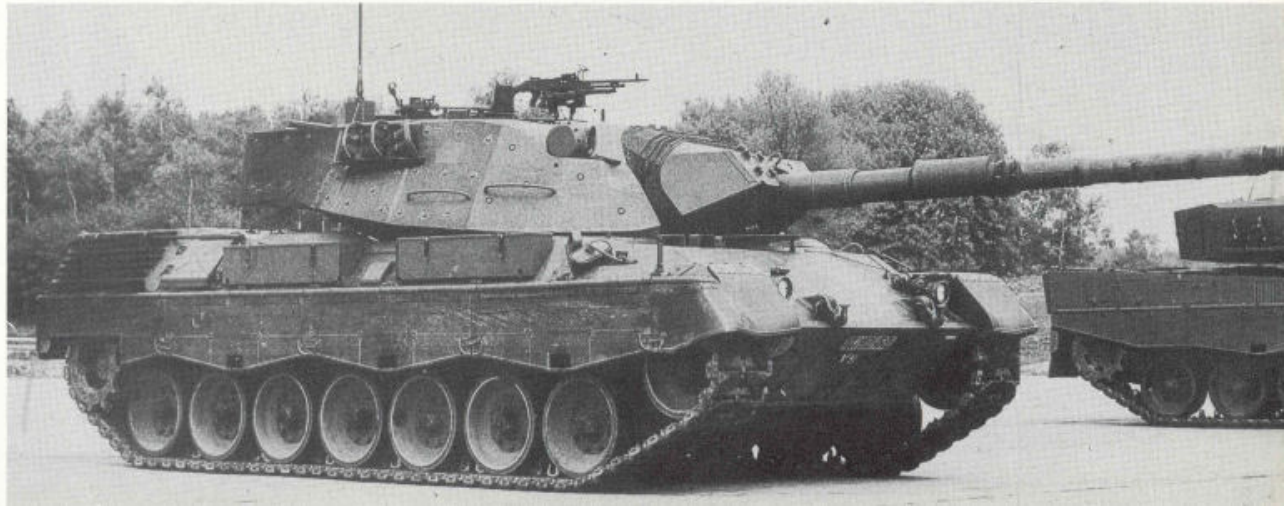
these vehicles to Test Centers 41 and 91 in Meppen and Trier and to Battle Troop School 2 in Münster took place as of June 1963.

In July of 1963 the Defense Committee of the German Parliament decided to put the German Standard Tank into series production and equip it with a British 105 mm cannon. Despite this, the planned comparison test of this tank, by now already named LEOPARD, with the AMX 30 was carried out in mid-September of 1963. This comparison was thoroughly favorable to the LEOPARD. The troop test took place between July 1964 and October 1965 in Tank Training Battalion 93 in Münster; important results of this testing affected the series production as of September 1965.

LEOPARD 1 battle tank of the Netherlands army, with changed aiming optics, Belgian secondary armament, a smoke-discharging system of Netherlands manufacture, and outboard stowage bins.

Right: LEOPARD 1-V battle tank, the enhanced-performance version of the LEOPARD 1 (NL). Battle tanks with changed armaments of this typewere equipped with, among other things, increased armor protection, track aprons, and the computer-directed AFS-L-2 integrated fire-control system.

LEOPARD 1 (BE) now with new D 640 A end-collector-tracks.



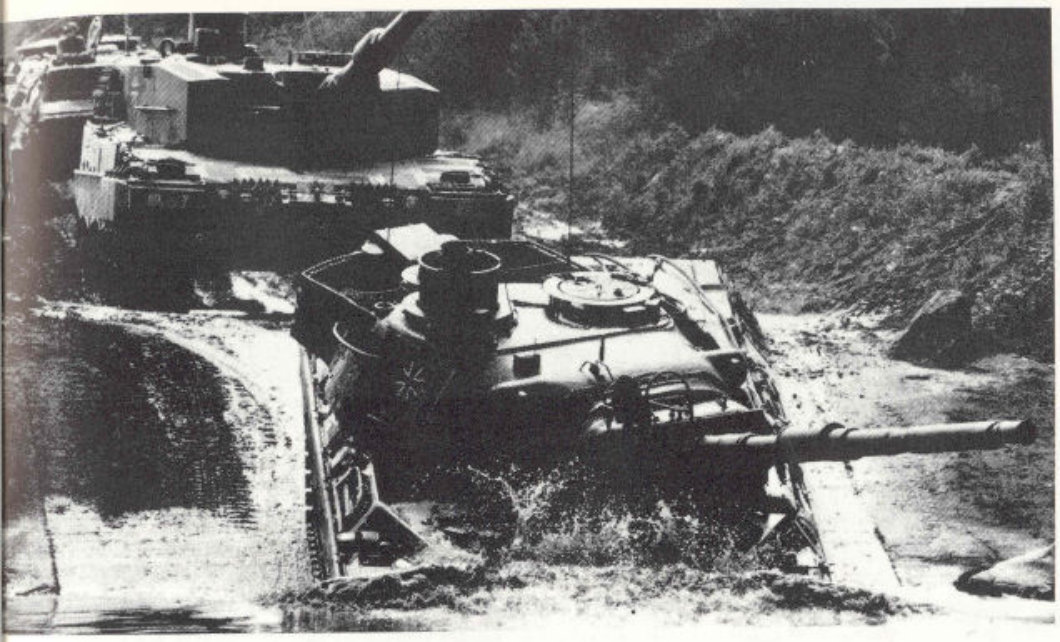
LEOPARD 1 A1 and A1A1

The first enhancement of the LEOPARD 1 Battle Tank's fighting value was begun in 1970; at that time the vehicles of the original series production received a weapons-stabilizing system, which allowed limited firing while underway, lateral track aprons, a thermal sleeve for the gun, deep-fording equipment, and several other improvements. All four production batches were up-rated in this way, thus gaining a considerable increase in their fighting power. These vehicles were designated LEOPARD 1 A1.

Between 1975 and 1977 the same vehicles were additionally armored with rubber-laminated steel plates elastically attached to the cast turret. The vehicles fitted with the additional turret armor and other internal improvements were designated LEOPARD 1 A1A1.

Production batches 1-4 of the original series production had their battle value enhanced by the addition of a weapons-stabilizing system, thermal sleeves for the gun, lateral apron plates, deep-fording equipment, and image-intensifying night viewers for the driver and loader. The up-rated vehicles are designated LEOPARD 1 A1.

Right: LEOPARD 1 battle tank of the Norwegian army with lateral track skirts and the new D 640 A linking-bar tracks with replaceable track pads. In addition, these vehicles are equipped with an on-board intercom system differing from that of the basic version and modified aiming optics. Of particular interest are the stowage bins on the bow of the vehicle and the red-outlined black turret numbers.



Fighting vehicles crossing a water obstacle.
Front: LEOPARD 1 A1A2 with adapted additional armor and deep-fording shaft on the commander's cupola; in the middle, LEOPARD 2 A1; behind it the amphibious FUCHS Transport Tank. (Soldat und Technik)

Below: A portion of the German Battle Tank 1 fleet was equipped with the PZB 200 passive aiming and observation device. These vehicles can be recognized by the camera mount on the right side of the hatch cover; they bear the A2 designation in second position, here, for example, LEOPARD 1 A1A2.

The LEOPARD 1 battle tanks of the Italian army were almost all produced under license by the OTO Melara firm. They differ from the German basic version by having a different type of on-board intercom system, different aiming optics, and secondary armament with MG 42/59 machine guns.

Below: All LEOPARD 1 A1 (batches 1-4) were up-rated with additional turret armor (here partly removed) and improved combustion air filters; these vehicles bear the designation LEOPARD 1 A1A1.

LEOPARD 1 A2 and A3

In the new construction of the fifth production batch in 1972 and 1973, the two halves of the batch were externally, differently equipped. The first half was given, as version A2, a strengthened cast turret; the second half, as version A3, the angular welded turret with bulkhead armor. Both versions were additionally produced with the improved D 640 A linking-bar tracks, improved engine-exhaust filters, and a new ABC firing ventilation system, image-intensifying night viewers (BIV) for driver and commander, and a turning and tilting periscope for the loader.

As of 1980 the A1A1 to A3 versions were equipped in part with a temporary solution to improve night battle capability, the PZB 200 passive aiming and observation device, which operates on the principle of image intensification. Vehicles equipped in this way are designated with A2 in second position, for example: A1A2.

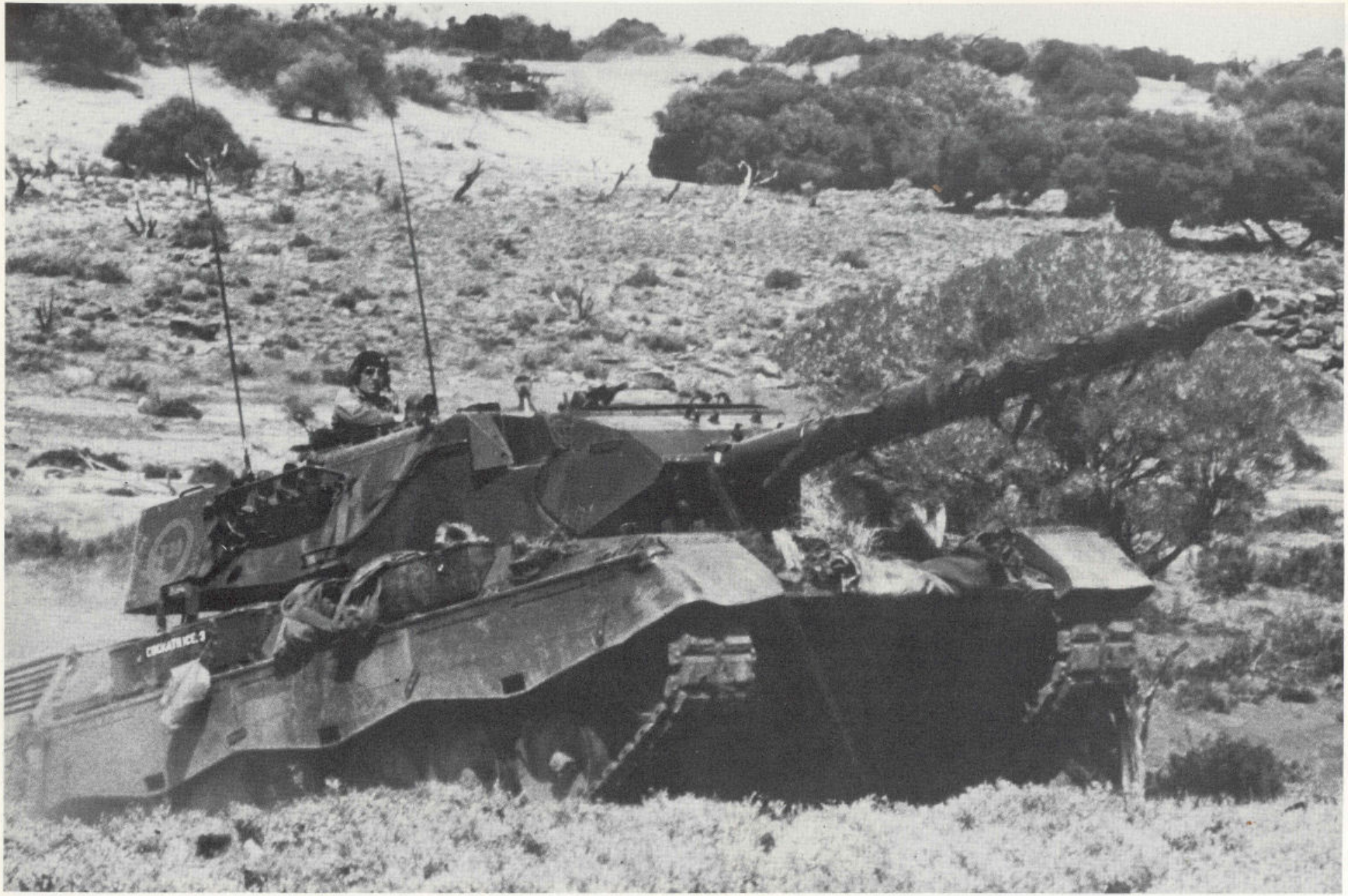
Of the 342 vehicles of the 5th production batch, the first 232 battle tanks were made with a thickened cast turret; they were designated LEOPARD 1 A2 and are externally recognizable by the oval viewing bulges of the range finder. Along with the addition of the new equipment to series production (except the adapted additional turret armor) of the A1 and A1A1, they were equipped with a compactly built ABC firing ventilation system. Readily recognizable on the bow of the vehicle is the snow grouser, interchangeable with the rubber pads of the new D 640 A linking-bar tracks. Because of the 2.4-ton higher fighting weight of 42.4 tons, the power-to-weight ratio decreased in comparison with the original series production, from 20.8 to 19.7 horsepower per ton.

LEOPARD 1 A2 Battle Tank without mounts for a snow grouser. The oval observation bulges of the range finder are recognizable only in side view.

110 vehicles of the 5th production batch received a welded angular turret housing, whereby the inner volume of the turret was increased by 1.5 cubic meters. These vehicles bear the designation LEOPARD 1 A3; they differ from the A2 by being equipped with a turning and tilting periscope for the loader.

Below: LEOPARD 1 Battle Tank of the Danish army. The LEOPARD 1 (DK) have different aiming optics, a periscope wiping and washing system, as well as attachments for a plow blade with electro-hydraulic height adjustment on the lower bow plate. (Krauss-Maffei)

LEOPARD 1 A3 on the march. The welded rolled-steel turret has a wedge-shaped cover and a long, box-shaped rear that allows protected stowage of the aiming light, camouflage net and gun-cleaning brushes. On the basis of this vehicle the export versions for Australia, Denmark, Canada, Greece and Turkey were built.



The LEOPARD AS 1 (Australia) is equipped with an electronic fire control calculator, a laser range finder (viewing opening only on the right), a wind and air-pressure sensor on the turret roof, automatic gearshifting, a plow-blade attachment and outboard stowage bins. (Krauss-Maffei)

Right: In addition to the equipment of the AS 1, the LEOPARD C 1 (Canada) has a cable drum on the right side of the turret, the PZB 200 passive aiming and observation device, a white-light headlight integrated into the turret instead of the left range-finder port, and a wiping and washing system for the driver's periscope, plus the Belgian FN machine gun as secondary armament.

Above: The LEOPARD 1 (GR) exported to Greece is equipped with a stabilized, computer-directed three-dimensional range finder with integrated laser (EMES 12 A3), the PZB 200, hydraulic end attachments for all carrying arms of the running gear, sea-watertight rectifier, powerplant governor, powerplant cover with opening ring grid, a periscope-cleaning system, and camouflage paint. (Krauss-Maffei)

Right: The LEOPARD 1 (TU) (Turkey) corresponds to the GR equipment but is not equipped with camouflage paint or hydraulic end attachments. (Krauss-Maffei)

LEOPARD 1 A4

The 6th production batch (new production) made from 1974 to 1976 received an integrated fire-control system with computer-supported range finder, a fire-control calculator, and a new stabilized panoramic periscope for the commander (PERI R12). In addition, the LEOPARD 1 A4 was equipped with improved controls and an integrated testing system. This enhancement of fighting value considerably increased the first-round hit probability while underway and while halted to shoot, and could simultaneously serve as a basis for future developments in computer-directed fire-control systems.

Two LEOPARD 1 A4 Battle Tanks with their characteristic large covered observation ports of the PERI R 12. (Krauss-Maffei)

Left: The vehicles of the sixth production batch bear the designation LEOPARD 1 A4. They are equipped with a computer-directed fire-control system with three-dimensional range finder and subsequent stabilized optics, including the PERI R 12 panoramic periscope for the commander. In addition, these vehicles were equipped with fully automatic gearshifting.
(Krauss-Maffei)

LEOPARD 1 A4 Battle Tank emerging from the underwater testing basis. After a short preparation time, the LEOPARD 1 is capable of driving through bodies of water with a depth of up to four meters. Vehicle openings with covers are sealed with a hydraulic hand pump in order to prevent water from reaching the engine and fighting compartments. As long as the turret turning ring is sealed, the hatches closed, the underwater driving tower erected on the open commander's hatch, and a few rubber plugs put in place, then nothing prevents underwater driving. Constant observation of the shore and bottom conditions is nevertheless important.

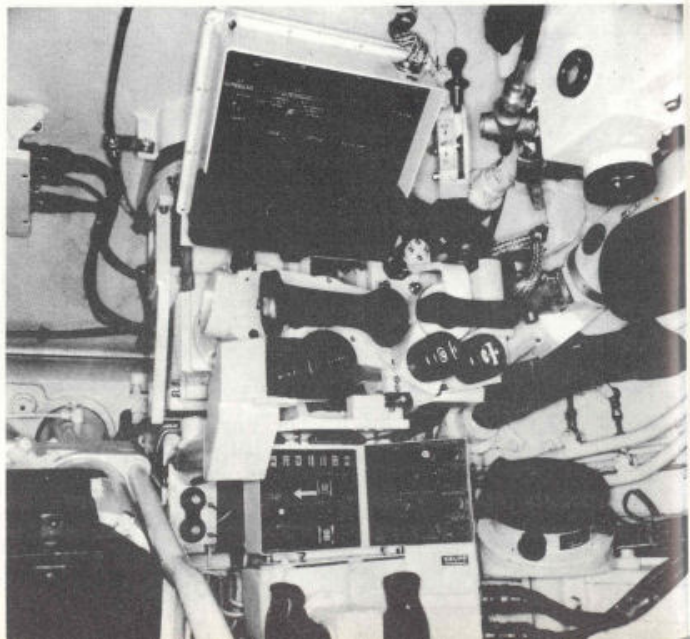
LEOPARD 1 A5 Battle Tank, the newest, enhanced fighting-value version of the LEOPARD 1 for the German army. These vehicles are externally recognizable by the box-shaped periscope exit of the main aiming telescope with heat-sensitive observation device on the turret roof and the panoramic aiming telescope extending out above it. (Kraus-Maffei)

LEOPARD 1 A5, still during testing; the superfluous observation bulges of the three-dimensional range finder have not yet been removed. From this perspective the higher-mounted panoramic periscope can be seen clearly. (Soldat und Technik).

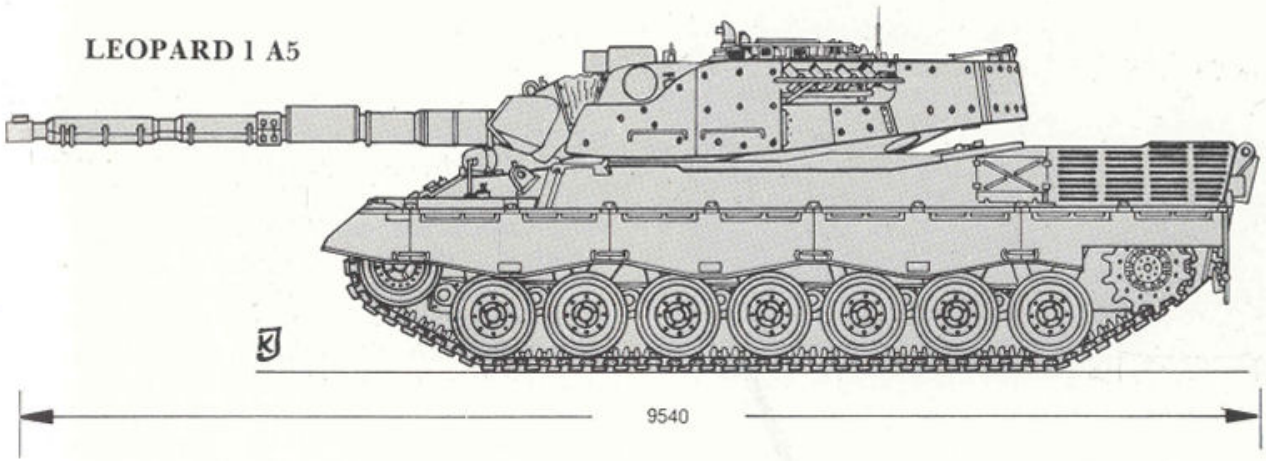
LEOPARD 1 A5

Since the end of 1986, 1850 German army LEOPARD 1 tanks have been equipped with the computer-supported EMES 18 fire-control system with integrated infrared observation device, laser range finder, fire-control computerr, new controls, and improvements in the realms of chassis and turret; proven construction units and components of the LEOPARD 2 Battle Tank were taken over in the process. On the basis of this enhanced fighting value, the LEOPARD 1 A5 Battle Tank is capable of conducting a firefight by day, night and limited sight, with high first-round hit probability using all types of ammunition.

For the A5 version a future up-rating of fighting value is conceivable through the use of new, more effective auxiliary turret armor, the fitting of the 120-mm smooth-bore gun of the LEOPARD 2 Battle Tank, and a fire-extinguishing system.



LEOPARD 1 A5



LEOPARD 1 A5 TECHNICAL DATA

Crew:	4 men
Dimensions:	Length 9540 mm—Width 3370 mm—Height 2400 mm
Fighting weight:	42 tons
Motor type:	10-cyl. multifuel motor, water-cooled, MTU MB838
Motor performance:	830 HP (611 kW)
Speed:	65 kph
Range of operation:	600 km
Armament:	1 105 mm cannon, 1 hatch-mounted 7.62 mm machine gun, 1 7.62 mm anti-aircraft machine gun
Optronic equipment:	infrared observation device (WBG), laser range finder

Left page: Gunner's fighting position in the LEOPARD 1 A5 with EMES 18 fire-control system. Above at the center is the computer control device, to its left, at the left edge of the picture, the laser electronics; monocular scope under the computer control device, the turret-aiming telescope; beside it to the right the binocular scope, the main aiming telescope, under it the gunner's control device. The last serves to switch the varying stages of operation to control the optics and central testing electronics as well as to control the operating conditions of the fire control system. (Soldat und Technik)

LEOPARD 1 A5 in its final form, without the observation bulges of the formerly used three-dimensional range finder; the field-adjusting system is mounted on the muzzle of the gun. (Soldat und Technik)

EXPORT VERSIONS OF THE LEOPARD 1

The LEOPARD 1 is in use in ten countries on four continents. In addition to the 2437 LEOPARD 1 Battle Tanks built for the German army, the following were built for export:

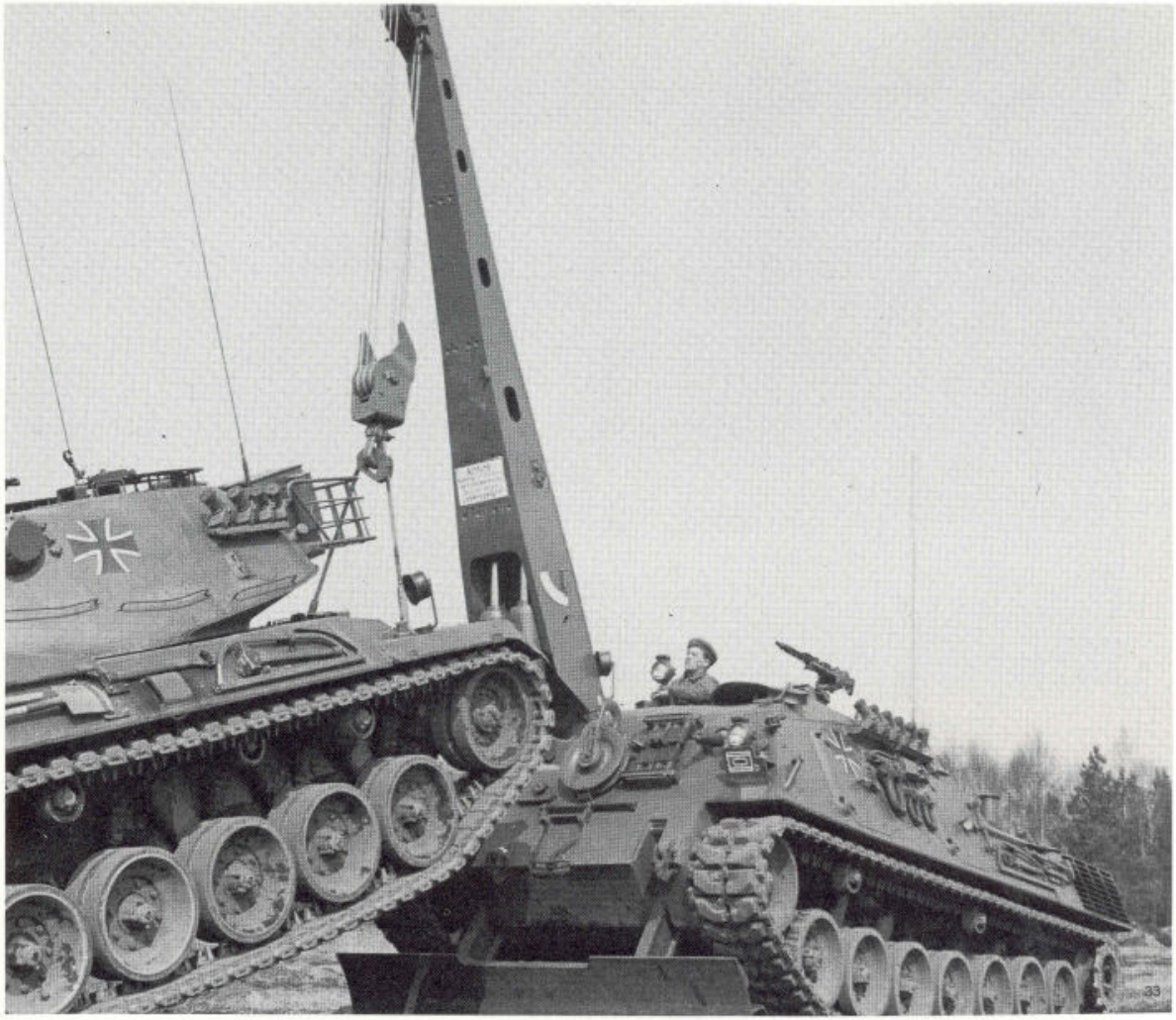
— on the basis of the A1
334 tanks for Belgium
468 tanks for The Netherlands
78 tanks for Norway
200 tanks for Italy (720 additional tanks were built under license)

— on the basis of the A3
120 tanks for Denmark
90 tanks for Australia
114 tanks for Canada
106 tanks for Greece
77 tanks for Turkey

The difference from the German basic version is sometimes considerable, particularly in terms of fire-control system, radio equipment and secondary armament.

The Italian firm of OTO Melara offers on the world market an adaptation of the LEOPARD 1 in various versions as an export model, under the name OF 40.

Export tank of the Italian armament industry, OF 40 Mark 2 of the OTO Melara firm. Eighteen OF 40 Mark 1 tanks were built for Dubai and revised to Mark 2 status (fire-control computer), another eighteen Mark 2 tanks were delivered new from the factory. (Soldat und Technik)



The construction batches of Armored Recovery Vehicle 2 are up to 75% identical to and interchangeable with those of the LEOPARD 1 Battle Tank. Its recovery equipment consists of a winch, crane and plow blade. The crane, which rotates 270 degrees, can lift loads of up to 20 tons. The electro-hydraulically height-adjustable plow blade serves not only as a brace for the vehicle but also for roadbuilding, grading and scraping, as well as for moving barricades and obstacles. With a special console, the Armored Recovery Vehicle 2 can carry a complete LEOPARD 1 powerplant on its rear for exchange purposes. It is also capable of fording and can travel underwater with additional equipment. Among the special equipment of Armored Recovery Vehicle 2 are:

— a powered screw-driver attachable to the on-board electrical system,
— an electric welding and cutting apparatus, also attachable to the electric system,
— a motorized chain saw,
— a console to carry a replacement powerplant,
— a lifting tackle for the powerplant.
(Krauss-Maffei)

ARMORED RECOVERY VEHICLE 2

To replace the superannuated American M 74 Armored Recovery Vehicle, the German army received the Standard Armored Recovery Vehicle a year after the delivery of the first LEOPARD 1 Battle Tank; later, to differentiate it from the M88, it was designated Armored Recovery Vehicle 2.

The establishment of military requirements for an armored recovery vehicle on the basis of the LEOPARD chassis was done in 1961. As early as 1964 two prototypes were delivered to the Federal Office of Military Technology by the Jung firm. Even during the factory testing and before the conclusion of the technical testing at Test Center 51 in Koblenz and the troop testing at Military Troop School 2 in Münster, the MaK firm in Kiel, as general contractor, received the contract for series development and production.

On September 9, 1966 the first series Armored Recovery Vehicles were delivered to the German army.

An up-rated version with a strengthened crane mount, a brace mounted at the right rear of the vehicle, and an increase of the cable paying-out speed of the winch was produced from mid-1977 to mid-1978 as construction batch 3; it was designated Armored Recovery Vehicle 2 A2 BUFFEL. The Armored Recovery Vehicle 2 A1 (batch 2) is the Engineer Tank 1, which we shall come back to later.

As a result, only the vehicles of the first production batch and the up-rated A2 version (batch 3) are designated Armored Recovery Vehicle 2 in the strict sense. The Armored Recovery Vehicle 2 used in the German army number:

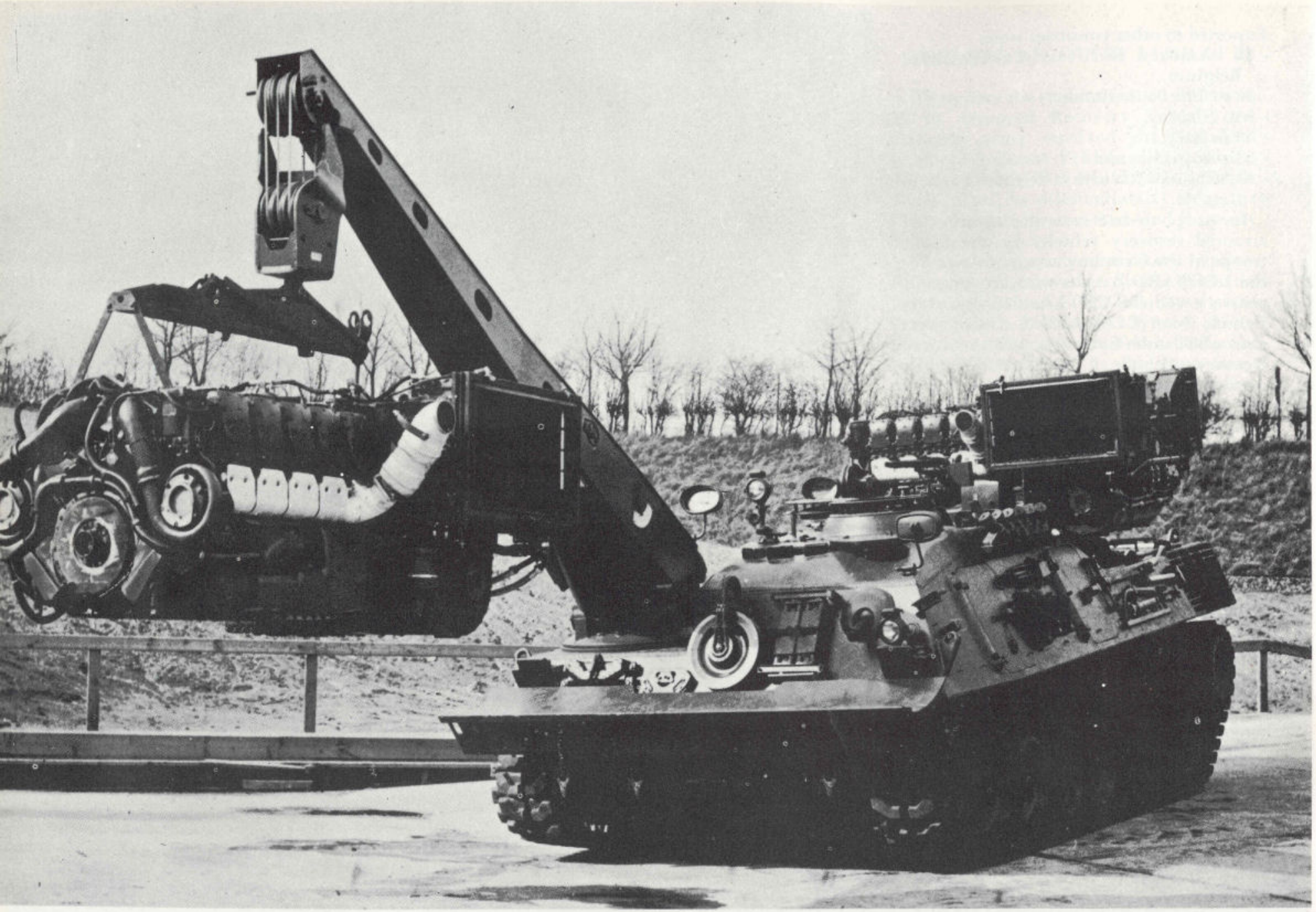
- 444 Armored Recovery Vehicle 2
- 100 Armored Recovery Vehicle 2 A2

Exported to other countries were:
- 36 Armored Recovery Vehicle 2 to Belgium,
- 30 to The Netherlands,
- 6 to Norway,
- 69 to Italy,
- 6 to Australia, and
- 8 Armored Recovery Vehicle 2 A2 to Canada.

In order to increase the number of armored recovery vehicles in the battle troops of the Germany army, and provide the LEOPARD 2 units with an adequate recovery vehicle, 220 Armored Recovery Vehicle 3 on LEOPARD 2 chassis were commissioned by 1994, 125 Armored Recovery Vehicle 1 (M 88) additionally used as recovery tractors, 80 M 48 vehicles ordered converted to recovery tractors with crane booms, and 130 additional M 48 vehicles and LEOPARD 1 tanks, as they became available, were ordered converted to recovery tractors. As armored recovery vehicles are prepared by preparation units, they are lifted free by vehicle cranes and turned over to the battle troops.

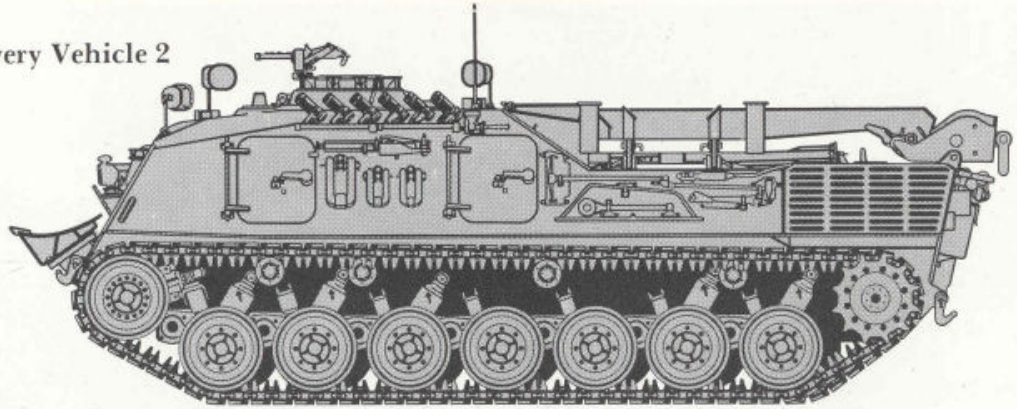
On the cable drum of the main winch, a wire cable 33 mm in diameter and 90 meters long is wrapped. The maximum towing power with a return roller is 70 tons. (MaK)

Immediately behind the winch opening is a cable-tightening apparatus that independently pays out the cable and also provides problem-free winding. (Krauss-Maffei)



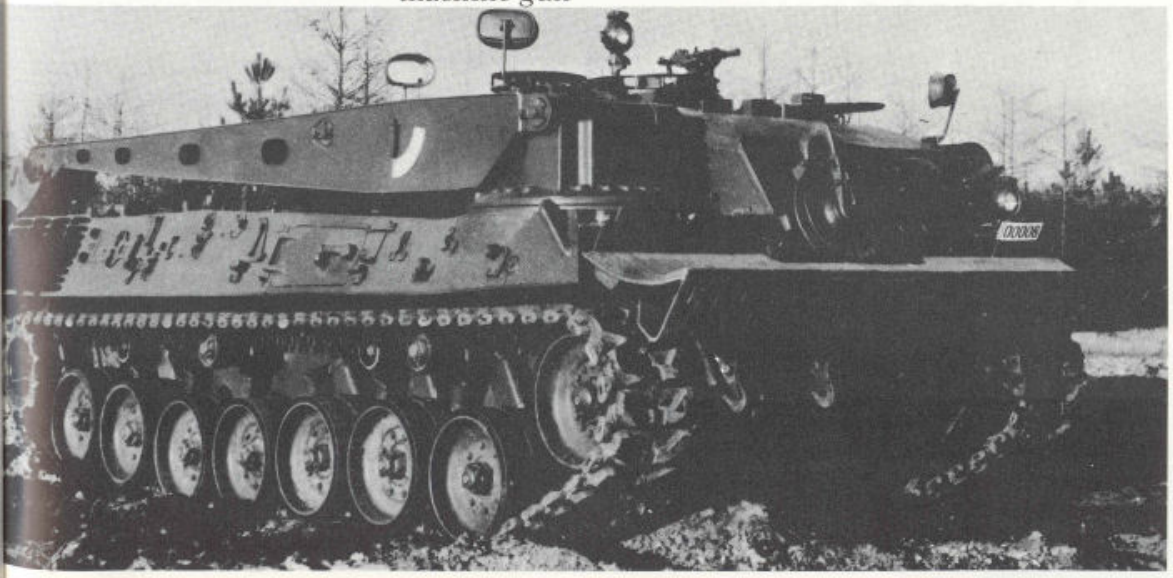
Armored Recovery Vehicle 2 with LEOPARD 1 powerplant
on the lifting tackle and a replacement motor on the rear console.

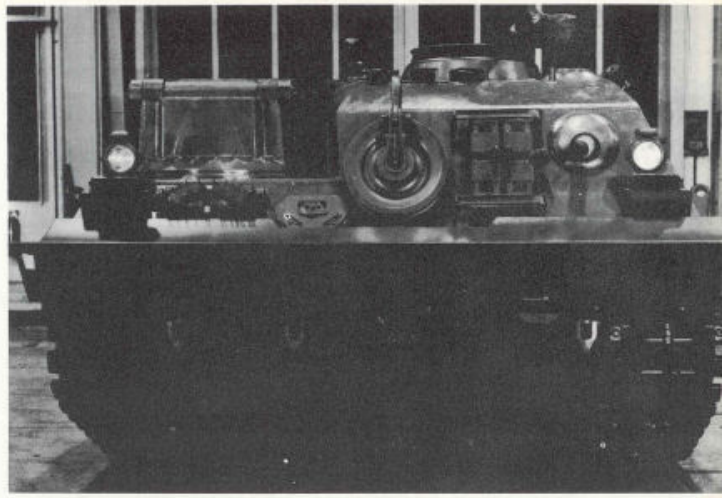
Armored Recovery Vehicle 2



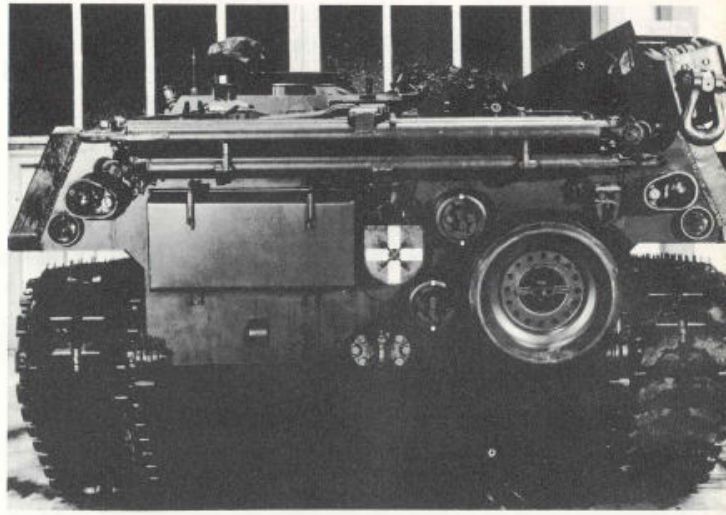
TECHNICAL DATA OF ARMORED RECOVERY VEHICLE 2

Crew:	3 men
Dimensions:	Length 7570 mm, Width 3250 mm, Height 2700 mm (over anti-aircraft machine gun)
Fighting weight:	39.8 tons
Range of operation:	800 km
Carrying power of the crane:	20 tons
Maximum towing power of the winch:	70 tons, in double towing
Towing power at the towing coupling:	approx. 29.5 tons in first gear
Plow-blade width:	2350 mm
Armament:	1 7.62 mm anti-aircraft machine gun, 1 7.62 mm bow machine gun

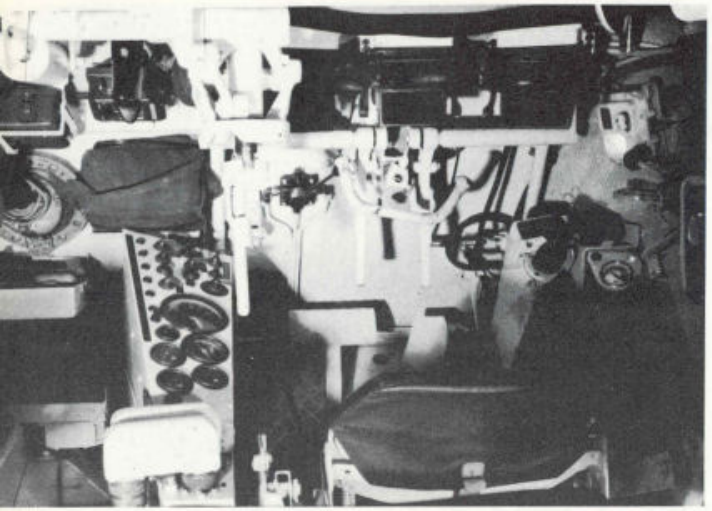




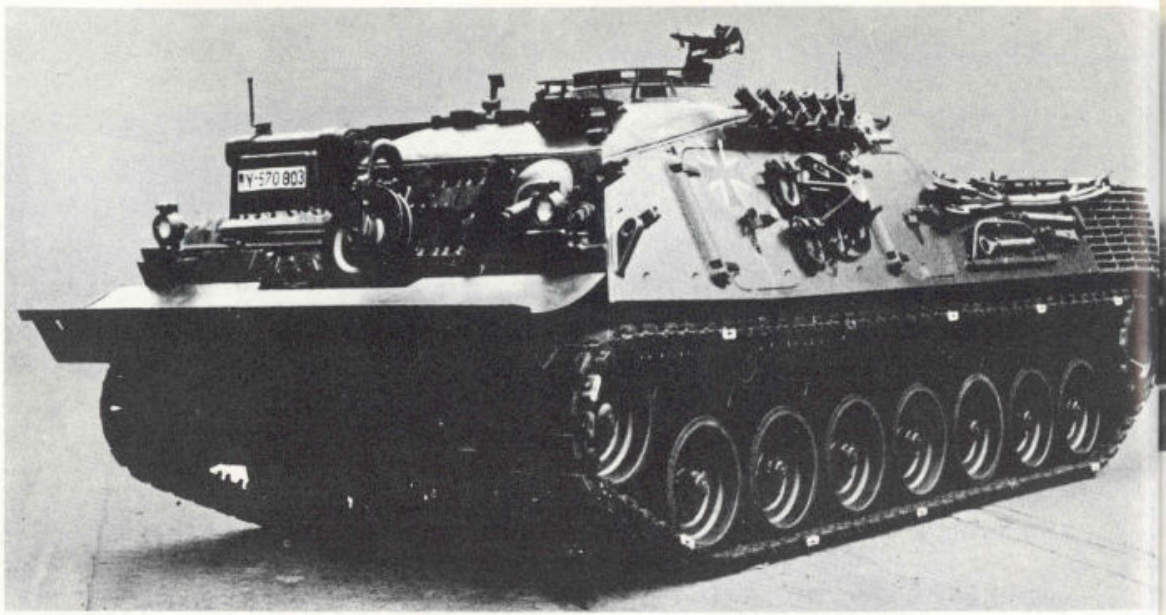
Bow of Armored Recovery Vehicle 2: in the middle is the return roller, next to it at right are replacement chain links and the mount of the bow machine gun; in the middle below the plow blade is the winch opening.



Rear of Armored Recovery Vehicle 2: at upper right is the crane arm; across the rear wall the towing shears, below it at left the stowage bin for tools, to the right of the emblem two spare idlers, two spare road wheels attached one atop the other, and one track-end link.

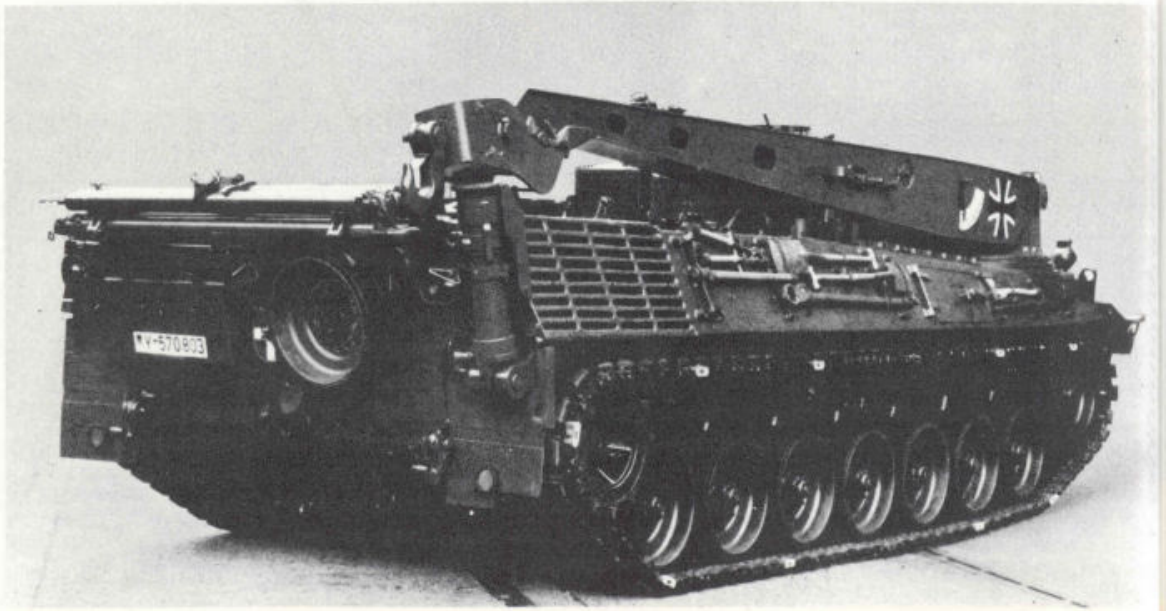


Cockpit of Armored Recovery Vehicle 2: under the first-aid kit at the left edge of the picture is the bullet shield of the bow machine gun; at right in front of it is the dashboard; in the foot space in front of the driver's seat at left is the foot brake, at right the gas pedal; above them are the semicircular steering wheel and the two stopping levers of the locking brakes; above them are the driver's three periscopes; at right next to the driver's seat are the gearshift lever and the operation range switch.



The newly developed and additional production batches of the BUFFEL have double-vane pumps for the hydraulic system, rear jack with jack plate and brace, new ventilator flap, mechanical plow-blade locking, and strengthened crane boom. (Soldat und Technik)

Right: The up-rated version of Armored Recovery Vehicle 2 (3rd production batch) is called BUFFEL or BPz 2 A2. These vehicles are externally recognizable by the rear jack mounted at the right rear.

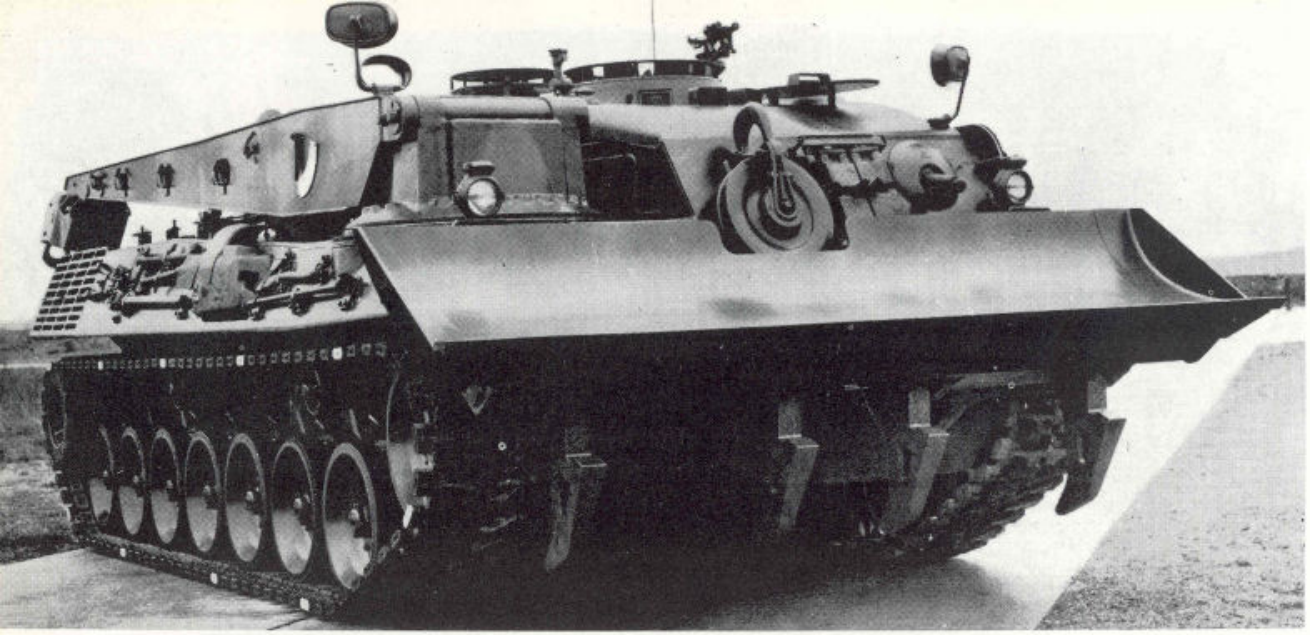


The BUFFEL, thanks to its enhanced performance, can lift heavier loads with the greater lifting power of its crane boom. Its length is now 7.68 meters, its fighting weight 40.6 tons, and the cable paying-out speed is increased from 22 to 74 meters per minute. (Soldat und Technik)

BUFFEL removing a GEPARD Anti-Aircraft Tank's turret. The rear jack is attached by one end to the right rear of the vehicle. When used in up-rated performance it is folded down manually. The support plate attached to the left side of the vehicle is put under the rear jack and a brace is mounted between the towing coupling and the support before the hydraulic cylinder is extended. (MaK)

Upper right: Up-rated Armored Recovery Vehicle 2, third production batch, for Canada. The hydraulic link for the rear jack is formed by two hoses with quick couplings. Hydraulic oil supply is done by the double-vane pump over one ventilator flap. A push-button is available on the rear of the vehicle as the control element.

Right: the same vehicle as shown above, but from another angle. Externally the Canadian Armored Recovery Vehicle 2 of production batch 3 differs from the German BUFFEL basic version by having a deflector bar in the area of the smoke-discharging barrel and by a different type of antenna or armament including the appropriate mantlets.



Pre-series production of the Combat Engineer Tank 1 (Armored Recovery Vehicle 2, 2nd production batch); especially eye-catching are the ripping teeth under the plow blade. The chassis is identical to that of the Armored Recovery Vehicle 2 (1st production batch), likewise the main production batches of the recovery version. The Combat Engineer Tank 1 is meant to support battle troops principally in overcoming obstacles and setting up barricades. (Soldat und Technik)

Below: Combat Engineer Tank 1, series production: an important external identifying mark that differs from Armored Recovery Vehicle 2 is the ladder on the crane boom; another is the auger lying at the rear in traveling position. The changed plow blade makes possible a theoretical movement of 200 cubic meters per hour as well as the application of ripping teeth.

COMBAT ENGINEER TANK 1 and 2

In connection with the delivery of the first production batch of Armored Recovery Vehicle 2, the Krauss-Maffei firm received a contract for the production, finishing and testing of a prototype engineer tank. The filling of this contract was done through the two firms of Porsche and MaK. Unlike the Armored Recovery Vehicle, this vehicle was given special engineering equipment, including a strengthened hydraulic system with an oil cooler, an auger bit on the crane boom, and an enlarged plow blade with attachable ripping teeth. Series production again took place with MaK as the general contractor. In August of 1969 production was already finished. Officially the designation of the Engineer Tank is "Armored Recovery Vehicle 2 A1".

After the German army had received 36 Engineer Tank 1 units, the following were exported to other countries:

- **6 Engineer Tank 1 to Belgium**
- **14 to The Netherlands**
- **12 to Italy**

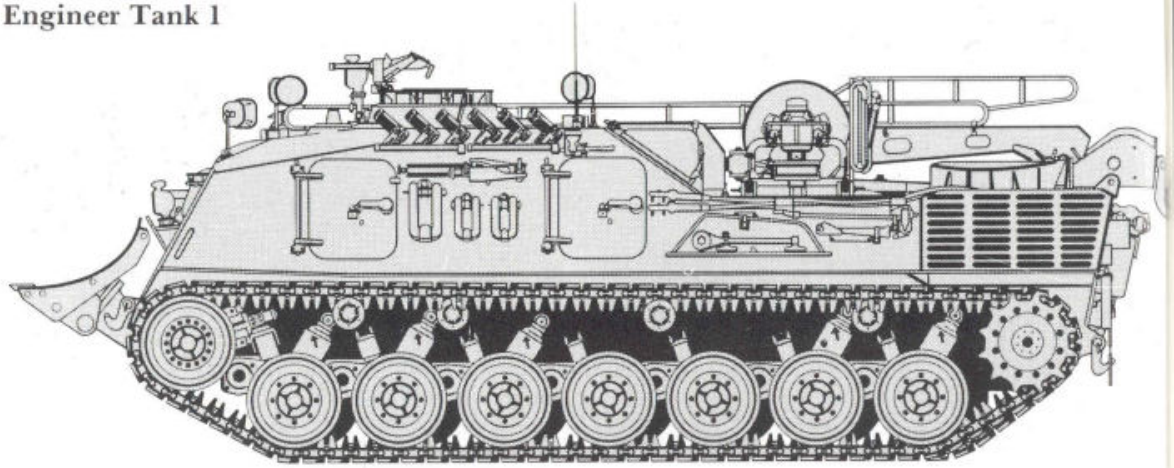
The earth auger bit in operation.

Good view from above of the auger bit lying on the rear of Engineer Tank 1 (BPz 2 A1).

With the hydraulically driven earth auger bit, which is attached to the crane boom for use, thirty holes of 700 mm diameter and 1900 mm depth can be drilled in an hour. (Krauss-Maffei)

Below: Engineering work using the crane boom. (MaK)

Engineer Tank 1



TECHNICAL DATA OF ENGINEER TANK 1

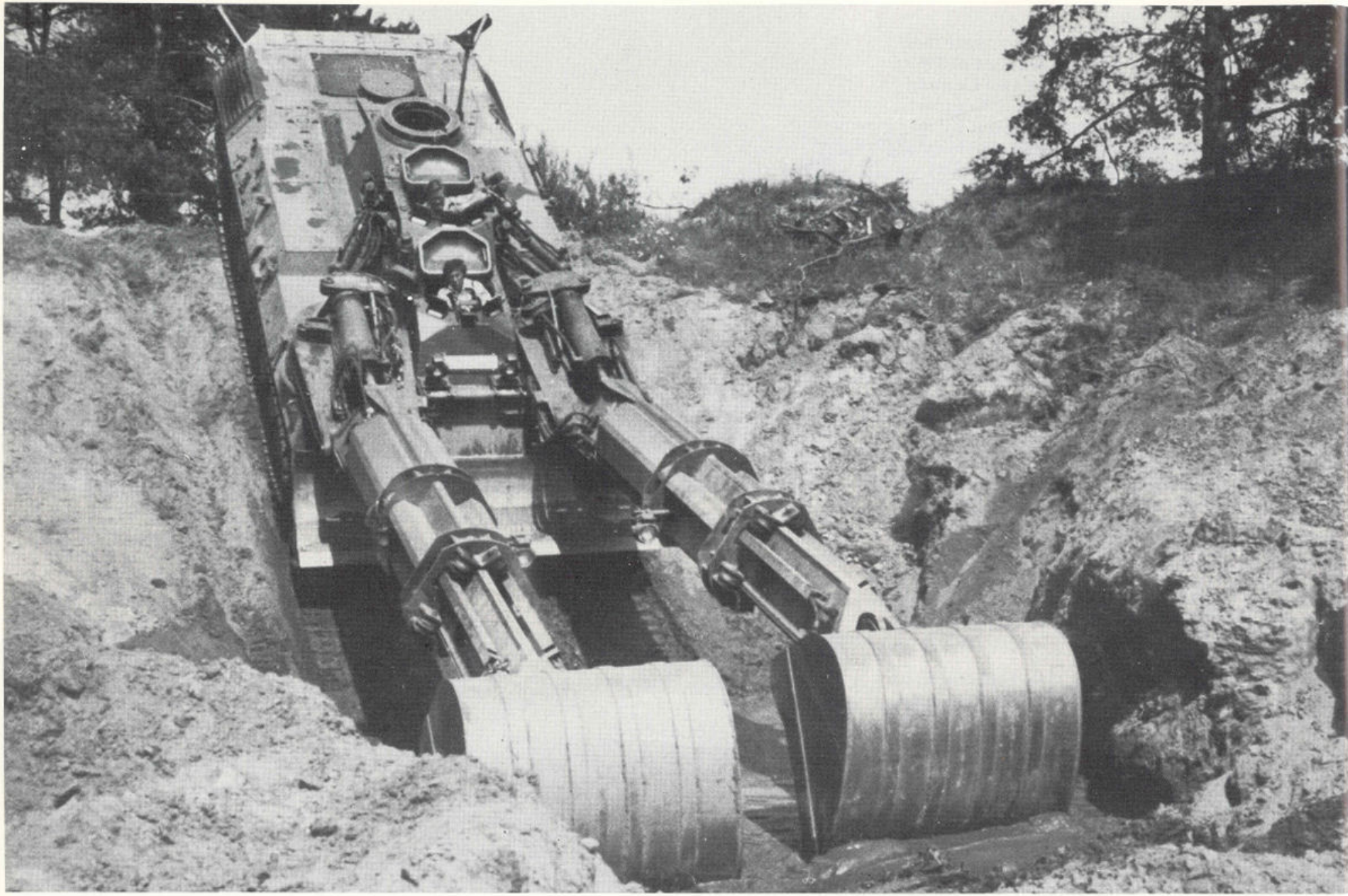
Crew:	3 men
Dimensions:	Length 7880 mm—Width 3250 mm—Height 2700 mm (over anti-aircraft machine gun)
Fighting weight:	39.8 tons
Range of operation:	800 km
Carrying power of the crane:	20 tons
Maximum towing power of the winch:	35 tons in single tow, 70 tons in double tow
Towing power at the towing coupling:	approx. 29.5 tons in first gear
Plow blade width:	3250 to 3750 mm
Ripping depth:	40 to 400 mm
Armament:	1 7.62 mm anti-aircraft machine gun and 1 7.62 mm bow machine gun

Meanwhile, armored engineer machines (GPM), based on military requests of 1969 and 1973, were developed by two German firms as forerunners of a future Engineer Tank 2. Acantilever-arm excavator by the MaK firm and a prototype with two telescopic-arm excavators by the Eisenwerken Kaiserslautern (EWK) were provided in 1984 for comparison testing combined with a troop test. This testing turned out in favor of the telescopic version. Early in the 1990's it is planned to develop 1430 Armoerd Recovery Vehicle 2 and/or Engineer Tank 1 into Engineer Tank 2 in the process of up-rating the quantity and quality of the towing mechanism; they will be equipped with, among other things, the telescopic-arm excavator in place of the former crane boom, and a mechanically adjustable three-piece plow blade. The Engineer Tank 2 will then be capable of closing the gap between the bridgelayers on the one hand and the building and working vehicles on the other, increase the aquatic mobility of the battle troops and provide better support to them in overcoming obstacles.

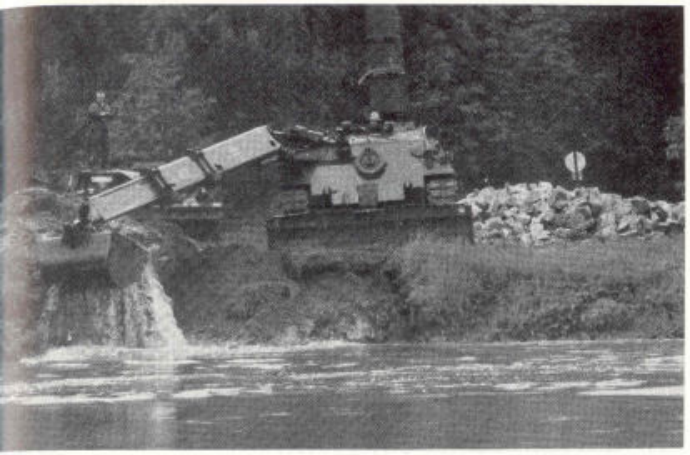
Above: One forerunner of the Engineer Tank 2, made by the MaK firm, with cantilever-arm excavator. Under the concept of "Armored Engineer Machine" (GPM), a universal vehicle to handle the whole scope of engineering tasks on land and in the water under the protection of armor and ABC fire was to be developed.

Right: The GPM of the MaK firm had as its working equipment a single-unit cantilever-arm excavator and a divided plow blade. This vehicle took part in comparison testing with a GPM with two telescopic-arm excavators (EWK system). (MaK)

Left page: Engineer Tank 1 (BPz A2 A1) setting a mast. Various components of the equipment of the Armored Recovery Vehicle 2 have been omitted (for example, the powerplant lifting tackle and the chain saw); instead, the Engineer Tank 1 carries various types of explosive and incendiary devices. (Krauss-Maffei)



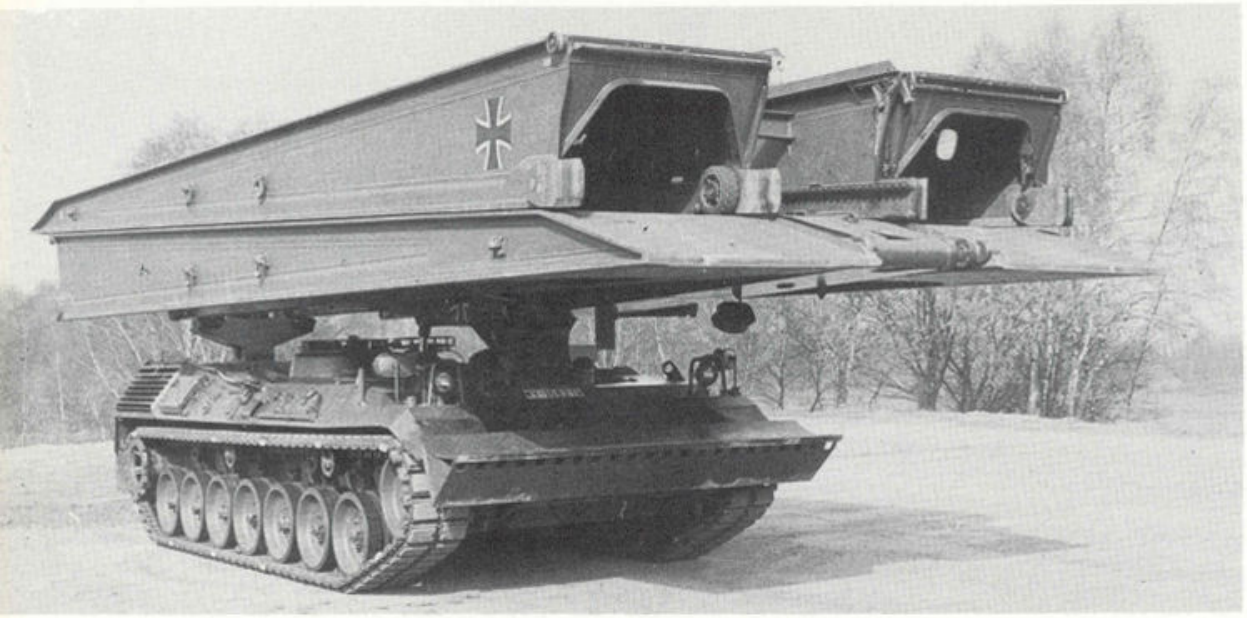
Forerunner version of the Eisenwerke Kaiserslautern (EWK) version of Engineer Tank 2. This vehicle has hydraulically driven working equipment with two telescopic-arm excavators, a removable plow blade and a cable winch. The telescopic excavator arms can also be used as cranes and are each equipped with a scoop shovel.

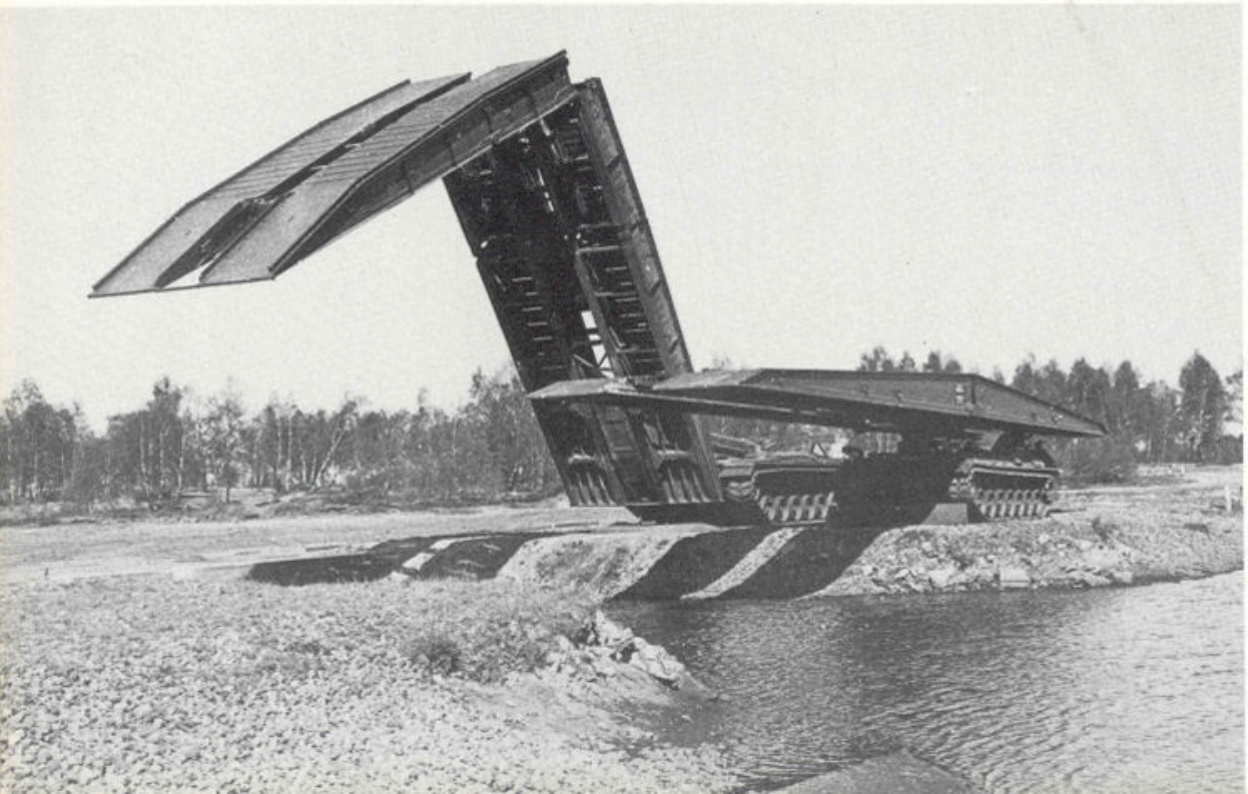


At the end of the Seventies, the development of the GPM was halted out of technical, conceptual and financial considerations. At the same time, though, it was decidedto up-rate the fighting value of 104 Armored Recovery Vehicle 2 units that were becoming available by fitting them with a telescopic-arm excavator of Engineer Tank 2. (Wieger)

Below: The essential differences between Engineer Tanks 1 and 2 basically concern the following components: telescopic-arm excavator, plow blade and hydraulic system, cutting and welding apparatus, remote control of the excavator and additional bilge pumps.

The plow-blade system of Engineer Tank 2 consists of a blade with ripping corners and unfolding side pieces. The blade itself is made of three pieces and mechanically adjustable. (MaK)





BIBER BRIDGELAYING TANK

In 1968, after studies by the Federal Office for Military Technology and the building of two prototypes of a future bridgelaying tank, contracts were given for their construction on zero-series chassis of the LEOPARD 1 Battle Tank. The following basic versions of bridgelaying were foreseen:

— Version A, suggested by the Klöckner-Humbold-Deutz firm: laying the bridge by means of tetescopic arms;
— Version B, suggested by the Porsche firm: free forward movement with support of the vehicle by a front support blade.

Unlike the folding bridges customary up to then, the two versions had the horizontal positioning of the bridge in common.

The construction and preparation of the chassis and bridges were done by the firm of Krauss-Maffei in cooperation with Porsche, KHD and MaK. Both prototypes were finished in September and then tested at the factories. The technical testing later took place at Test Center 51 in Koblenz, the troop testing at the Engineer School in Munich. In August of 1970 Version B was

Upper left: The BIBER Bridgelaying tank replaced the American armored quick bridge on M48 A2 chassis. The armored engineer companies of the brigades were equipped with four BIBER each.

Left: Compared to the American quick bridge, the BIBER has numerous advantages: a greater bridge span, a lower silhouette through horizontal positioning, quicker bridgelaying (approx. 2 minutes), greater mobility of the chassis, a more robust laying device for the bridge, simpler operation and lower weight of the vehicle.

chosen for further development. The MaK firm of Kiel received the contract for series development and production in 1972. Preparation took place from 1973 to 1978. The series-production bridgelaying tank was later named **BIBER** (beaver).

After the German army had received 105 **BIBER**, the following were exported to other countries:

- 5 **BIBER** to Australia
- 6 **BIBER** to Canada

In comparison with other bridgelaying tanks, the **BIBER** has tactical and technical advantages:

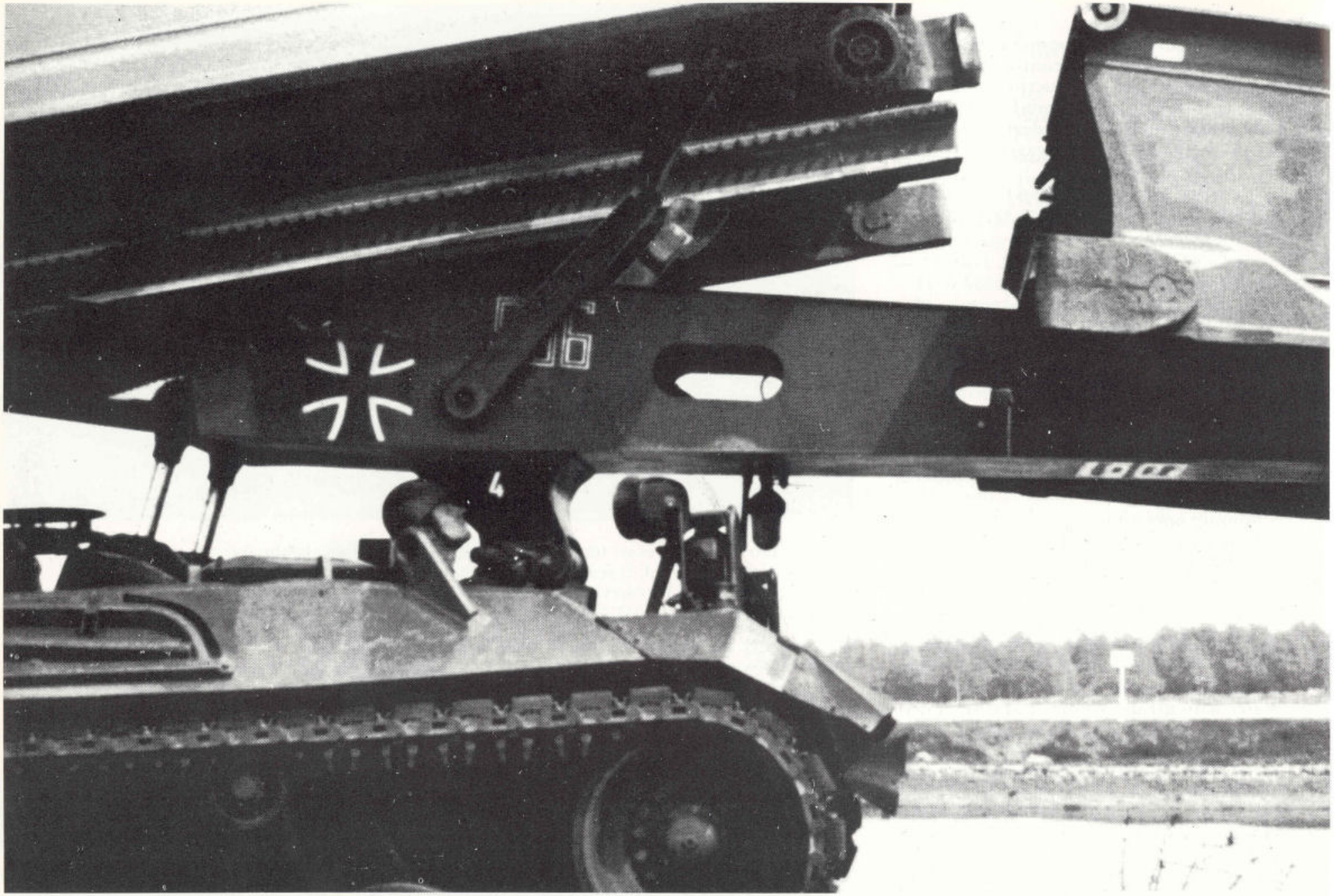
- Greater span of the armored bridge (21 meters)
- Horizontal projection of the bridge and thus a lower silhouette
- Quicker placing of the bridge (approx. 2 minutes)
- Simpler operation
- Lower weight of the vehicle
- Better view for the driver.

With the **BIBER**, defiles of up to approximately 20 meters on the battlefield can be bridged quickly under armored protection. In order to bridge bodies of water with greater widths, likewise under armored protection, experiments were carried on meanwhile with a quick bridge on supports (SAS); here the first portion of the bridge, made shorter than the **BIBER** bridge for reasons of weight, is additionally equipped with a support. After the process of laying it, the bridgelaying tank drives onto the first portion of the bridge and then lays the next portion of the bridge, which is brought along on trucks.

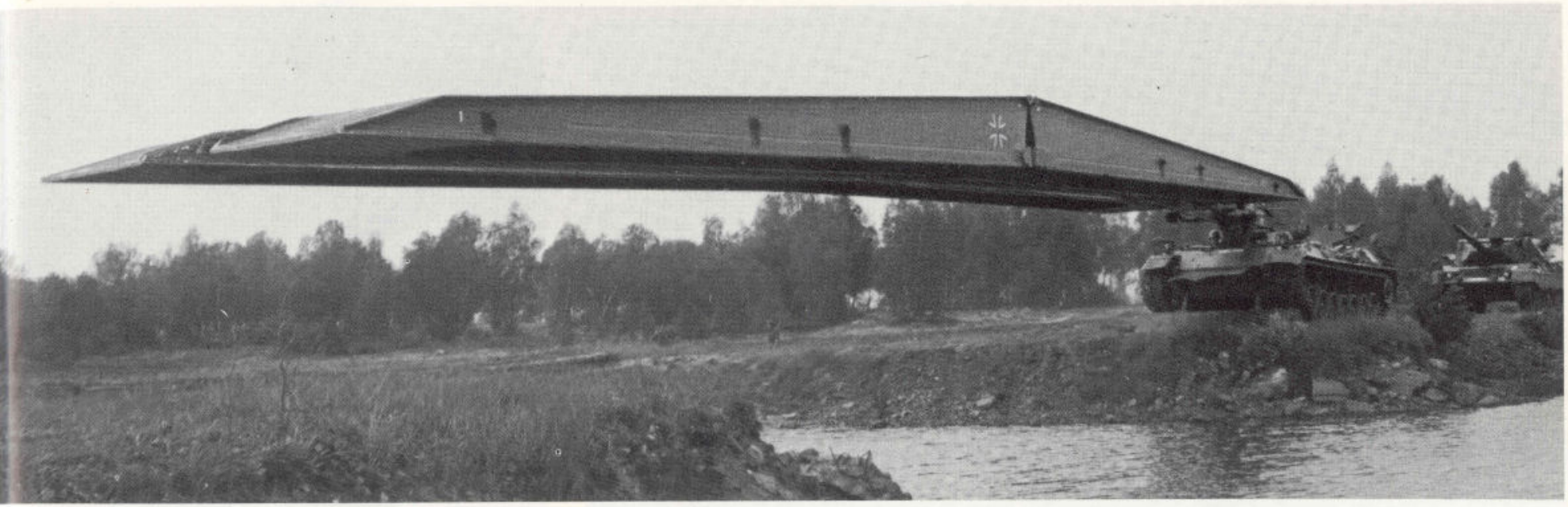
A decision as to the adoption of this enhanced-performance version of the **BIBER** has not yet been made.

The 9.8-ton bridge consists mainly of profiled sections made of the light-metal alloy Constructal; it rests on the chassis in transport, divided into symmetrical halves. Its carrying capacity amounts to MLC 50, with an exceptional capacity of MLC 60. (MaK)

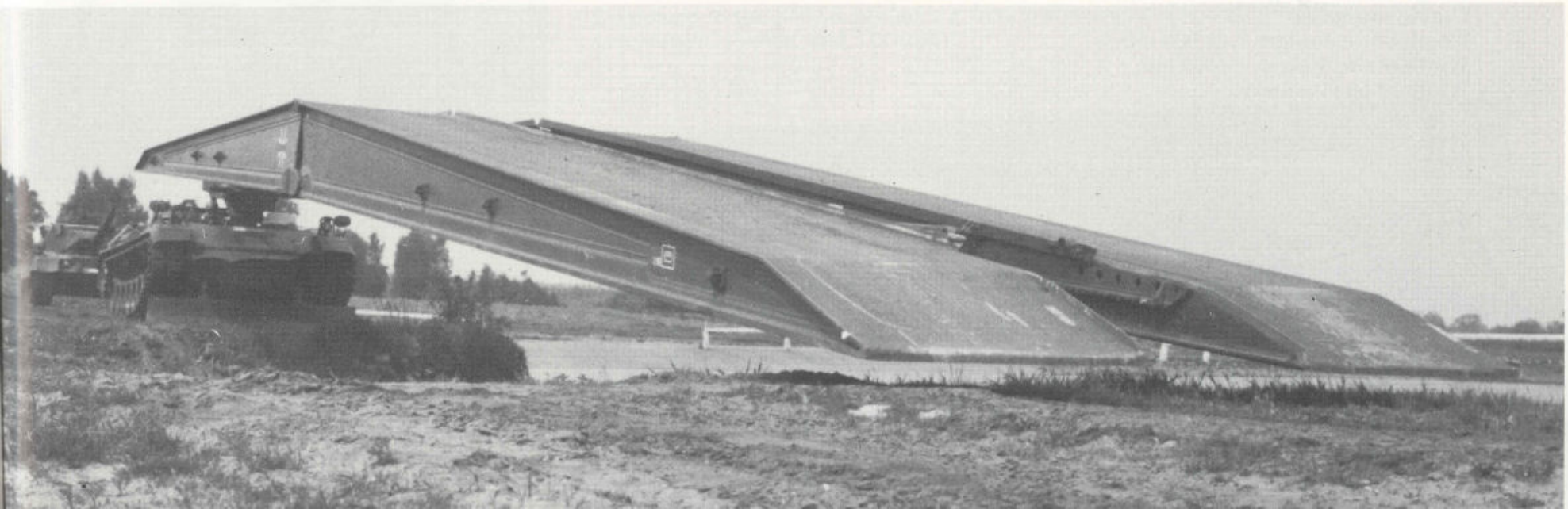
Below: After the two halves of the bridge are linked, the bridge is pushed freely out over the obstacle by the extender, and put in position by lowering of the extender, first on the far, then on the near side. During the laying process the chassis is supported by the support blade on the bow. (MaK)

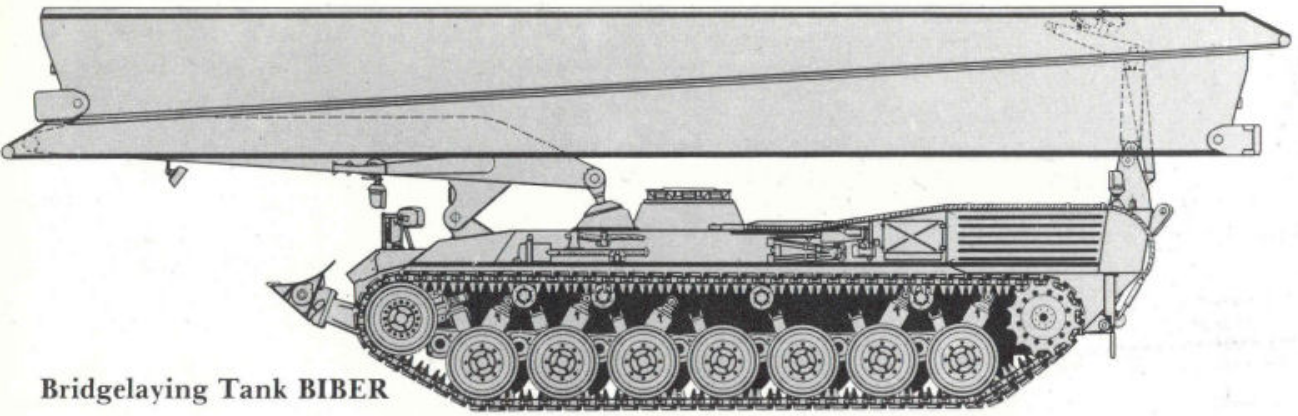


In order to couple the two halves of the bridge together to form a unit, the lower part must be pushed forward and the upper part lowered. Through this lowering, the two parts of the bridge are coupled together on their underside; a short raising of the main extender also connects the bridge on the top.



Above and below: the BIBER Bridgelaying Tank in the process of bridgelaying, with a LEOPARD 1 A4 Battle Tank behind it. The bridge of the BIBER is rolled forward over the rolling track of the main extender with the help of the forward-pushing apparatus and then rolled out by the lowering of the main extender. After the conclusion of the laying process, the bridge lies in a usable position. After the bridgelaying vehicle has lifted its support blade and moved back to clear the way for the following vehicles, the bridge can be crossed. (Krauss-Maffei and MaK)



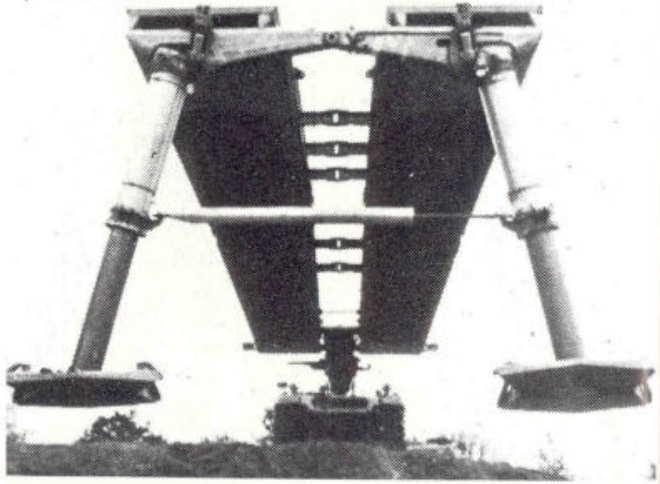


Bridgelaying Tank BIBER

TECHNICAL DATA OF THE BRIDGELAYING TANK BIBER

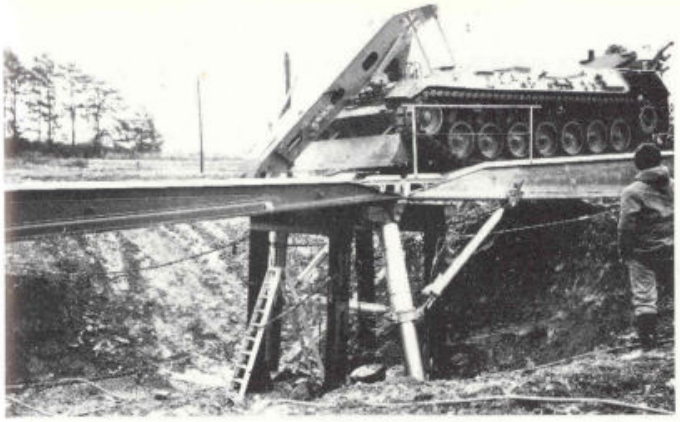
Crew:	2 men
Dimensions:	Length (bridge in traveling position) 11,400 mm
Fighting weight:	with bridge 45.1 tons, without bridge 35 tons
Motor type:	10-cylinder multifuel motor, water-cooled, MTUMB 838
Motor performance:	830 HP (611 kW)
Speed:	62 kph
Range of operation:	550 km
Carrying capacity of the bridge:	MLC 50, exceptional weight MLC 60.
Length of the bridge:	22,000 mm
Usable supported length of the bridge:	21,000 mm
Width of the bridge:	4000 mm
Width of one roadway:	1550 mm
Weight of the bridge:	9.8 tons
Armament:	2 racks with 4 smoke-discharging barrels each

An M48 A2 battle tank with plow blade, formerly in army use,crossed a bridge laid by a BIBER.

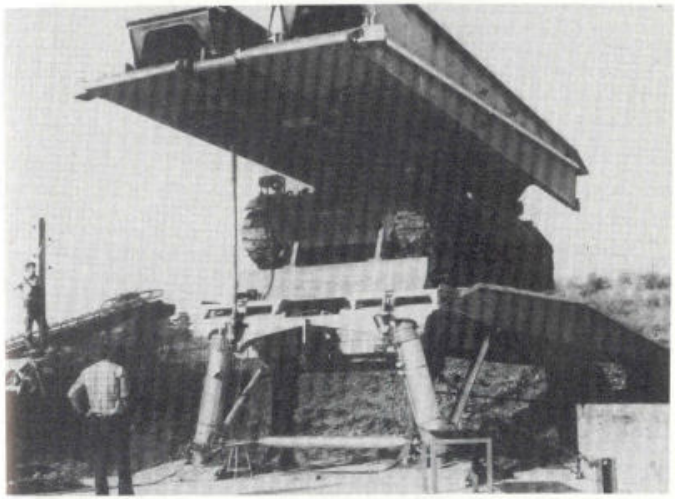


To extend the potential use of the BIBER for surmounting wider obstacles, a quick bridge on supports (SAS) was developed.

Left: A view under the bridge as it is extended forward; of particular interest are the U-shaped reinforcing elements. The far-side resting point can be 5 meters lower or 3.5 meters higher than that of the near side. Lateral inclinations of up to 10% are possible. (MaK)

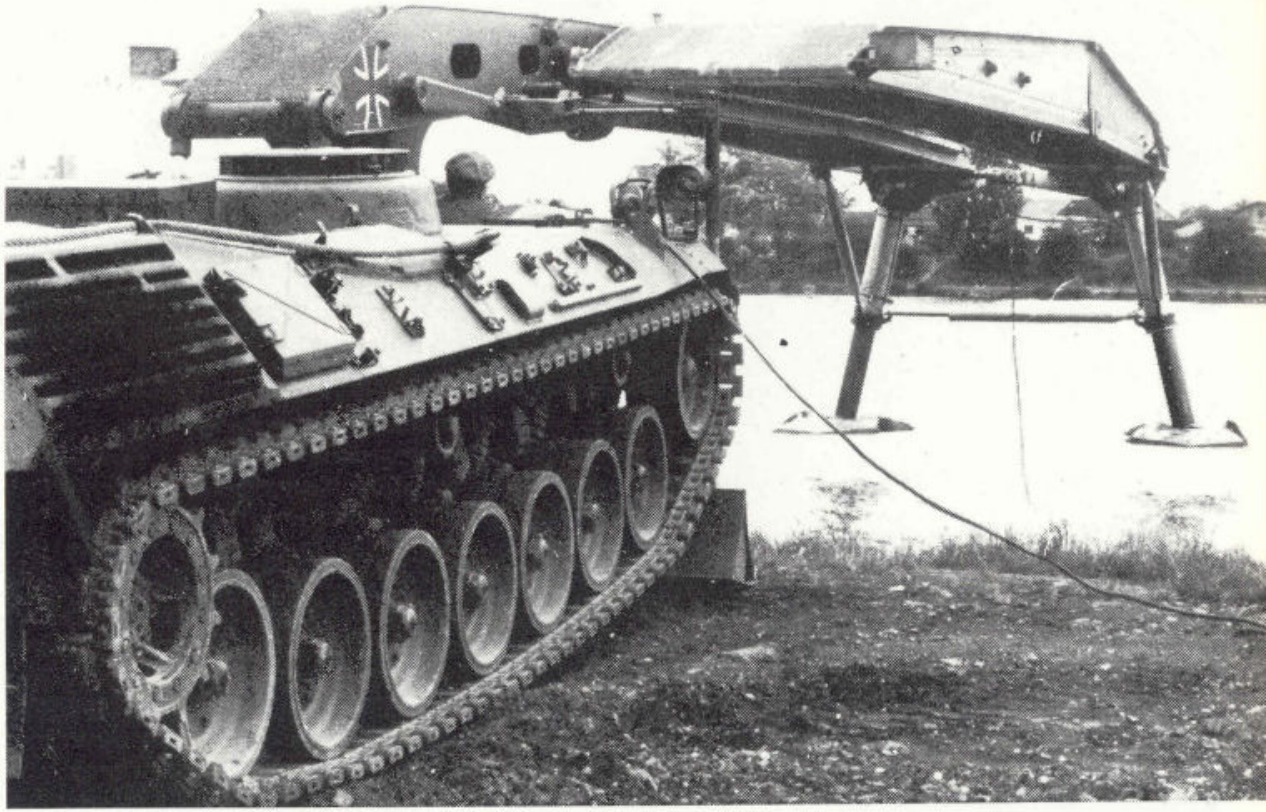


Instead of the overlapping use of several customary BIBER bridges, the quick bridge on supports makes possible the taking up again of all portions of the bridge from the far side of the obstacle.

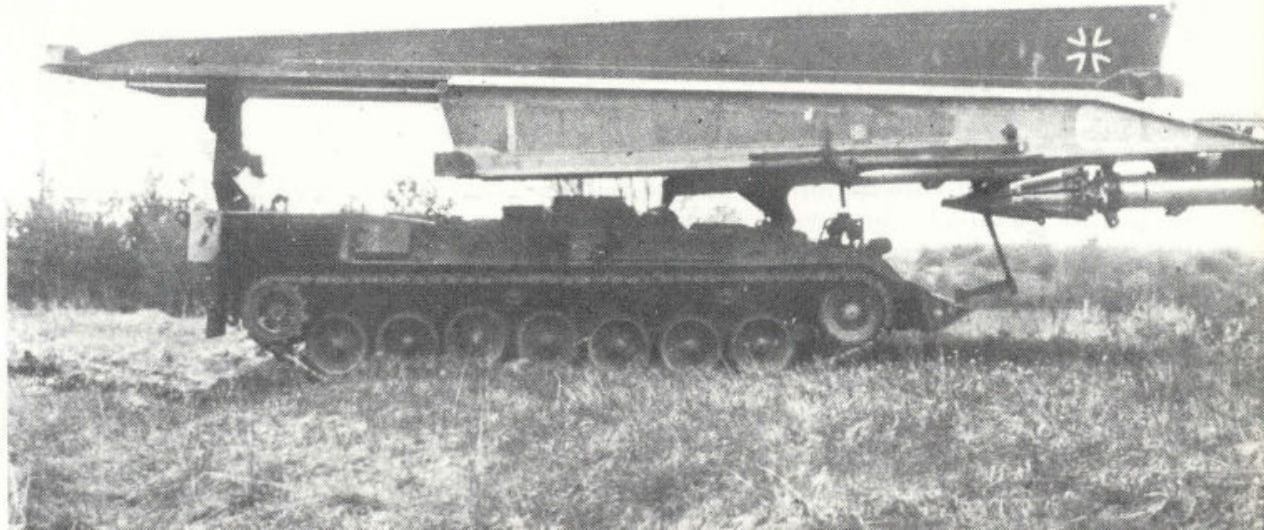


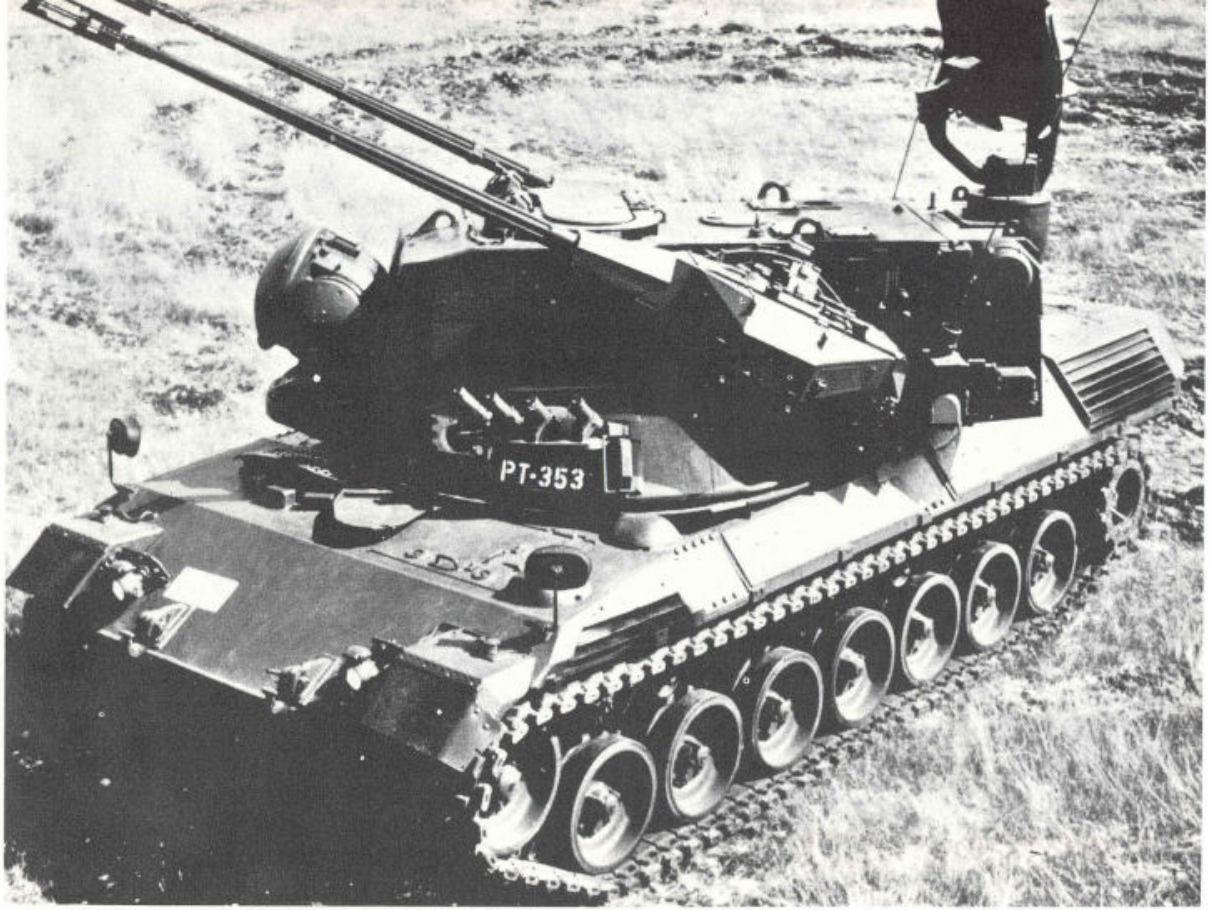
The SAS allows the protected quick construction of bridges longer than 20 meters over dry defiles as well as the construction ofapproaches to a pontoon bridges, use as entry and exit ramps along bodies of water, the replacement of destroyed road bridges. (Soldat und Technik)

Right: The quick bridge on supports was tested extensively; series production and delivery to the army have not yet taken place. (Soldat und Technik)



Compared to the BIBER bridge, the first bridge segment was shortened to save weight. (Soldat und Technik)



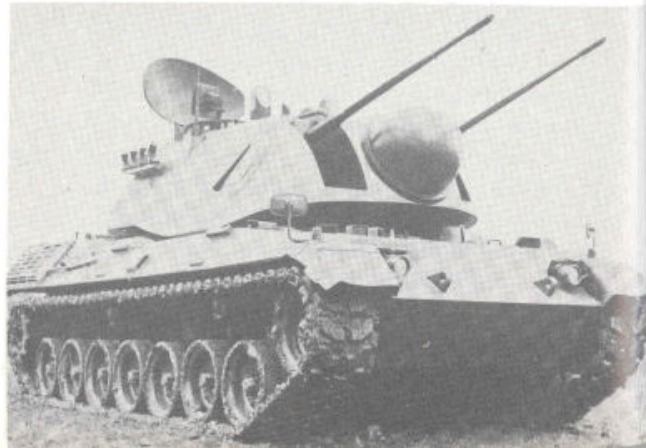


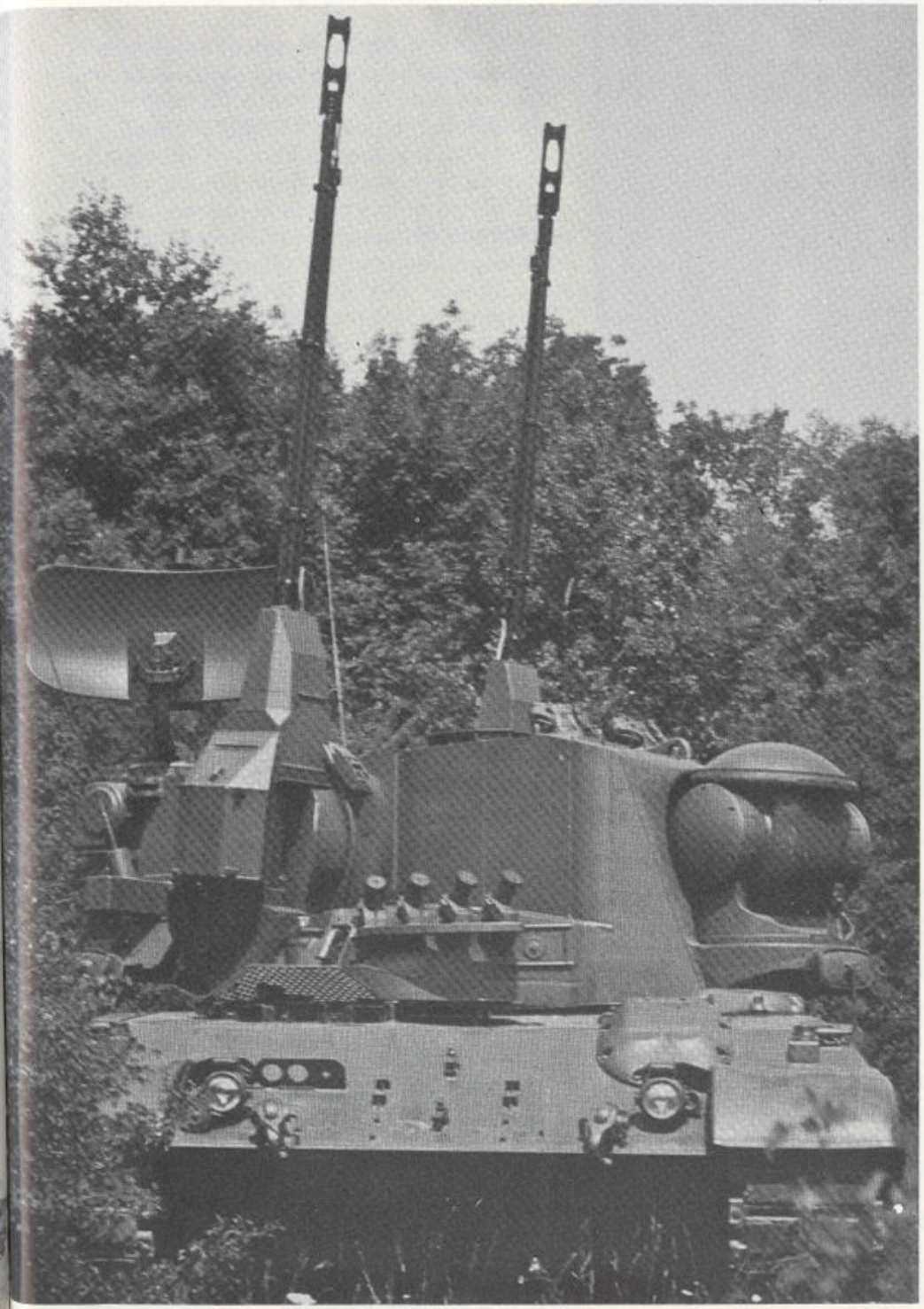
Prototype of the GEPARD (PT-353) Anti-Aircraft Tank for the Federal Republic of Germany, with 35 mm weapons and "B1" radar system with "Siemens MPDR-12" search radar and "Siemens-Albiswerk, Zürich: Pulsdoppler, Conical Scan" target-tracking radar. In the modified chassis of the LEOPARD 1 Battle Tank the following additional construction units were housed: the energy-supply system, an inclinometer, a position indicatior for the vehicle navigation system, as well as additional relays and regulating devices. Built into the turret are the armaments, consisting of: search radar with friend/foe recognition, fire-control radar apparatus, emergency calculator, twin 35 mm weapons with velocity measuring system, two panoramic aiming telescopes, a guide viewer with periscope, the radio and intercom speaker system, the vehicle navigation and hydraulic systems.

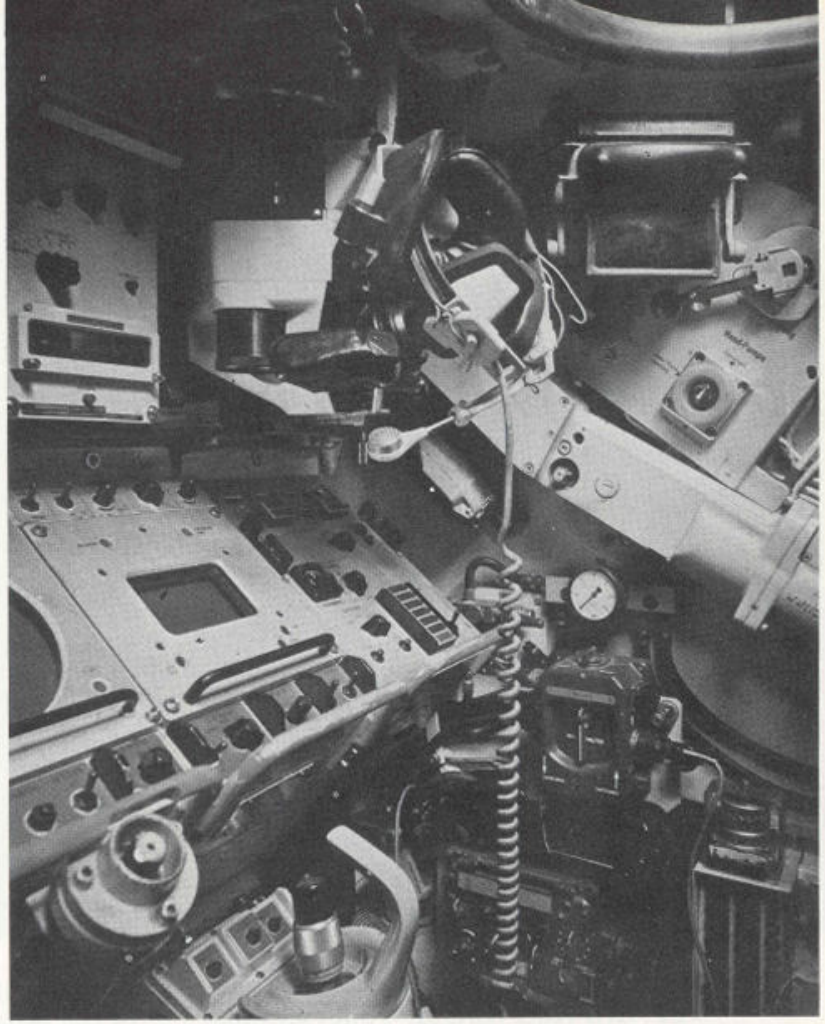
Right: the MATADOR 30 ZLA, a suggestion by the Rheinmetall firm, which for the first time embodied the elements of a mobile all-weather low-flying-plane defense system. This system also used the LEOPARD 1 chassis, but was armed with two 30 mm quick-firing cannon. This development was discontinued in 1970 in favor of the Oerlikon design.

GEPARD ANTI-AIRCRAFT TANK

In 1963 the development of an all-weather low-flying-aircraft defense system began, intended to replace the outmoded American M 42 Anti-Aircraft Tank, developed in the Forties, in the German army. This system was to be equipped with Doppler radar and twin 30 mm guns. For weight considerations, the decision was made in 1965 not to mount the heavy weapons and fire-control system on the chassis of the later MARDER SPz, as originally intended, but to use the LEOPARD 1 chassis. The firms of Siemens, AEG-Telefunken, Porsche, Rheinmetall and Krauss-Maffei took part in the development. The last-named firm built two LEOPARD chassis of the zero series to carry anti-aircraft turrets for this use and a parallel development of an anti-aircraft system by the Oerlikon-Contraves firm of Sweden. In the same year, Oerlikon-Contraves received a contract from the Federal Ministry of Defense to build two anti-aircraft turrets with 35 mm weapons systems. After three prototypes of the 30 mm anti-aircraft system called MATADOR had been ordered by BWB from the Rheinmetall firm, the factory testing began a year later with both types of vehicles. At the same time, additional prototypes of the second generation were ordered from Oerlikon by BWB and The Netherlands, so

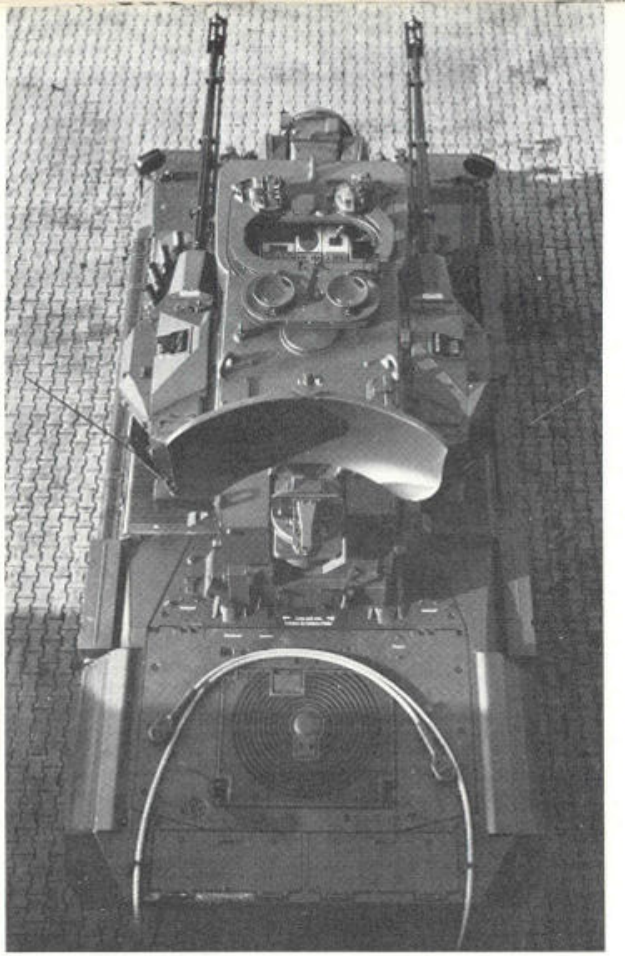




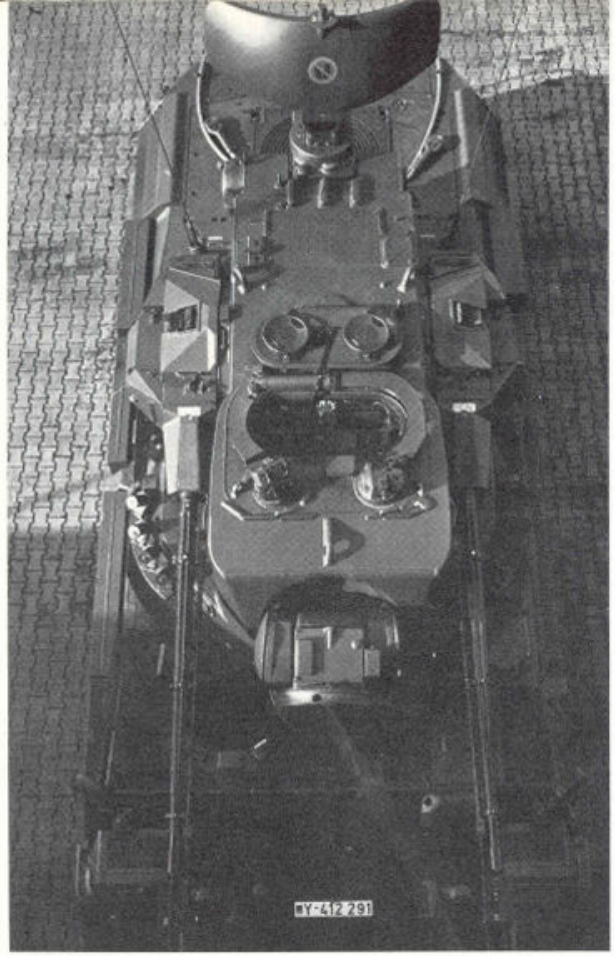


View of the fighting compartment of a GEPARD Anti-Aircraft Tank (Prototype), showing the gunner's seat. At the left edge of the picture is the round screen of the panoramic search radar; at the right of it the operating and indicator elements of the aiming radar; the panel to the right includes surveillance and operating equipment for the power-supply system and the electronics of the velocity-measuring system; under the panel is the gunner's aiming handle; above the panel the eyepiece of the periscope, partly obscured by the intercom and radio; to the left of it the indicator unit of the friend-foe recognition. (Krauss-Maffei)

Left: GEPARD Anti-Aircraft Tank, 1975 prototype. The ammunition supply it carries consists of 660 rounds of air-target and 40 rounds of armor-piercing ground-target ammunition.



Overhead view of a series-production GEPARD Anti-Aircraft Tank. Readily visible is the lengthened rear of the vehicle with its power-supply sustem accessible from above, the round grid of the ventilator and the other service openings on the engine cover. On the back of the turret is the panoramic search radar device, which can be folded up from its traveling position, with the scoop-shaped antenna for the German version of the GEPARD; in front of it is the turret cupola, serving as fighting compartment and control center for the commander and gunner. Readily visible in the hatch opening are the panels in front of the commander at left and the gunner at right.



Overhead view from the front. At left in front of the turret cupola is the opened driver's hatch; at right beside it, between the gun barrels on the turret, the fire-control radar apparatus; behind it, before the opened turret hatch, two panoramic aiming telescopes, which allow the commander and gunner to orient themselves in the environment with the hatch closed and, if necessary, to maintain optical surveillance of the air space and recognize, lock onto, allot or pursue aircraft. The 35 mm jacketed cannons in twin mountings are capable of being elevated high outside the turret cupola. The high-performance weapon has a cadence of 550 rounds per minute and a velocity of 1.175 meters per second.

as to have a further basis of comparison. The contract for the new construction of three chassis for the MATADOR anti-aircraft turrets, signed at the beginning of 1970, was announced by BWB six months later. In June of 1970 the decision was made to halt further development of the MATADOR 30 mm anti-aircraft weapons system and equip the German army with the 35 mm Oerlikon-Contraves weapons system on LEOPARD chassis. Four LEOPARD chassis with 35 mm anti-aircraft turrets were delivered in late 1970 and early 1971. Five pre-production anti-aircraft tanks were ordered from Krauss-Maffei and Oerlikon by BWB 12 and the Defense Ministry of The Netherlands for delivery in 1973. The Netherlands version differed from the German type in including its own radar equipment. On February 5, 1973 the Federal Ministry of Defense decided to introduce the anti-aircraft tank with 35 mm weapons system. The firm of Krauss-Maffei was chosen as prime contractor for series production, in cooperation with the firms of Oerlikon-Contraves, Siemens and Wegmann. The German army received between 1976 and 1980:

— 420 GEPARD B2 and B2L Anti-Aircraft Tanks

GEPARD B2 Anti-Aircraft Tank. (Soldat und Technik)

Exported to other countries were:
— 95 CA 1-3 Anti-Aircraft Tanks to The Netherlands
— 55 GEPARD B2 Anti-Aircraft Tanks to Belgium.

The stages of development of the anti-aircraft tank were designated by the following combinations of letters and numbers:

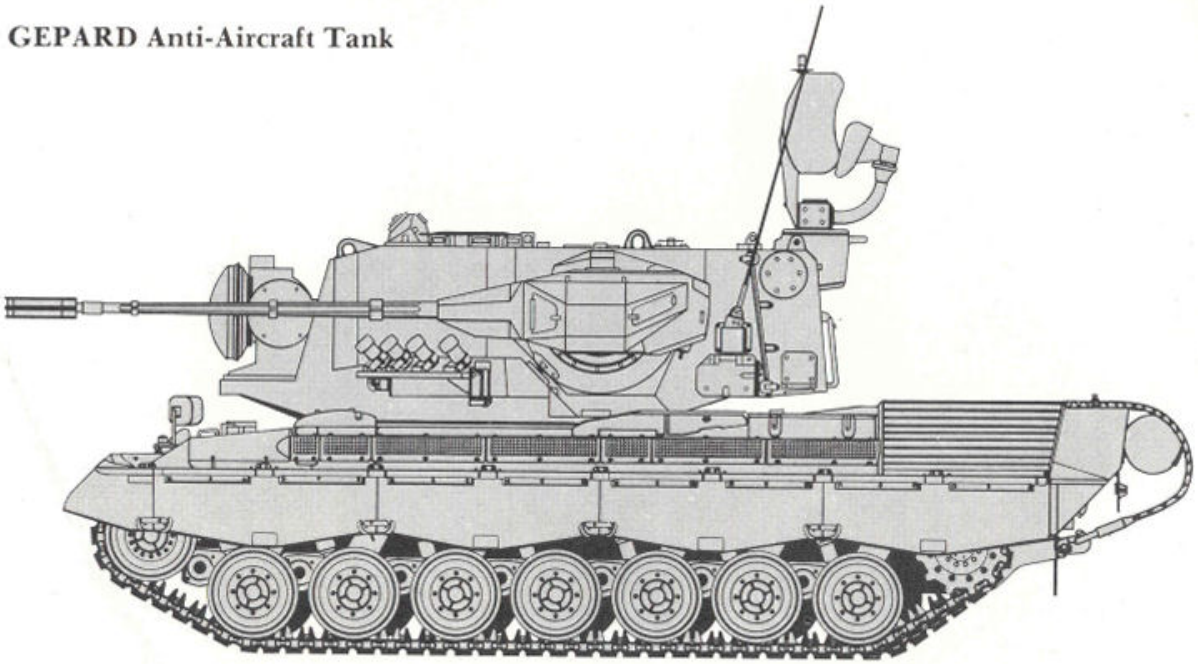
Prototype 1st generation:	A
2nd generation:	B
Netherlands version:	C
Pre-series (conical scan):	B1
(optimized Monoplus):	B2R
Netherlands version:	CA
Series: Federal Republic:	B2, B2L
Netherlands:	CA1, CA2, CA3
Belgium:	B2

The main differences consist mainly of the use of different radar systems or their ancillary components.

With the GEPARD Anti-Aircraft Tank, these or other countries possess the most modern fully automatic all-weather anti-aircraft system in troop use at this time.

The high effectiveness of the turret system was further enhanced on the part of the industry and, as ATAK 35, mounted on various chassis for testing purposes.

GEPARD Anti-Aircraft Tank

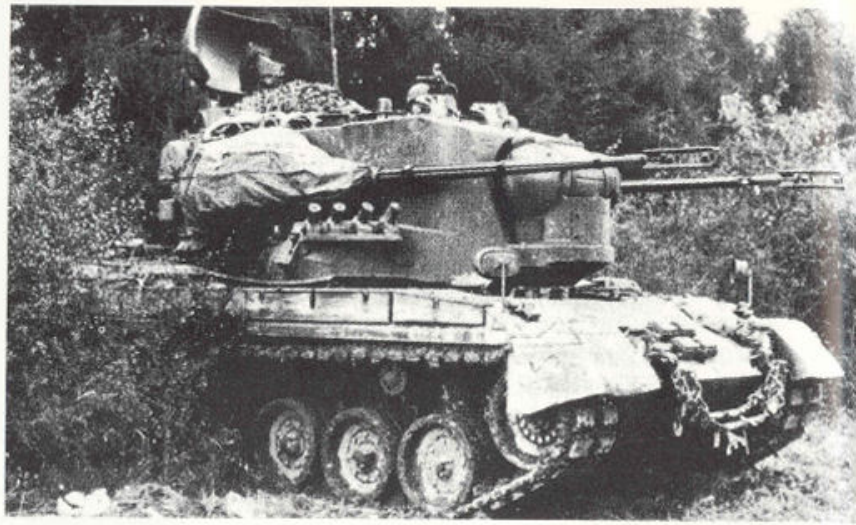


TECHNICAL DATA OF THE GEPARD B2 ANTI-AIRCRAFT TANK

Crew:	3 men
Dimensions:	Length 7700 mm (barrel at 12:00 position)—Width 3250 mm—height 3070 mm (search radar folded down)
Fighting weight:	45 tons
Motor type:	10-cylinder multifuel motor, air-cooled, MTU BM838
Motor performance:	830 HP (611 kW)—95 HP (auxiliary motor)
Speed:	65 kph
Range of operation:	550 km
Armament:	2 Oerlikon 35 mm machine cannon
Arc of elevation:	-5 to +85 degrees
Arc of traverse:	360 degrees
Aiming system:	electric
Cadence:	2 x 550 rounds per minute
Panoramic search radar:	Pulse-Doppler principle, MPDR 12, optimized
Aiming radar:	Pulse-Doppler principle, Monoplus Computer: analog

Left: GEPARD B2 in a firefight. The 660 belted rounds against air targets are stowed in magazines in the turret box; the additional ammunition for use on armored ground targets is stowed in external magazines. Both types of ammunition can be fired at will, separately of each other.

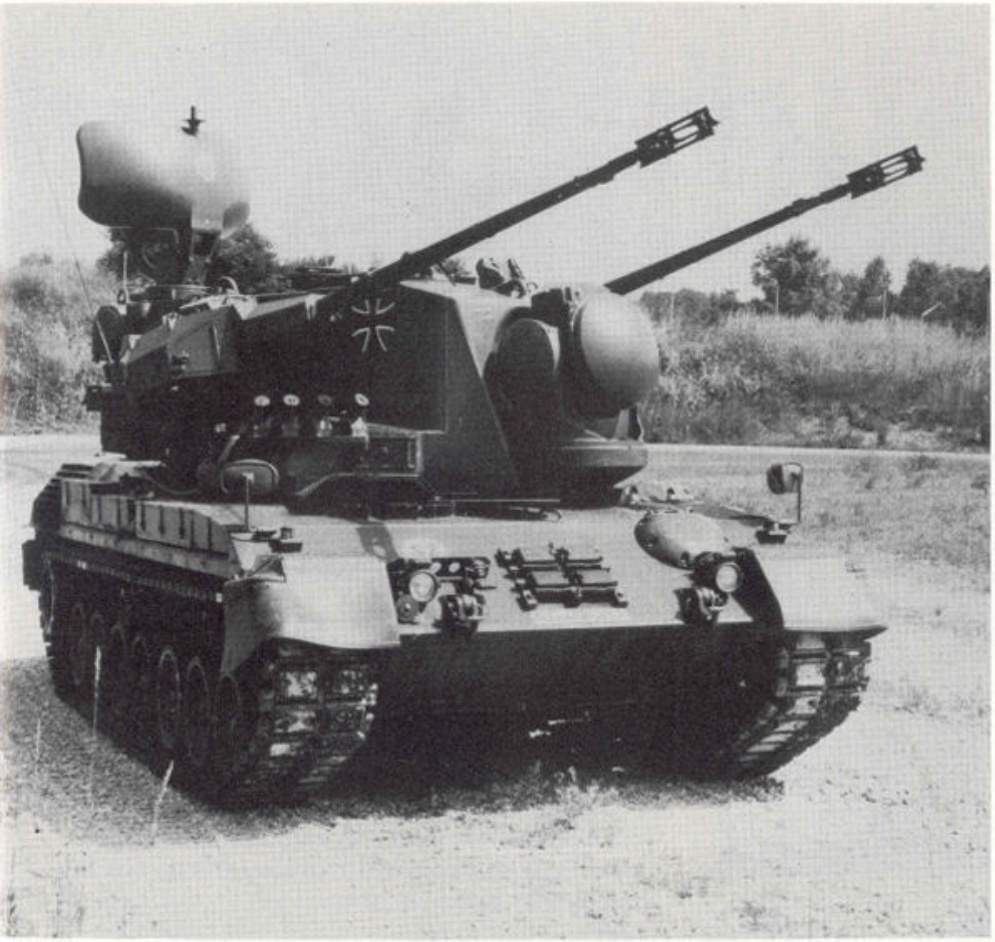
GEPARD B2 Anti-Aircraft Tank for the Belgian army. This version does not differ from the basic German version; it is also equipped with optimized Siemens MPDR 12 panoramic search radar and Siemens-Albiswerk, Zrich Pulsdoppler Monoplus aiming radar. (Krauss-Maffei)



GEPARD B2 as used in the Belgian army. Of particular interest are the loading chains for railroad transport hanging on the bow shackles, the canvas covers of the weapons system, and the non-activated aiming radar lowered into the front of the turret. On the roof of the turret, between the panoramic aiming telescopes, is the commander's lookout.

Below: GEPARD B2L Anti-Aircraft Tank driving over a war bridge; over it a BO 105 liaison helicopter. These vehicles are recognizable by the boxy device above the aiming radar.

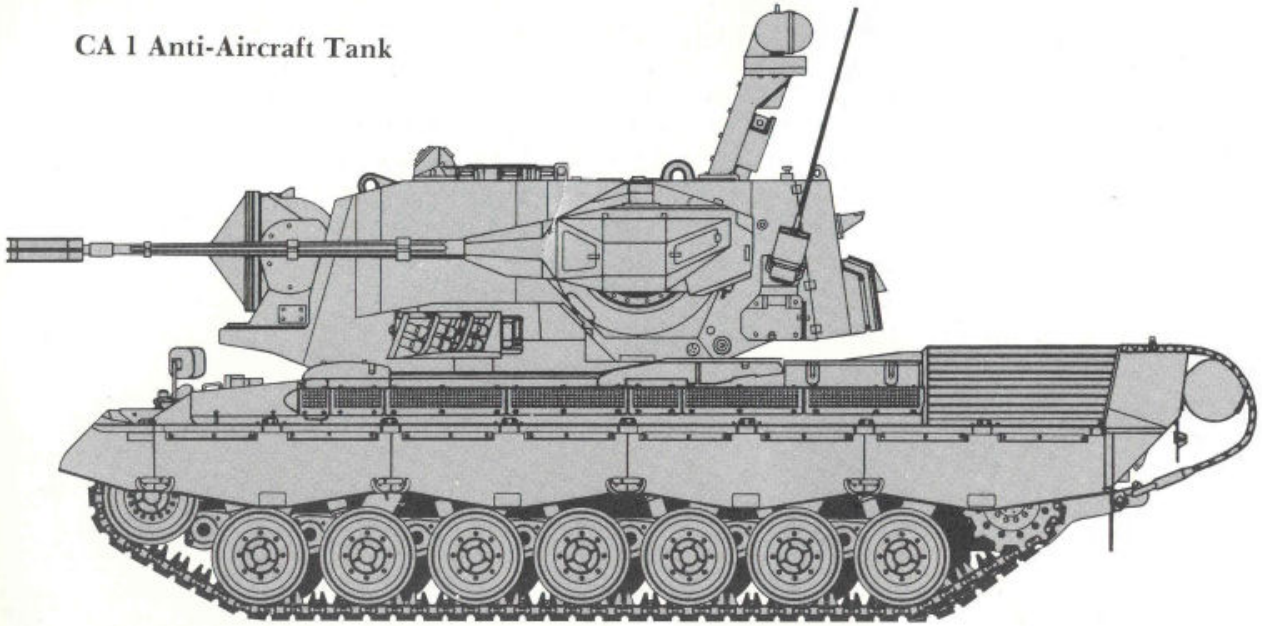
In the foreground a GEPARD B2L Anti-Aircraft Tank with aiming radar not activated; behind it a LEOPARD 1 A1 A1 Battle Tank. (Soldat und Technik).

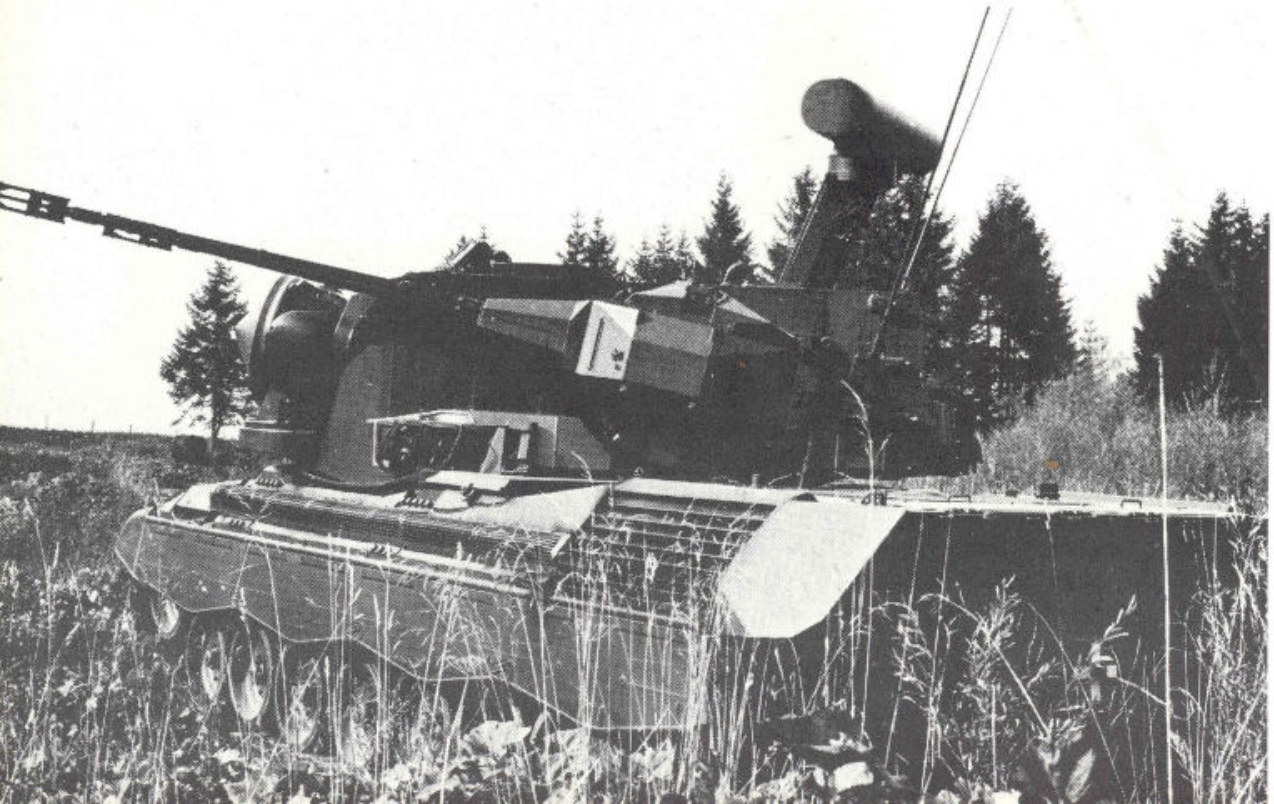


GEPARD B2L with activated aiming radar. Easily recognizable are the boxlike laser range finder mounted on the aiming radar, the spare track links on the bow, four smoke-discharging barrels on the right side of the turret, and the outboard stowage bins on the right side of the hull. An interesting detail is the protective grid over the driver's lookout.

Well-camouflaged GEPARD B2L. On the turret roof as it slopes away to the front, is an attachment point for removing the turret for necessary repair work. On the aiming radar, partially not activated, is the laser range finder with its convex, rippled upper surface. The operating processes for attacking air targets are extensively automated but can, if necessary, also be carried out by eye and hand.

CA 1 Anti-Aircraft Tank



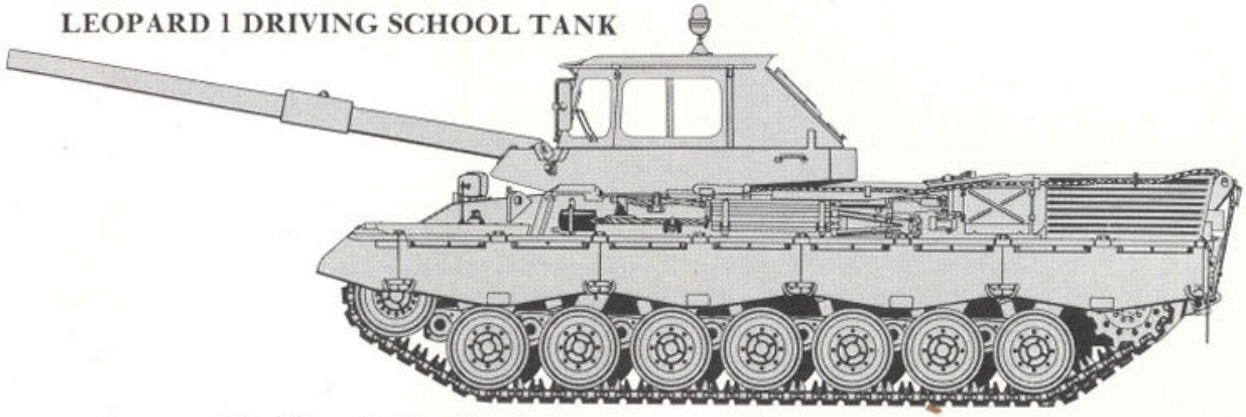


The CA 1 Anti-Aircraft Tank, the Netherlands version of the GEPARD Anti-Aircraft Tank, differs from the basic German version by, among other things, the use of radar equipment made by the Netherlands firm of Hollandse Signaalaparaten. The antenna mountings are particularly significant: the antenna of the panoramic search radar is cylindrical, that of the aiming radar is a conical scoop.

The automated operating processes have remained the same: An aircraft that flies into the area under surveillance is shown as an echo on the screen. A target recognized as hostile is turned over to the fire-control apparatus and independently sought by the aiming radar; this switches on as it passes over the flying target, follows it and continually transmits the coordinates to the fire-control computer; this now computes the firing coordinates, taking all necessary parameters into consideration. When turret and weapons are moved to the correct position, the crew opens fire after evaluating the threat. (Krauss-Maffei)

Left: CA 1 Anti-Aircraft Tank with non-standard smoke-discharging and on-board intercom systems. (Krauss-Maffei)

LEOPARD 1 DRIVING SCHOOL TANK



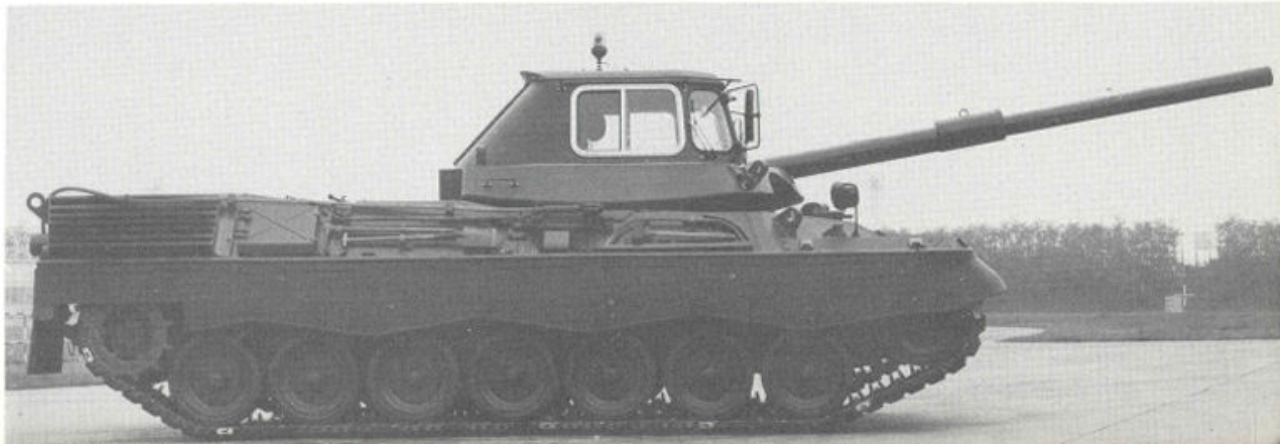
LEOPARD 1 DRIVING SCHOOL TANK

In 1978 and 1979 the Krauss-Maffei firm converted sixty LEOPARD 1 chassis built by the MaK firm into driving school tanks with a student-override system. Instead of a traversing turret, these vehicles are equipped with driving school cabs of equal weight, interchangeable with the armored turret. All sixty vehicles are used in the German army's driving school centers.

Lower right: The raised cabin of the DRIVING SCHOOL TANK is equipped with a student-override system which allows the instructor to intervene for safety reasons if necessary. The redundant armored turrets were used for another purpose in the realm of training. (Krauss-Maffei)

Two LEOPARD 1 DRIVING SCHOOL TANKS meet in heavy country. Although the driving-school training of tank drivers is carried out mainly on simulators for the sake of economy, the experience that one acquires in the country and on the road is irreplaceable. At the end of driving-school training, that training is completed at the driving-school centers with a few days in DRIVING SCHOOL TANKS.

The raised cab of the LEOPARD 1 DRIVING SCHOOL TANK equals the turret of the LEOPARD 1 Battle Tank in the most important dimensions and in weight; the gun is naturally a dummy. (Soldat und Technik)



In 1976 the project of a "Rocket System 80" (RS 80) medium rocket launcher system was discontinued while still in the definition phase. It was to fire six 280 mm rockets with a range of 60 to 80 km. (Soldat und Technik)

The PzH 155-1 fired 24 km, or 30 km with enhanced-range ammunition. The magazine held 32 rounds, for which 35 driving charges were available in the turret and hull. As secondary armament the PzH 155-1 had a 7.62 mm anti-aircraft machine gun and a smoke-discharging system. At the rear of the turret the ammunition-loading system is lowered.

Armored Howitzer 155-1, also called PzH 70, was a trilateral development of Great Britain, Italy and the Federal Republic of Germany. The illegitimate child of the LEOPARD family, it was developed with newly-constructed construction units plus parts of the LEOPARD 1 and 2 Battle Tanks, the MARDER SPz and the 155-1 Field Howitzer. (Rheinmetall)

TEST VEHICLES, EXPERIMENTAL VEHICLES AND STUDIES

Besides the LEOPARD 1 family vehicles in series production, there are large numbers of developmental and experimental projects that used, or were intended to use, the proven LEOPARD 1 chassis as the carrier of a weapons system. These include, among others, a MEDIUM ROCKET LAUNCHER SYSTEM" Rocket System 80" (RS-80), a European joint development that did not come into being, despite the initial interest of Great Britain and Italy.

As a German solo development, the project was discontinued for economic reasons in 1976 while still in the definition phase.

A similar fate befell the costly and time-consuming development of the 155-1 ARMORED HOWITZER. Again a trilateral development was to contribute to the standardization of the weapons system and the lowering of the cost of development. The developmental responsibility was divided as follows:

Federal Republic of Germany:
- Chassis and powerplant
- 155 mm gun barrel complete with cradle lengthening and free-flight activation apparatus
- Electric and hydraulic systems
- Hull

Great Britain:
- Turret
- Magazine
- Aiming apparatus
- Traverse drive

Italy:
- Power-supply system
- Fuel system
- Elevation and equalization system
- Elevating mass

Systems already in troop use that were to be used were:

— Of the 155-1 Field Howitzer, the barrel conception with muzzle brake, closing and interior ballistics
— Of the LEOPARD 1 Battle Tank, the running gear and ABC firing and fire-extinguishing systems
— Of the MARDER SPz, several transmission modules

After thirteen years of developmental work at developmental stages A and B, the progressively conceptualized armored howitzer did not fulfill expectations. The developmental agreement was annulled at the beginning of 1987 by unanimous agreement. The experience gained in this project will hopefully prove to be useful and economical in the next developmental project, the ARMORED HOWITZER 2000.

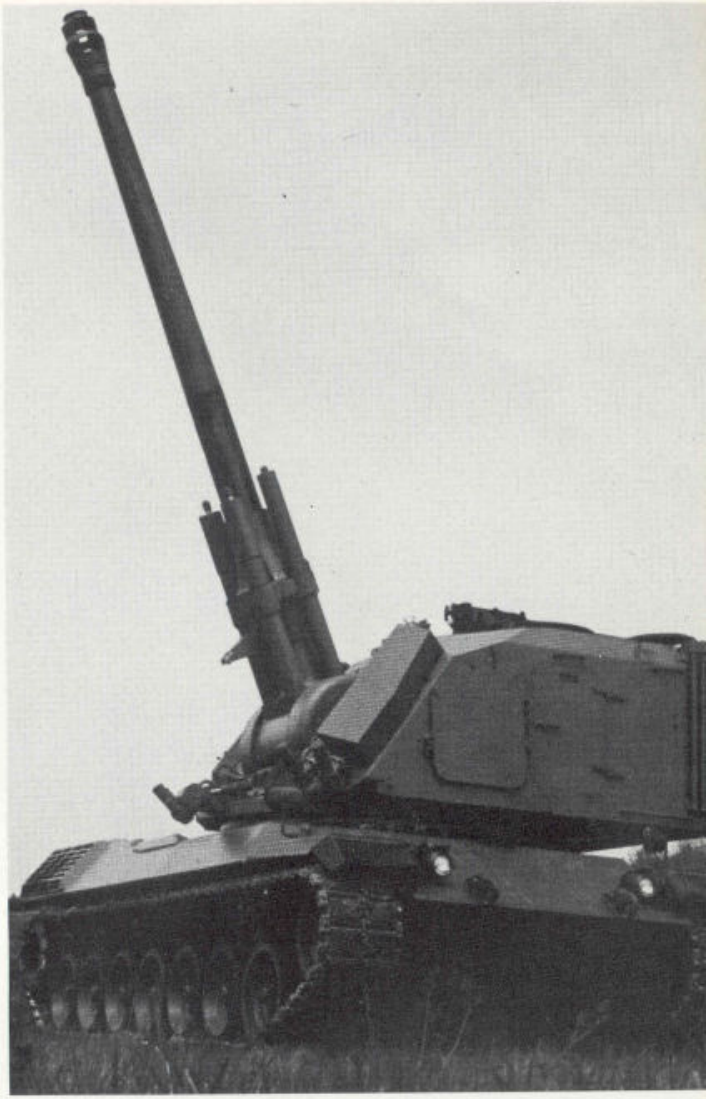
As early as 1973 the ARMORED HOWITZER 155 GCT-LEOPARD was presented as a joint development of two firms, Krauss-Maffei and GIAT (France). The armored howitzer turret could be mounted on either the LEOPARD 1 or the AMX 30 chassis, but no series production took place.

In 1978 the Krauss-Maffei firm carried out a study of an anti-aircraft rocket tank that was to be a combination of proven construction units, the ROLAND II anti-aircraft rocket system and the LEOPARD 1 chassis. This vehicle would have offered two advantages:

1. With a total weight of 37.85 tons, it has a performance reserve of seven tons for rearmaments that might become necessary in the future.
2. Countries that are already equipped with vehicles of the LEOPARD 1 family can stay with already available logistics.

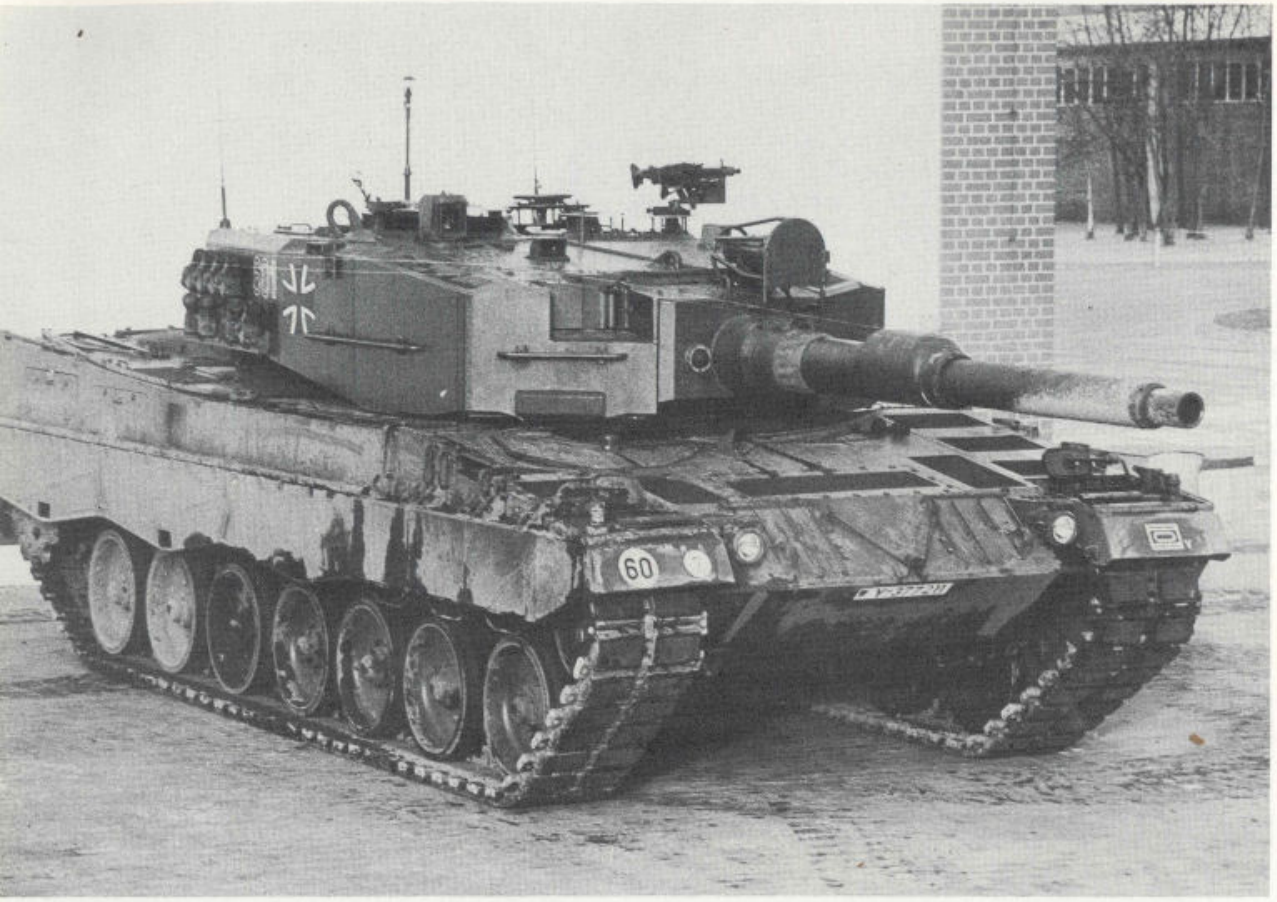
A technical realization of this project did not take place. Under the project name of ATAK 35 the Swiss Contraves firm carried out a performance upgrading of the anti-aircraft weapons system of the GEPARD Anti-Aircraft Tank, using a faster-working digital computer and improved radar apparatus. This project was technically realized in 1984 on the chassis of an Italian OF 40 export tank. Externally similar to the CA1 Anti-Aircraft tank of The Netherlands, this vehicle bears the designation "Anti-Aircraft Tank ATAK35".

A combination of the ROLAND anti-aircraft rocket system on a LEOPARD 1 chassis was a study of the Krupp MaK, Blohm & Voss and Eurmissile firms. The proven performance data of both systems were to remain fully preserved, while at the same time a gross weight of 37.85 tons left a performance reserve of seven tons available for rearming and up-rating performance. (Soldat und Technik)



A testing unit on a LEOPARD 1 chassis is the 155 GCT Armored Howitzer of the French GIAT firm. The French 155 mm armored howitzer turret could be mounted on the chassis of either the LEOPARD 1 or the AMX 30 battle tank. Only prototypes were made. (Krauss-Maffei)

Left: The ATAK 35 Anti-Aircraft Tank resembles the CA 1 Anti-Aircraft Tank of The Netherlands, but uses the chassis of the Italian OF 40 Battle Tank. (Soldat und Technik)



LEOPARD 2 BATTLE TANK

Proceeding from the project study of the development of an up-rated version of the LEOPARD 1 Battle Tank in 1966, and after the close of the German-American KAMPFPANZER 70 experimental development, the decision was made by the Federal Ministry of Defense in December of 1969 to develop a new battle tank unilaterally. The knowledge and experience gained from the KPz 70 program was to find useful application here. Between 1972 and 1974 seventeen different chassis and turrets of the first prototype generation were tested. On the basis of the German-American standardization agreement the so called AV version (second prototype generation) appeared in the fall of 1976, with improved ballistic protection, primary stabilized optics, a new division of space for ammunition, fuel and hydraulic power supply. The experiences that had been gained with the two chassis and three turrets in testing and troop trials from 1976 to 1978 resulted in improvements when series production

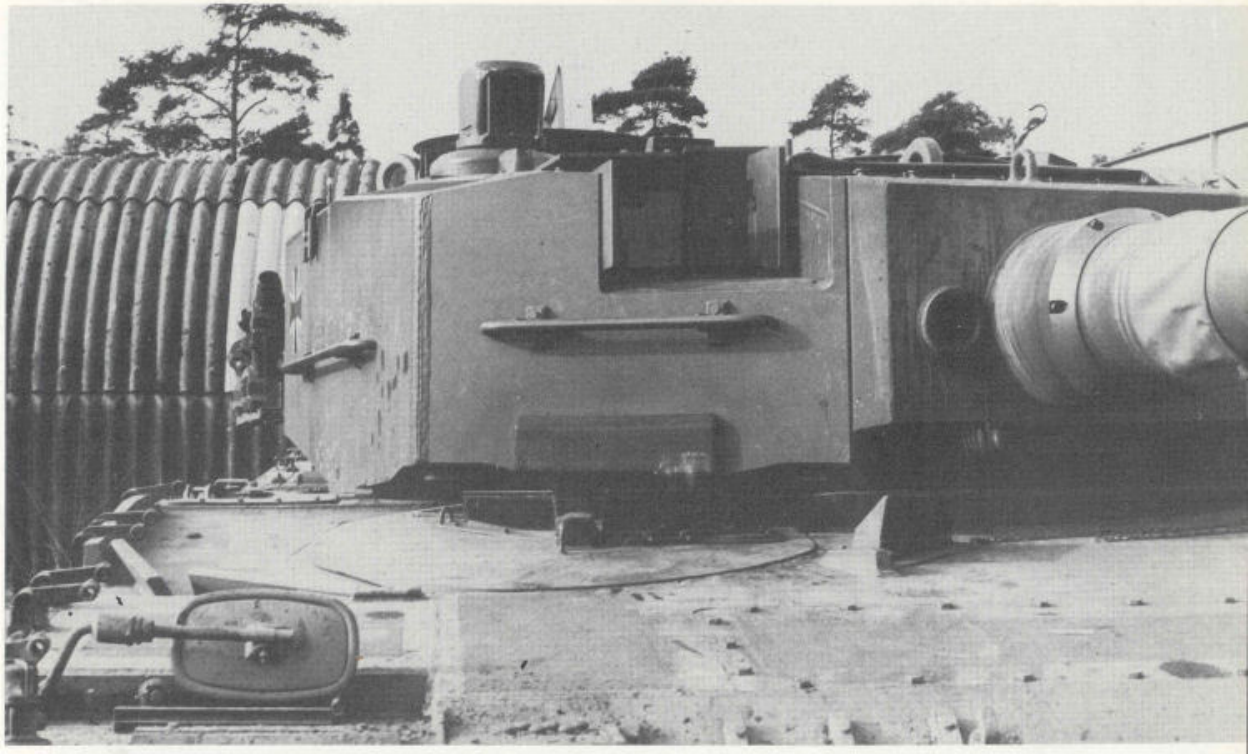
Left: likewise a LEOPARD 2 AO Battle Tank with PZB 200. Easy to recognize is the PZB 200 camera, which operates on the image intensification principle. Harder to identify is the small intake port of the ABC shot ventilation system on the upper side of the hull below the cross emblem, unique to the first production batch. (Wegmann)

Upper left: A LEOPARD 2 AO (first production batch) with passive aiming and observation device (PZB 200) on the hatch cover. The vehicles of the first production batch are externally recognizable by, among other things, the staff-shaped crosswind sensor on the turret roof and the lower mounting of the commander's panoramic periscope, the later bulging support of which is still absent.

began. The first LEOPARD 2 Battle Tanks were delivered to the German army in the fall of 1979. The LEOPARD 2 was also built in several production batches. Either planned in advance as new technical developments for series production or evolved over the course of time as results of troop use, changes and improvements resulted which are reflected in the various production batches or introduced as revisions in already delivered vehicles.

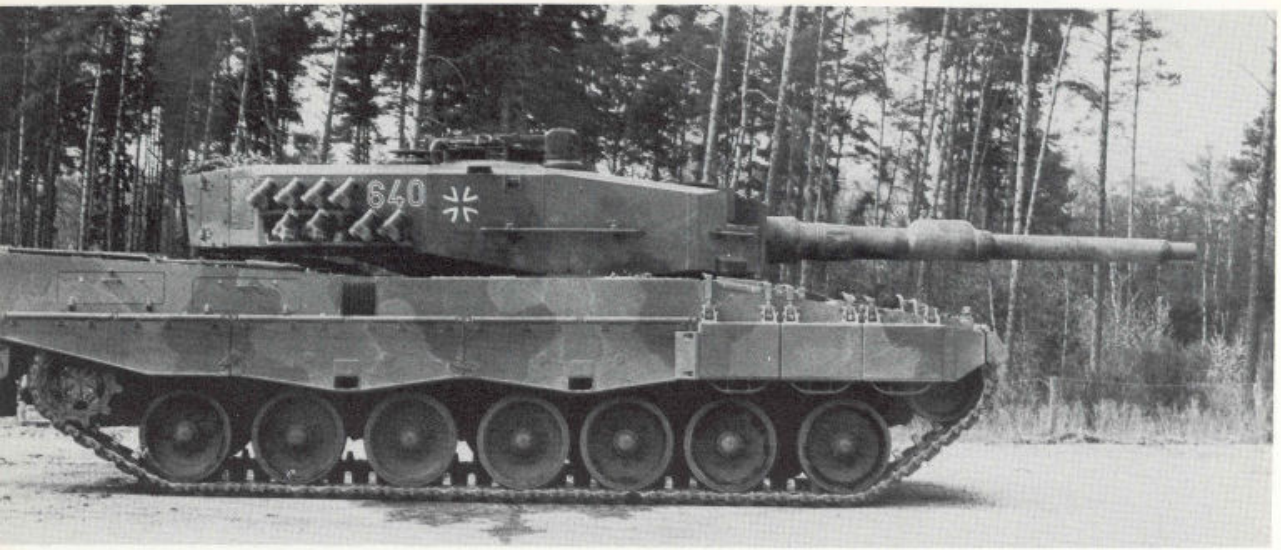
LEOPARD 2 AO (FIRST GROUP) LEOPARD 2 A2

380 vehicles of the original series production were supplied in two different equipment versions. Since the projected infrared viewer (WBG) was not yet available when production began, approximately half of the tanks were equipped with the PZB 200 passive aiming and observation device. The vehicles of the first production run are easy to recognize externally by the staff-formed crosswind sensor mounted on springs on the turret roof. Further identifying marks of this version of the LEOPARD 2 Battle Tank are the fuel filler caps far back on both sides of the hull, the anti-aircraft machine gun ring rail for the lower mantlet of the anti-aircraft machine gun, and the lower mounting of the commander's panoramic periscope. Until mid-1987 these tanks were up-rated and reequipped to LEOPARD 2 A1 standards; they are now designated LEOPARD 2 A2.



Upper right: Turret front of the LEOPARD 2 A1 (second production batch): the crosswind sensor has been eliminated, the commander's panoramic periscope is mounted higher, the opened E-measuring flaps now offer a view of the big germanium plate of the WBG.

Right: An Armored Recovery Vehicle 2 A2 (with rear brace) lifting the turret of a LEOPARD 2 A1 Battle Tank (third production batch). (Krauss-Maffei)



LEOPARD 2 A1 (third production batch) with higher panoramic periscope mounting and fuel fillers moved farther forward on both sides of the hull. The 120 mm smooth-bore cannon fires fin-stabilized multipurpose and -weight cartridges.

Below: The same vehicle from the loader's side: directly under the cross emblem is the ammunition hatch through which cartridges are handed into the fighting compartment; under it is the flat, larger intake port of the ABC shot ventilation system; to the right of the rearmost smoke-discharging barrel is the attachment for the outboard speaker connection.

LEOPARD 2 A1 (2nd and 3rd groups)

The 450 vehicles of the 2nd and the 300 of the 3rd batch can scarcely be told apart externally; only the larger covering of the port for the ventilation and ABC firing systems marks a tank of the third batch. All vehicles now have the infrared viewer and computer-directed armor-testing system (RPP) built in. The crosswind sensor is gone, the fuel fillers were moved forward to the niche tanks, and the anti-aircraft machine gun's ring rail is gone from the commander's hatch. The panoramic periscope was mounted 5 cm higher to give the commander a better view.

In addition, connections near the left rear of the turret make it possible for the crew to communicate with those outside when the hatches are closed, and the crosswise attachment of the towing lines on the rear of the vehicle was created.

Armored Recovery Vehicle 2 A2 and LEOPARD 2 A1 (3rd construction group).

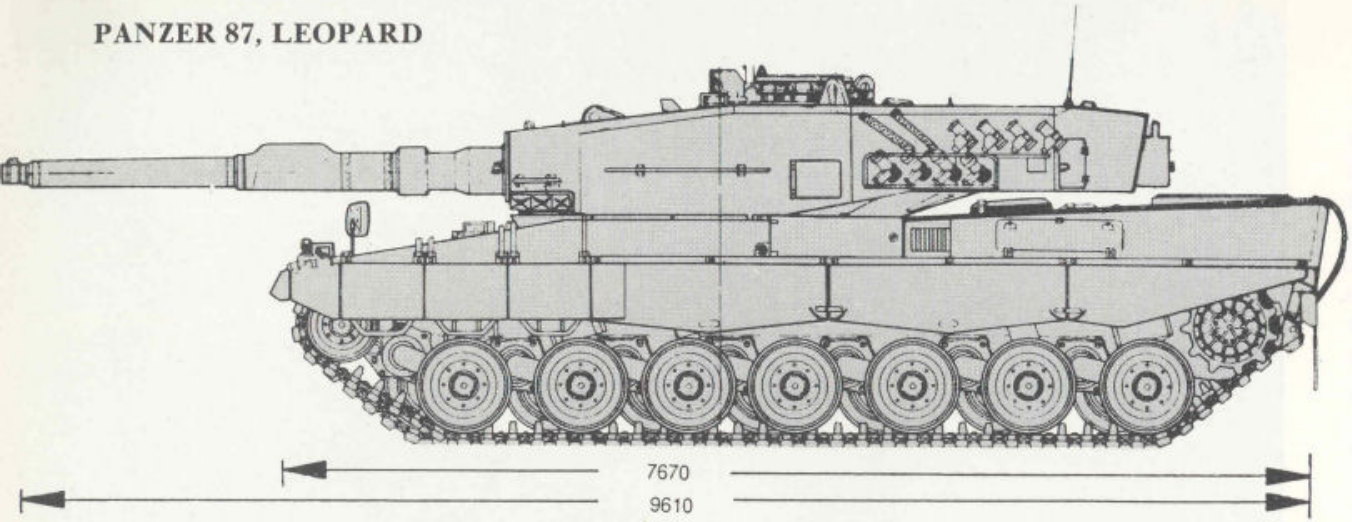
LEOPARD 2 A3 (4th group)

300 LEOPARD 2 of the 4th batch were built in 1984 and 1985. These vehicles were equipped with the new SEM 80/90 radio system-recognizable by the shorter antenna staffs and thinner antenna bottoms. In addition, these tanks were finished in the new spot camouflage paint at the factory, and given a modified exhaust system, an improved locking brake and a chest brace for the gunner.

The thin antenna bottoms and short antenna staffs of the new SEM 80/90 on-board radio system, as well as the lack of the ammunition hatch on the loader's side, mark this tank as a LEOPARD 2 A3 (4th construction lot).

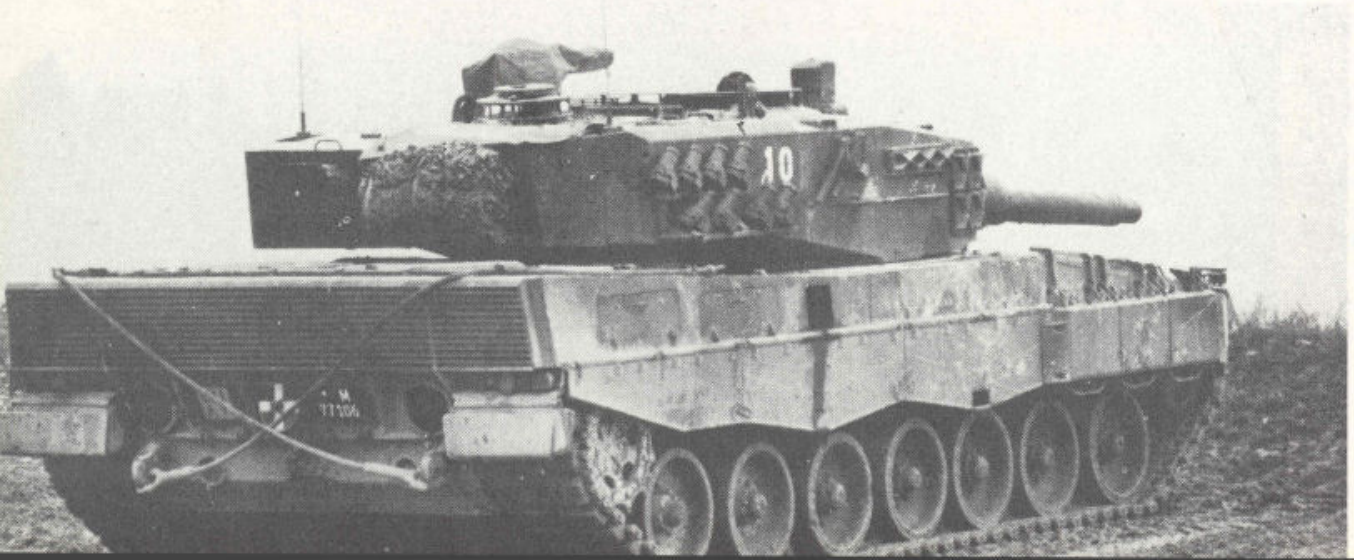
Right: A typical representative of interim solutions, a LEOPARD 2 A1, updated with the new SEM 80/90 radio system and the digital computer instead of the analog fire-control computer. The absence of the fire-extinguishing system (BUA) prevents it from being a full-blooded A4.

PANZER 87, LEOPARD



TECHNICAL DATA OF THE PANZER 87, LEOPARD

Crew:	4 men
Fighting weight:	55.15 tons
Dimensions:	Length 9610 mm—Width 3700 mm—Height 2480 mm
Motor type:	12-cyl. multifuel, water-cooled
Motor performance:	1500 HP (1104 kW)
Top speed:	68 kph
Range of operation:	340 km
Armament:	1 120 mm gun (smooth-bore), one hatch-mounted 7.5 mm M 51/71 machine gun, one 7.5 mm M 51/71 anti-aircraft machine gun, 16 smoke-discharging barrels.



The PANZER 87, LEOPARD corresponds to the equipment level ofthe LEOPARD 2 A4, but it is equipped with the AN/-VRC 12 on-board intercom system made under license in the USA and with 7.5 mm hatch and anti-aircraft machine guns. (Schweizer Soldat)

In addition, the PANZER 87 differs from the basic German version in having modified front perimeter lights, extended covering of the turret's rear box, and additional attachments. (Schweizer Soldat)

Left: PANZER 87, LEOPARD of the Swiss army in a partly concealed position. Noticeable are the quiver for the hot-fired machine gun barrels and the additional attachments for snow grousers on the side of the turret. (Schweizer Soldat)

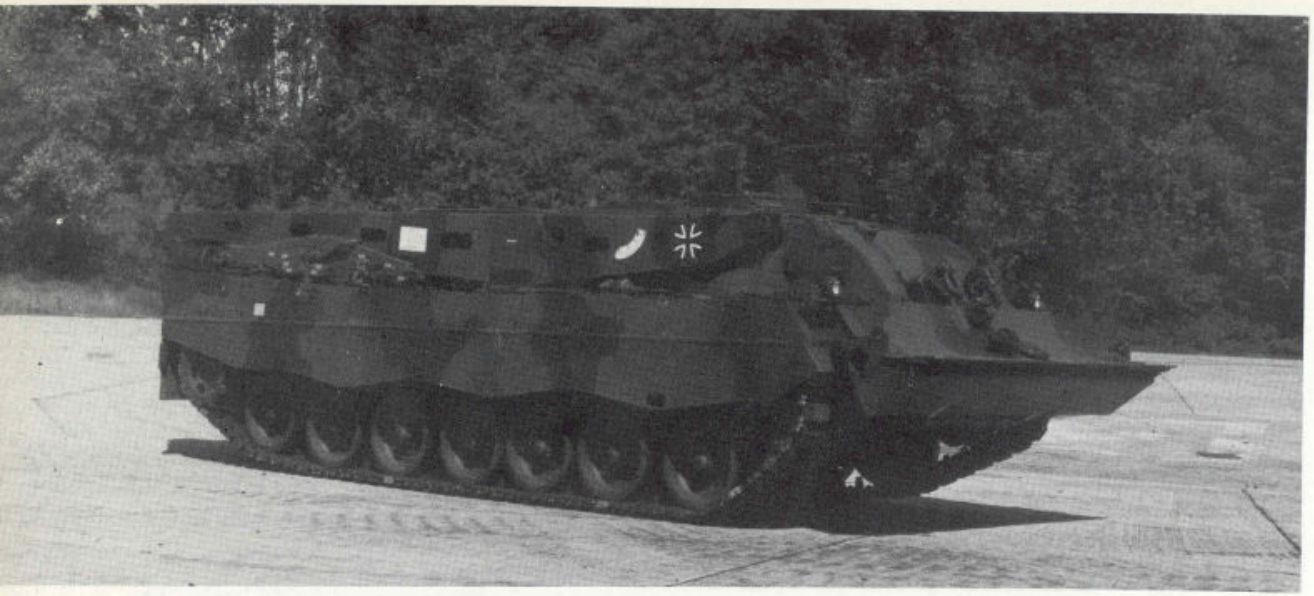
LEOPARD 2 DRIVING SCHOOL TANK

Since 1986 the Krauss-Maffei firm has delivered 22 LEOPARD 2 driving school tanks to the German army. As were the LEOPARD 1 driving school tanks, these vehicles are also equipped with a student-override system. If necessary, the driving school cab can be exchanged for the tank turret, which weighs the same. After successful training on the driving simulator, the driving school tank contributes to practical training under realistic conditions.

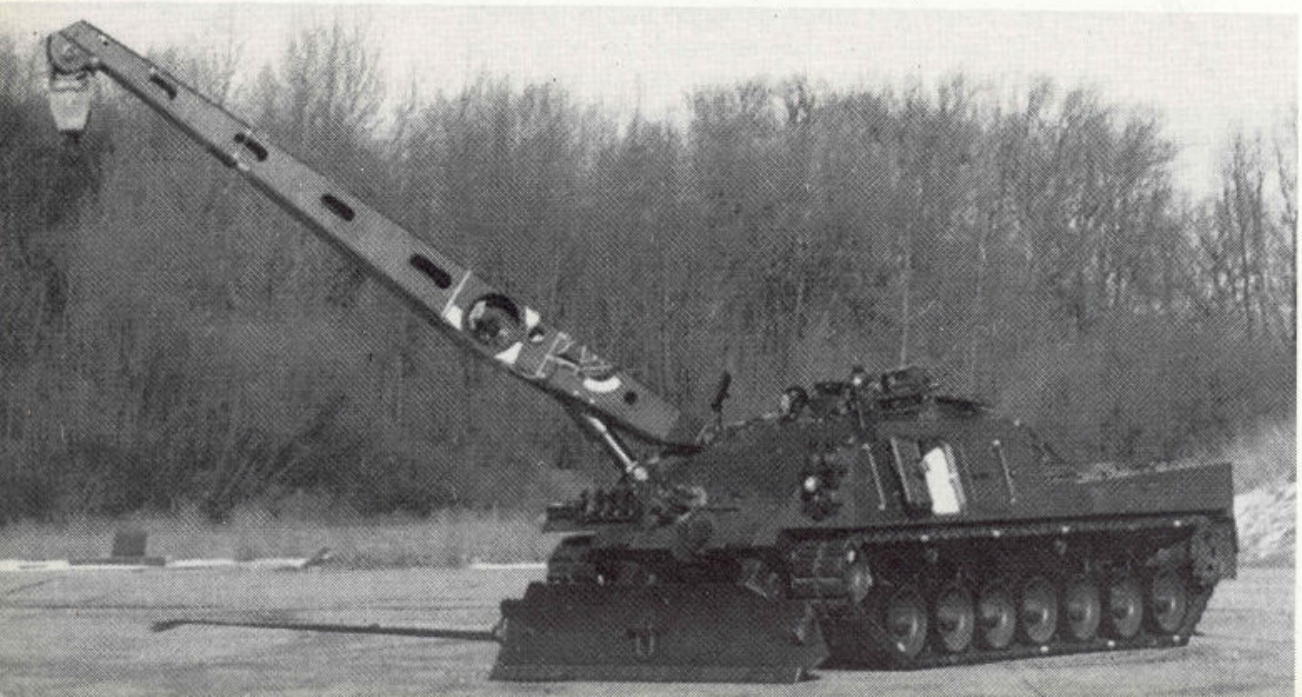
Right: LEOPARD 2 DRIVING SCHOOL TANK for the Netherlands army. (Krauss-Maffei)

Lower right: The driving school cab of the LEOPARD 2 corresponds in weight and the most important dimensions to the turret of the battle tank, in order to maintain the driving characteristics and the dimensions of the vehicle. (Krauss-Maffei)

LEOPARD 2 DRIVING SCHOOL TANK in heavy country. Noteworthy are the additional outboard weights, particularly in the area behind the cab. (Krauss-Maffei)



The Armored Recovery Vehicle 3 is a joint development of Germany and The Netherlands, built on the LEOPARD 2 chassis. The BPz 3 is capable of salvaging and towing away track-damaged vehicles of up to MLC 60. It also supports repair work by shunting tracked vehicles, removing powerplants and turrets, handling other crane work, making use of its cutting and welding apparatus, and working on electrical and hydraulic connections. In addition, it is useful in fueling and emptying tracked vehicles, transporting powerplants for short distances, and removing obstacles. (MaK)



ARMORED RECOVERY VEHICLE 3

To replace the obsolete Armored Recovery Vehicle 1 (M 88) and to assure quick salvage for battle troops, the ARMORED RECOVERY VEHICLE 3, presently being developed on the basis of the LEOPARD 2, is to be produced between 1991 and 1994, with a total number of 220 vehicles. In particular, the insufficient supplying of LEOPARD 2 tank units with the comparatively light Armored Recovery Vehicle 2 makes the introduction of this vehicle necessary. The ARMORED RECOVERY VEHICLE 3 will be equipped with a series of tools and equipment that allow it to provide help itself to other vehicles that are having trouble or to salvage them. Its most important salvage equipment includes:

- the towing system
- the main winch
- the crane boom
- the support and removal system

In addition there are:

- loading tackle for turrets
- lifting tackle for powerplants
- cable spools
- shackles of varying sizes, without which it would be impossible to do a variety of jobs.

With the ARMORED RECOVERY VEHICLE 3 the German army will receive a recovery vehicle that uses a number of proven and tested construction units of the LEOPARD 1 and 2 Battle Tanks and is up to date in the realm of regulating and hydraulic technology.

Left: With a particular type of equipment the BPz 3 can quickly rescue disabled battle tanks from the front lines without the crew having to get out.

Engineer Tank 1 (BPz 2 A1) with earth auger.

BIBER Bridgelaying Tank with horizontally positionable bridge which moves freely forward.

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