

# ARCHIVED REPORT

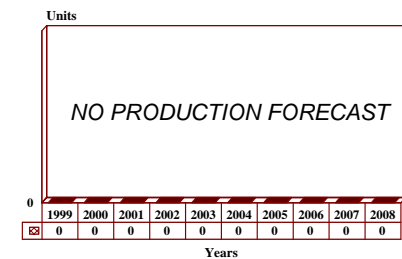
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## C-13 and Armored Vehicle 90 - Archived 6/2000

### Outlook

- C-13 program is dormant and not expected to be revived
- Armored Vehicle 90 available for orders
- Armored Vehicle 90 being promoted as replacement for M113
- There is presently no modernization and retrofit potential

10 Year Unit Production Forecast  
 1999-2008



### Orientation

**Description.** Tracked vehicles

**Sponsor.** The development of the C-13 program has been on a private basis funded by Otobreda. MaK System Gesellschaft, in cooperation with Otobreda, has further developed the C-13 into the Armored Vehicle 90; again, the funding has been on a private basis, funded by both contractors.

**Contractors.** The C-13 was developed and, if ever placed into production, will be manufactured by Otobreda, La Spezia, Italy. The Isotta Fraschini and Zahnradfabrik Friedrichshafen firms are the main subcontractors. MaK System Gesellschaft and Otobreda are considered the joint prime contractors for the Armored Vehicle 90. Motoren- und Turbinen-Union and Zahnradfabrik Friedrichshafen are the main subcontractors for the Armored Vehicle 90.

**Licensees.** None

**Status.** The development of the C13 is complete and the vehicle is available for production. The initial

development of the Armored Vehicle 90 is complete, and various phases of contractor and operational testing are ongoing; development continues. The Armored Vehicle 90 is available for production orders.

**Total Produced.** As of January 1, 1999, a total of five prototype and developmental C-13 vehicles had been manufactured. As of the same date, six prototype and developmental Armored Vehicle 90 vehicles had been manufactured; these vehicles were being used in an extensive evaluation program.

**Application.** The C-13 and Armored Vehicle 90 are armored personnel carriers of advanced design for the transport of infantry to and within the battlefield.

**Price Range.** In equivalent 1999 United States dollars, the basic version of the C-13, armed with an M2HB machine gun, has a unit price of \$1.252 million. In those same dollars, the base version of the Armored Vehicle 90, equipped in the same manner, has a unit price of \$1.414 million.

### Technical Data

C-13

**Crew.** Three: commander; gunner; and driver, plus nine infantrymen.

**Armor.** The C-13 is fabricated from aluminum alloy armor with a maximum thickness of five centimeters. In addition, steel appliqué armor with varying thicknesses from six to 13 millimeters is placed over vital areas.

**Dimensions.** The following data are for the latest prototype of the C-13:

	<u>SI units</u>	<u>US units</u>
Length	5.65 meters	18.54 feet
Width	2.71 meters	8.89 feet
Height	2.48 meters	8.14 feet
Combat weight	14.65 tonnes	16.15 tons
Fuel capacity	400 liters	106.38 gallons

**Performance.** The automotive performance is on a metallated road.

	<u>SI units</u>	<u>US units</u>
Maximum speed	70 kilometers per hour	43.5 miles per hour
Maximum range	500 kilometers	310.5 statute miles
Step	70 centimeters	2.3 feet
Trench	1.8 meters	5.91 feet
Slope	30%	30%
Gradient	60%	60%
Fording	1.3 meters	4.27 feet

**Engine.** Isotta Fraschini provides the Model ID 38 SS V6 six-cylinder, supercharged, four-cycle diesel engine rated at 268.56 kilowatts (360 horsepower) at 46.67 revolutions per second (2,800 revolutions per minute). The power-to-weight ratio with this engine is 18.33 kilowatts per tonne (22.29 horsepower per ton). A 12-volt electrical system is the standard electrical fit.

**Gearbox.** The C-13 uses an unspecified, automatic gearbox from Zahnradfabrik Friedrichshafen; this gearbox has five forward- and one reverse-gear ratios. Hydrostatic steering is used.

**Suspension and Running Gear.** This vehicle uses a torsion bar-type suspension with six dual-tired roadwheels and three return rollers on each side. The first, second, fifth and sixth roadwheel stations are fitted with hydraulic shock dampers.

**Armament.** The basic armament fit of the C-13 is an M2HB machine gun in a protected mount; 200 rounds are at the ready. Also, eight smoke grenade launchers are fitted, four on each side of the cupola. Other armament options are described below.

### **Armored Vehicle 90**

**Crew.** Three: commander; gunner; and driver, plus nine infantrymen.

**Armor.** The Armored Vehicle 90 is fabricated from pattern 5083 aluminum alloy with a maximum thickness of five centimeters (1.97 inches). In addition, steel appliqué armor with varying thicknesses from six to 13 millimeters is placed over vital areas.

**Dimensions.** The following data are for the initial prototype of the standard vehicle. The height figure is to the top of the machine-gun mount; the height to the top of the hull is 1.72 meters (5.64 feet). The weight is the maximum weight; other versions will weigh less, depending on the configuration.

	<u>SI units</u>	<u>US units</u>
Length	6.03 meters	19.78 feet
Width	2.71 meters	8.89 feet
Height	2.59 meters	8.49 feet
Combat weight	20.04 tonnes	22.09 tons
Fuel capacity	480 liters	127.66 gallons

Performance. The automotive performance is on a metalled road.

	<u>SI units</u>	<u>US units</u>
Maximum speed	64 kilometers per hour	39.7 miles per hour
Maximum range	565 kilometers	350.9 statute miles
Step	70 centimeters	2.3 feet
Trench	2.07 meters	6.79 feet
Slope	30%	30%
Gradient	60%	60%
Fording	1.3 meters	4.27 feet

**Engine.** Motoren- und Turbinen-Union provides the 8V 183 TC22 (OM 422 LA) eight-cylinder, supercharged, liquid-cooled, four-stroke diesel engine rated at 331.0 kilowatts (443.69 horsepower) at 35 revolutions per second (2,100 revolutions per minute). For a vehicle weight of 20.04 tonnes (22.09 tons), the Armored Vehicle 90 has a power-to-weight ratio of 16.52 kilowatts per tonne (20.09 horsepower per ton). A 24-volt electrical system is the standard electrical fit.

**Gearbox.** The Armored Vehicle 90 uses the Zahnradfabrik Friedrichshafen LSG 1500 automatic gearbox with four forward- and two reverse-gear ratios. A regenerative hydrostatic cross-drive steering unit is used. The final drive unit is the P9000, also provided by Zahnradfabrik Friedrichshafen.

**Suspension and Running Gear.** This vehicle uses a torsion bar-type suspension with six dual-tired roadwheels and three return rollers on each side. The first, second, fifth and sixth roadwheel stations are fitted with hydraulic shock dampers. The two front and two rear roadwheels on each side are further supported by volute spring assemblies. The model 224 double-pin track is provided by Diehl.

**Armament.** The armament fit of the basic armored personnel carrier version of the Armored Vehicle 90 is an M2HB machine gun in a protected mount; 200 rounds are at the ready. Also, eight 77 millimeter electrically operated smoke grenade launchers are fitted, four on each side of the cupola. Other armament options are described below.

## Variants/Upgrades

**Variants.** Even though the C-13 has yet to enter serial production, several variants have been developed from the basic vehicle. The contracting team MaK System Gesellschaft and Otobreda have developed a number of proposed variants of the Armored Vehicle 90.

### C-13

C-13 Armored Personnel Carrier - The basic tracked armored personnel carrier developed as a private venture for the export market. The vehicle can be fitted with a range of turrets armed with different armaments.

C-13/20 Infantry Fighting Vehicle - This version is fitted with the Otobreda T20 turret, which is armed with various types of 20 millimeter cannon.

C-13/25 Infantry Fighting Vehicle - This version is fitted with the Otobreda T25 turret, which is armed with various types of 25 millimeter cannon.

C-13/60 A and C13/60 M Infantry Fighting Vehicles - These versions are fitted with different versions of the Otobreda-powered T60/70 turret, which is armed with a 60 millimeter cannon. The 60 A features an automatic

loader while the 60 M is manually loaded. The 60 A system features two fire-control options: the Fire Control System Mod 60 Mark 1, which is a clear-weather system; and the Fire Control System Mod 60 Mark 2, a day/night system. A crew of three plus four infantrymen is carried.

C-13/90 Infantry Fighting Vehicle - This version is fitted with the Otobreda T90 CKL two-man turret, which is armed with a 90 millimeter cannon and a coaxially mounted 7.62 millimeter machine gun.

C-13/4 x 25 Anti-Aircraft Mobile System - This version is armed with an Otobreda turret with four model KBA 25 millimeter automatic cannon. This installation is used on the M113 by the Italian Army as the SIDAM 25 quadruple anti-aircraft artillery system.

C-13 TOW Under Armor - This version of the C-13 is fitted with the ESCO TOW Under Armor turret. This turret is used on the M901 Improved TOW Vehicle, which is based on the M113. Two BGM-71 TOW missiles are at the ready, and an additional ten are stored in the vehicle. A crew of four is carried.

C-13 Coastal Defense System - This version of the C-13 is fitted with a twin OTOMAT anti-ship missile launcher.

Other models and variants of the C-13, which have been developed to the prototype stage, include an ambulance version and the C-14 Cargo Carrier. A version fitted as an armored recovery vehicle has been proposed, but it is not known if a prototype has been developed.

### **Armored Vehicle 90**

Even though only three developmental prototypes of the Armored Vehicle 90 (the basic armored personnel carrier) have been manufactured to date, the contractors already have several variants of this vehicle developed on paper. The ones presently developed are as follows; other variants are expected to be developed as the program matures:

Armored Infantry Fighting Vehicle - This version is fitted with an as-yet-unspecified one- or two-man turret, which is armed with one of several types of 20 or 25 millimeter cannon, and a coaxially mounted 7.62 millimeter machine gun. The Otobreda T25 turret is one probable fitting.

TOW Under Armor Vehicle - This version of the C-13 is fitted with the Systems & Electronics TOW Under Armor turret (formerly ESCO Corporation (Electronics and Space Corporation) and before that, Emerson Electric). This turret is used on the M901 Improved TOW Vehicle, which is based on the M113. Two BGM-71 TOW missiles are at the ready, and an additional ten are stored in the vehicle. A crew of four is carried.

Armored Ambulance - This version can accommodate two sitting and two stretcher patients and an orderly.

## Program Review

**Background.** The C-13 was developed as a private venture intended for the export market. The then-OTO Melara originally envisioned the C-13 as filling the gap between the M113 and the more-expensive and sophisticated true mechanized infantry combat vehicles, such as the Dardo (Veicolo Corazzato de Combattimento-80) and FV510 Warrior. Later, the vehicle began to be pushed as a direct replacement for the M113, more than 70,000 of which are in service around the world. The vehicle is offered with a wide range of turrets with various armaments.

The development of the C-13 commenced in the late seventies. The first two prototype vehicles were completed in 1983; tests with a wide range of different turrets, carrying various armaments, were conducted through 1984. By early 1987, three more prototypes and several armament variations for the C-13 family had been completed, thus increasing the vehicle's marketability. However, as of mid 1999, no sales had been reported and the development program was dormant. In late 1994, as part of a larger reorganization of the Italian defense industry, OTO Melara was integrated with the Breda Meccanica firm and renamed Otobreda.

**Description.** The hull of the C-13 is constructed entirely of welded aluminum armor plates. The aluminum alloy armor provides a maximum of five-centimeters protection, sufficient against some small-arms fire and ballistic fragments. In vital areas, the protection is increased by six to 13 millimeters by the application of steel appliqué armor plate. Protection is enhanced by the sloped design of the front and upper hull sides.

The vehicle is manned by a crew of three and can carry up to nine fully equipped infantrymen in the rear troop compartment. The driver sits at the front left side of the vehicle and is equipped with four periscopes for external observation. The center periscope can be replaced with an infrared or passive vision device for night operations. The vehicle is steered by means of a hydrostatic steering system. The commander, or gunner (depending on the configuration), is seated in the center of the hull. The center point of the vehicle can mount either a commander's cupola capable of traversing 360 degrees and fitted with five periscopes, or a turret, depending on the variant. The troop compartment is located directly behind the commander's cupola or turret.

Access to the vehicle is through either a large ramp at the rear of the vehicle or through roof-mounted hatches. The troop compartment is fitted with five vision blocks, all of which have a firing port below it for use by the troops. The C-13 is powered by an Isotta Fraschini Model ID 38 SS V6 supercharged diesel engine rated at 268.56 kilowatts (360 horsepower) at 2,800 revolutions per minute. The engine is mounted at the front of the vehicle on the right side. The engine is coupled to an automatic gearbox with five forward- and one reverse-gear ratios. The maximum road speed is 70 kilometers per hour, and ranges of up to 500 kilometers can be attained. The fuel capacity is 400 liters.

The suspension system features torsion bars with six dual rubber-tired roadwheels per hull side and hydraulic shock absorbers at the first, second, third and sixth roadwheel stations. The drive sprocket is located at the front of the vehicle with the idler at the rear. There are

three track-return rollers per hull side. The upper part of the suspension, as well as part of the hull side, is protected by metal side skirts. The vehicle is amphibious, though the amphibious kit is part of the optional equipment. The vehicle comes with a pair of bilge pumps and a fire detection and extinguishing system for both the engine and fighting compartments as standard equipment. Optional equipment for the C-13 includes amphibious equipment, an air-conditioning system and a nuclear/biological/chemical protection system.

The basic vehicle is armed with a single M2HB 12.7 millimeter machine gun mounted on the forward part of the cupola. If required, the cupola can be replaced with a variety of turret designs. The prototype vehicles have been successfully tested with the following turrets: the T90 CKL two-man turret armed with the Cockerill Mark 3 90 millimeter cannon and a coaxial 7.62 millimeter machine gun; the T60/70 turret armed with a hypervelocity 60 millimeter cannon that can be used in both anti-tank and anti-helicopter roles, and a coaxial 7.62 millimeter machine gun; the T25 turret armed with a 25 millimeter model KBA cannon from Örlikon-Contraves and a coaxial 7.62 millimeter machine gun; the T20 turret armed with various 20 millimeter cannon and a coaxial 7.62 millimeter machine gun; and the Otobreda SIDAM 25 turret armed with four Örlikon-Contraves model KBA 25 millimeter automatic cannon.

Otobreda has also developed a version of the C-13 fitted with the Systems & Electronics (formerly ESCO - Electronics and Space Corporation and before that, Emerson Electric) TOW Under Armor turret; a coastal defense version fitted with two OTOMAT missile launchers in place of the turret or commander's cupola; an unarmed ambulance version which can carry up to six seated wounded and various medical equipment; and a cargo carrier version which has a redesigned hull but uses the same track, engine and gearbox. The suspension has been lengthened on this version to enable the vehicle to carry a payload of 6,500 kilograms.

Advent of the Armored Vehicle 90 Program. In the early eighties, MaK System Gesellschaft of the Federal Republic of Germany also perceived an eventual need to replace the ubiquitous M113. In 1985, MaK System Gesellschaft entered into a joint venture with the then-OTO Melara to develop a vehicle for this requirement. As the C-13 program was already well along, the two firms decided to combine their expertise and further develop the C-13 to address the potentially lucrative M113 replacement market.

The two firms decided to make a fresh start on the new vehicle, albeit heavily based on the C-13. The Isotta

Fraschini engine was replaced with the Motoren- und Turbinen-Union 8V 183 TC22 diesel, more widely known as the OM 422 LA. To this compact and efficient engine was added a new high-efficiency cooling system, provided by Behr and a heavy-duty air filtration system, provided by Mann & Hummel. These components allow for the efficient operation of the engine in the severest environmental conditions, in temperatures up to 55 degrees Celsius (131 degrees Fahrenheit). The automatic, electronically controlled LSG 1500 gearbox and a new-design track also contribute to the efficient operation of the vehicle.

The new vehicle was lengthened slightly from the C-13, and other design changes were made in order to allow for the most efficient operation of the vehicle. From the outset, it was decided that the Armored Vehicle 90 was to be a family of vehicles based on the standard armored personnel carrier described above. This version, with a present weight of 20.04 tonnes (22.09 tons) has the potential to grow to a 25-tonne (27.56-ton) weight. In addition, a lighter version of the Armored Vehicle 90 has been proposed for users with different requirements that cannot be met in the best manner by the heavier version. This version has a maximum weight of 17.5 tonnes (19.29 tons) and is powered by a lower-rated engine.

The vehicle is manned by a crew of three and can carry up to nine fully equipped infantrymen in the troop compartment. The driver sits at the front left side of the vehicle and is equipped with four periscopes for external observation; one of the periscopes is raised so as to provide a better view to the right. The center periscope can be replaced with an infrared or passive vision device for night operations. The vehicle is steered by means of an advanced-design hydrostatic steering system. The commander and gunner are seated in the center of the hull. The center point of the vehicle can mount either a commander's cupola capable of traversing 360 degrees and fitted with five periscopes, or a turret, depending on the variant. The troop compartment is located directly behind the commander's cupola or turret.

Access to the vehicle is through either a large hydraulically operated ramp at the rear of the vehicle or through roof-mounted hatches. The troop compartment is fitted with five vision blocks, all of which have a firing port below the compartment for use by the troops. Eight of the 11 seats in the troop compartment can be removed to allow for the carriage of ammunition, weapons or other loads.

The engine is mounted at the front of the vehicle on the right side. The engine is coupled to the LSG 1500 automatic gearbox with four forward- and two

reverse-gear ratios. The maximum road speed is 64 kilometers per hour (39.7 miles per hour), and ranges of up to 565 kilometers (350.9 statute miles) can be attained. The fuel capacity is 480 liters (127.66 gallons). The torsion bar-type suspension system has six dual rubber-tired roadwheels per hull side and hydraulic shock absorbers at the first, second, fifth and sixth roadwheel stations. The drive sprocket is located at the front of the vehicle with the idler at the rear. There are three track-return rollers per hull side. The upper part of the suspension, as well as part of the hull side, are

protected by metal side skirts. The vehicle comes with a fire-extinguishing system for both the engine and fighting compartments as standard equipment. Optional equipment includes an air-conditioning system and a nuclear, biological and chemical defense system.

The basic armored personnel carrier is armed with a single M2HB 12.7 millimeter machine gun mounted on the forward part of the cupola. If required, the cupola can be replaced with a variety of cupola or turret designs.

## Funding

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The C-13 development has been privately funded by Otobreda, the contractor. The development of the Armored Vehicle 90 is being jointly funded by MaK System Gesellschaft and Otobreda.

## Recent Contracts

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Not available, as contractual information is not released.

## Timetable

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This timetable is applicable to the C-13 and Armored Vehicle 90 only, and not to the similar Dardo (Veicolo Corazzato de Combattimento-80), which is covered in a separate report in this section.

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
	1978	Development of the C-13 commenced
February	1983	Initial prototype vehicle completed
October	1983	Second prototype vehicle completed
Mid	1984	C-13 basic development completed
September	1984	C-13/4 x 25 prototype completed
Early	1985	C-13 TUA prototype completed
Late	1986	C-13 Coastal Defense prototype completed
December	1988	First Armored Vehicle 90 completed
Mid	1999	C-13 awaiting production orders; development and testing of Armored Vehicle 90 continues

## Worldwide Distribution

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**Export Potential.** The C-13 was designed solely for the export market. The vehicle is a highly functional and cost-effective design, which has justifiably earned good reviews for its protection, mobility and versatility. It is also an impressive-looking and even an aesthetically attractive vehicle, which is not an unimportant factor when the decision is made to buy or not to buy. However, no orders have been received to date, a reflection of the growing glut of vehicles of this type on the market.

The already-good points of the C-13 have been greatly improved in the newer Armored Vehicle 90. If MaK System Gesellschaft and Otobreda have done their homework correctly, this vehicle could become at least a moderately good money earner, even in the glutted market conditions now prevailing. While it is still too early to forecast the impact of this program on the export market, it appears that the growing interest in the vehicle may well portend at least a respectable future for the program.

Countries. **Federal Republic of Germany** (three prototype/developmental vehicles with the contractor) and **Italy** (five C-13 developmental prototypes with the contractor).

## Forecast Rationale

Our latest research shows no good news for the long-dormant C-13 program. Despite its competitive unit price, the C-13 has never made a sale nor is it currently generating the interest needed to change that. Although the vehicle is still available for orders, over a decade of no sales and a saturated export market cause us to forecast no production of the C-13.

The Armored Vehicle 90 development program saw three new vehicles fabricated in 1998 for development purposes. This vehicle, while more modern than the

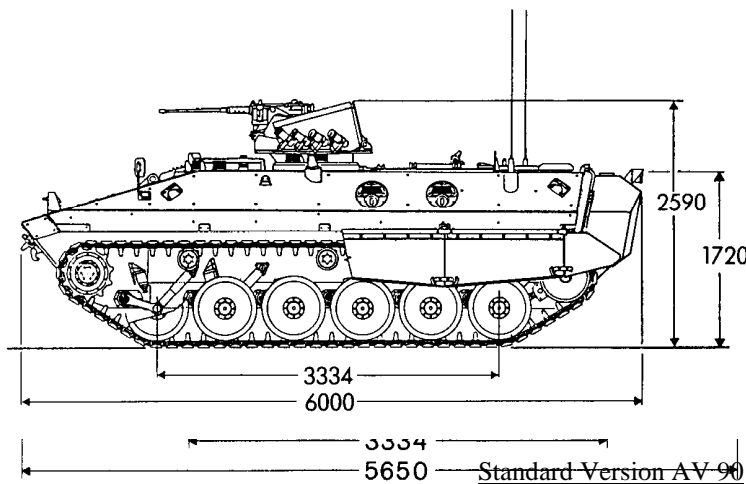
C-13, is also being affected by glutted market conditions and continues to see a grimmer and grimmer production future. Although the purchase of this vehicle by a NATO nation is still a possibility, due to the continued lack of sales and the available market competition we are not forecasting any production of the Armored Vehicle 90 at this time. The vehicle could be purchased as a replacement for the M113 or a similar vintage vehicle, so of course we will continue to monitor this program and provide report updates on an interim basis if warranted.

## Ten-Year Outlook

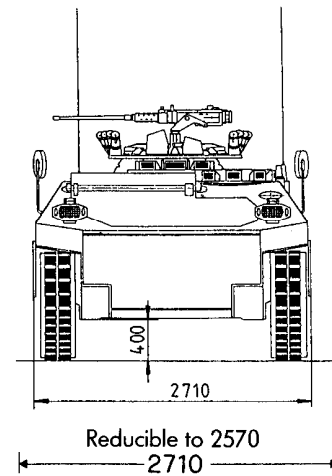
### ESTIMATED CALENDAR YEAR PRODUCTION

Vehicle	(Engine)	High Confidence Level				Good Confidence Level				Speculative				Total 99-08
		thru 98	99	00	01	02	03	04	05	06	07	08		
OTOBREDA														
C 13(a)	ID 38 SS V6	5	0	0	0	0	0	0	0	0	0	0	0	
Subtotal - OTOBREDA		5	0	0	0	0	0	0	0	0	0	0	0	
MAK SYSTEM GMBH/OTOBREDA (Consortium)														
ARMORED VEHICLE 90(b)	8V 183 TC22 (OM 422 LA)	6	0	0	0	0	0	0	0	0	0	0	0	
Subtotal - MAK SYSTEM GMBH/OTOBREDA (Consortium)		6	0	0	0	0	0	0	0	0	0	0	0	
Total Production		11	0	0	0	0	0	0	0	0	0	0	0	

(a)The through 1998 production is the initial prototype and development vehicles.  
 (b)The through 1998 production is for the developmental prototype and contractor demonstration vehicles.



C13



Source: MaK System Gesellschaft/Otobreda

Source: Otobreda