

ARCHIVED REPORT

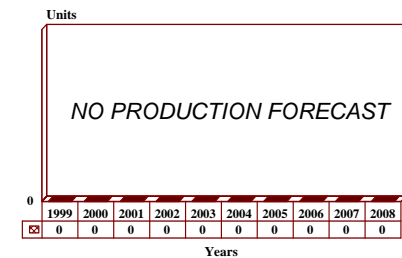
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OF 40 - Archived 1/99

Outlook

- The production of the OF 40 remains dormant
- The OF 40 remains in service with the export customer
- All production of OF 40 tanks has been brought up to Mark 2 standard
- The development of the Mark 3 model is dormant
- No additional significant modernization and retrofit is forecast

10 Year Unit Production Forecast
1999-2008



Orientation

Description. A tank

Sponsor. The OF 40 is a private venture of Otobreda (formerly OTO Melara) and FIAT developed specifically for the export market.

Contractors. This tank was developed and manufactured by Otobreda, La Spezia; and IVECO FIAT, Turin, Italy. The AEG Telefunken, Alenia, Motoren- und Turbinen-Union, Officine Galileo, Societe de Fabrication d'Instruments de Mesure and the Zahnradfabrik Friedrichshafen firms act as subcontractors.

Licensees. None

Status. The production of the OF 40 Mark 2 is complete but can be resumed if needed; the OF 40 Mark 2 is in service with one export nation. The development of the OF 40 Mark 3 is also complete, and this model is available for purchase. Since 1993, the entire OF 40 program has been dormant although it is still being marketed.

Total Produced. As of January 1, 1998, a total of 39 OF 40 tanks had been manufactured. This total includes two prototypes, 18 Mark 1 and 18 Mark 2 tanks (all subsequently brought up to Mark 2 standard) and a single Mark 3 prototype.

Application. A tank for the projection of power as well as defensive operations. The OF 40 is designed as the prime offensive weapon for export nations desert and/or tropical regions.

Price Range. The OF 40 Mark 1, at 43 tonnes and without a stabilization system for the main armament or sights, had a unit price of \$1.121 million in equivalent 1985 United States dollars. If production were resumed today, the OF 40 Mark 2 unit price would be \$3.06 million in equivalent 1998 United States dollars. The OF 40 Mark 3 unit price is \$3.983 million in those same dollars.

Technical Data

Design Features. The OF 40 was designed for the export market as a low price but still effective alternative to the much more expensive competition.

Crew. Four: commander, gunner, loader and driver.

Armor. Conventional with spaced armor in critical areas.

Dimensions. The following data are for the OF 40 Mark 2 as it is presently in service. The width figure is

with the side skirts fitted. The height figure is to the top of the sight.

	<u>SI units</u>	<u>US units</u>
Length	9.22 meters	30.25 feet
Width	3.51 meters	11.51 feet
Height	2.68 meters	8.79 feet
Combat weight	45.5 tonnes	50.16 tons
Fuel capacity	1000 liters	265.95 gallons

Performance. The maximum speed and range figures are on a metalled road. The OF 40 can ford four meters (13.12 feet) when equipped with a snorkel.

Maximum speed	60 kilometers per hour	37.26 miles per hour
Maximum range	600 kilometers	372.6 statute miles
Step	1.15 meters	3.77 feet
Trench	3.0 meters	9.84 feet
Slope	30%	30%
Gradient	60%	60%
Fording	1.2 meters	3.93 feet

Engine. Motoren- und Turbinen-Union supplies the MB 838 CA M500 supercharged, liquid-cooled, ten-cylinder, multi-fuel diesel engine developing 618.93 kilowatts (830 horsepower) at 36.67 revolutions per second (2,200 revolutions per minute). This engine is equipped with a thermostatically controlled radial blower for desert conditions. The power-to-weight ratio is 13.60 kilowatts per tonne (16.55 horsepower per ton). The cooling system capacity is 165 liters (43.88 gallons). A 27-volt, 9-kilowatt generator is driven by the engine; eight 100-ampere-hour 12-volt batteries are also fitted. FIAT has investigated the installation of its V-12 MTCA diesel engine in the OF 40 and subsequently selected it to power the Mark 3 version of this tank. This supercharged engine is rated at 746 kilowatts (1,000 horsepower) but could be increased to 895.2 kilowatts (1,200 horsepower). This engine will be used in any new production tanks as well as for the possible retrofitting to the existing inventories.

Gearbox. Zahnradfabrik Friedrichshafen supplies the 4 HP 250 gearbox with four forward and two reverse gear ratios. A hydraulic torque converter is used, and the steering mechanism is a cross-drive type.

Suspension and Running Gear. A trailing arm torsion bar suspension with dual-action hydraulic shock dampers is used. Seven double road wheels with rubber tires are used.

Armament. The main armament of the OF 40 Mark 1 and 2 is the 105 millimeter/52-caliber cannon manufactured by Otobreda; elevation is +20° and

depression is -9°. The cannon is stabilized in elevation; traverse stabilization is optional. The cannon is fitted with a thermal sleeve and fume extractor. The ammunition storage is 15 ready rounds in the turret and 42 in reserve. Two FN Nouvelle Herstal MAG machine guns of 7.62 millimeter caliber are fitted, one coaxially with the main armament and one for anti-aircraft defense. A total of 2,700 7.62 millimeter rounds is immediately available to both machine guns, and 3,000 additional rounds are stored in reserve. Four electrically operated smoke grenade launchers are mounted on each side of the turret. The OF 40 Mark 3 is fitted with the same 120 millimeter smooth bore cannon as used in the new C1 Ariete tank; this cannon is discussed in the C1 report. The secondary armament is the same as the Mark 2.

Fire Control. The original fire control suite of the OF 40 was too austere; all OF 40 tanks produced to date have been updated to the Mark 2 level of fire control. Societe de Fabrication d'Instruments de Mesure provides the VS 580-B unstabilized panoramic periscopic sight and the night sight for the OF 40 commander's station. Alenia manufactures the C215 coaxial scope, while Officine Galileo SpA is the prime contractor for the fire control system and supplies the OLG14L2A/B digital fire control computer and the gunner's primary sight. Alenia provides the VAQ33 neodymium yttrium-aluminum garnet laser rangefinder, and AEG Telefunken provides the low-light television night sight for the gunner. The OF 40 Mark 2 can fire on the move.

Variants/Upgrades

Variants. As of early 1998, the following variants have been developed from the OF 40 chassis.

OF 40 Armored Recovery Vehicle. A recovery vehicle version of the OF 40 has been developed and produced for the United Arab Emirates. A front dozer blade, twenty tonne crane and a sixty tonne winch are standard. Three units were delivered.

Chassis Base. The OF 40 chassis and running gear are also the basis for other weapons. These weapon systems include: the OTO 76/62 anti-aircraft artillery system, the Palmara 155 millimeter self-propelled artillery system, and a twin 35-millimeter anti-aircraft artillery system which is a paper design only. The first two programs are covered in the Munitions and Ordnance book that is a companion volume to this.

Modernization and Retrofit Overview. To date, the only modernization and retrofit program developed for this tank is the Mark 2 enhancements. As this is essentially a new production model, it is discussed below.

The only direct purchase customer of this tank to date is the United Arab Emirates, which originally procured 18 Mark 1 tanks and then placed a follow-on order for another 18. However, the second 18 were of the enhanced Mark 2 model; the original 18 were subsequently brought up to the Mark 2 standard. Our research indicates that the Emirates were never happy with the OF 40 and had investigated several options regarding their entire tank inventory before it was transferred. The main areas of concern were the power-to-weight ratio and the fire control suite. The United Arab Emirates also had long desired to join the 120-millimeter bandwagon, although mainly for prestige purposes; with the early 1993 selection of the Leclerc, this has come to pass.

While the opportunity exists for any firm to compete for the upgrading of the existing OF 40 inventory, it appears that the prime contractor has the inside track if any programs should be undertaken by the new owner, Bosnia and Herzegovina. Otobreda and FIAT have already made a number of proposals to the United Arab Emirates for the enhancement of this tank before they were transferred.

Hull

Given the volatile nature of the Balkan region, this tank is an obvious candidate for retrofit with explosive reactive armor. According to industry sources (and based on a quantity order), to fund this enhancement to a tank of this size costs the equivalent of approximately

23,000 1998 United States dollars. While this program can be accomplished at a major modernization/retrofit center specializing in such work, or by the prime contractor, to save costs it is usually done in the user country.

Propulsion and Drive Train

While the existing Motoren- und Turbinen-Union MB 838 CA M500 diesel is a well-known and reliable engine, its 618.93 kilowatt (830 horsepower) rating means that the OF 40's power-to-weight ratio of 13.60 kilowatts per tonne (16.55 horsepower per ton) is simply too low by modern standards. In addressing this problem, FIAT has developed the installation of its V-12 MTCA diesel engine in the OF 40. This supercharged engine is rated at 746 kilowatts (1,000 horsepower) but could be increased to 895.2 kilowatts (1,200 horsepower) if desired. The retrofit of this engine would greatly benefit the power-to-weight rating of the OF 40. It is known that a retrofitting of this engine to the United Arab Emirates' inventory was proposed by the prime contractor some time ago. Another option is to upgrade the existing engine to a 708.42-kilowatt (950-horsepower) rating.

Of course, any number of similar size/power engines from the main manufacturers could be a candidate for retrofit to this tank.

Electronics

While the existing fire control suite of the OF 40 Mark 2 is much better than the original, the United Arab Emirates long felt that there was still room for improvement. The United Arab Emirates wanted the commander's sight to be stabilized, and the data transmission between the sensors and the computer to be improved.

Of course, if a 120 millimeter cannon is ever integrated with the OF 40, new fire control components have to be incorporated in the system.

Vehicle Navigation System. The need to closely coordinate land forces on a modern battlefield in all types of weather, day or night, has pushed the move toward installing vehicle navigation units. Both air and sea assets have benefited from similar systems for many years, and now land forces need such equipment to enhance their mobility and to aid battlefield management. The premier system of this type is the United States' NAVSTAR Global Positioning System program, the receivers for which are rapidly being integrated in a wide variety of platforms, including armored vehicles. Vehicle navigation systems in various

types are available from numerous sources, including the following: Allied Signal Aerospace Company, Land Vehicle Systems Marketing/Bendix Guidance Systems Division, which is offering the Stabilization Reference Package/Position Determining System, the Ring Laser Gyroscope Land Navigation System and the Gyrocompass Navigation System; Bodenseewerk Geratetechnik, which offers the FNA 615 Vehicle Navigation System; GEC Ferranti Defence Systems Limited which has the FIN 1155 Land Navigation and Attitude Reference System, the Positioning and Azimuth Determining System Mark 2, the Land Navigation System and the Azimuth Position and Elevation System; Honeywell Military Avionics, offering the Modular Azimuth Position System; Israel Aircraft Industries/TAMAM Precision Instruments Industries with a number of components and systems including the TAMAM Land Navigation System in several marks and the TAMAM Vehicle Navigation System; Kearfott Guidance and Navigation Corporation, offering the Modular Azimuth Position System; Magellan Systems Corporation, which is manufacturing the NAV1000M Global Positioning System receiver; Magnavox Government and Industrial Electronics Company which offers the MX 6102 Terrain Navigator System and the Vehicle Integrated Navigator System; Rockwell Collins Government Avionics Division which is manufacturing NAVSTAR Global Positioning System ground terminals; Sextant Avionique/

Navigation Systems Division which has the AVERNE (APX M539), SYDADE, and NAVYX systems; Smiths Industries, offering the POS-NAV Position Navigation System and the Model 9265 Vehicle Navigation Aid System; Société d'Application Générales d'Electricité et de Mécanique, which offers the NSM 20 Land Navigation System, the CITA 20 Navigator and Inertial Goniometer, the ULISS 30 Position and Azimuth Determination System and the SIGMA 30 Ring Laser Gyroscope Inertial Navigation System; Teldix, which has a wide range of this equipment including the FOA 25 and FOA 50 Vehicle Orientation Systems, the FNA 50 and FNA 55 Vehicle Navigation Systems and the NKA 55 North Seeking Gyroscope System and Teledyne Ryan Electronics, which is manufacturing the Model 1058 Vehicle Navigation Aid System.

Armament

Otobreda and FIAT have developed the latest model of the OF 40-the OF 40 Mark 3, with a 120 millimeter smoothbore cannon. This cannon is 44 calibers in length and draws heavily on the Rh 120 design. It is compatible with all present 120 millimeter ammunition types. This cannon can be integrated with the present OF 40 turret, but the fire control components, ammunition storage, and other internal components have to be modified or replaced outright. Due to the transfer of the tanks to Bosnia-Herzegovina, the probability of this upgrade is now almost nil.

Program Review

Background. The then-OTO Melara and FIAT started development on the OF 40 tank in the late seventies, with the first prototype completed in 1980 and first production models completed in February of 1981. OTO Melara was responsible for the overall design and FIAT for the powerpack integration. Since then, FIAT has joined the IVECO consortium to continue to develop and produce armored vehicles. The similarities of the OF 40 to later models of the German Leopard 1 (which the then OTO Melara co-produced for the Italian Army) include the basic hull, engine, suspension, gearbox and tracks. The cannon and turret assembly, however, are all-welded and not cast, while the three track rollers have been replaced with five track return rollers (three in the rear and two near the idler wheel in front). The requirement for additional cooling (tropicalization) has resulted in a large wrap-around engine exhaust, and cooling air inducts at each rear corner of the vehicle. To date, the United Arab Emirates has been the only direct sales customer, with two orders totaling 36 tanks and three armored recovery vehicles. However, in 1997, the tanks were transferred to Bosnia-Herzegovina. In late 1994, as part of a larger

reorganization of the Italian defense industry, OTO Melara absorbed the Breda Meccanica firm with the new firm called Otobreda.

Description. The OF 40 follows conventional tank design with the driving compartment forward, the fighting compartment at the center and the powerpack to the rear. The driver is seated to the right with the nuclear, biological and chemical defense system pack and 42 rounds of ammunition beside him. The all-welded turret seats the commander and gunner to the right, and loader to the left. The commander is not provided with a cupola but has a panoramic sight manufactured by Societe de Fabrication d'Instruments de Mesure of France.

The rifled 105 millimeter tank cannon is 52 calibers in length and employs a vertically sliding breech block assembly, concentric buffer and a spring recuperator. Firing is electric with a manual back-up. A thermal sleeve and bore evacuator are fitted. Stabilization was optional on the OF 40 Mark 1 but standard (in elevation) on the OF 40 Mark 2. A total of 57 rounds of

ammunition are carried. Turret traverse and ordnance elevation/depression are electro-hydraulic.

Due to the fact that the OF 40 is designed for export to desert areas, extensive filtration and cooling equipment is provided for both the engine and crew compartments. An over-pressure nuclear, biological and chemical warfare defense system, smoke grenade launchers and an automatic fire extinguishing apparatus are standard on the OF 40.

OF 40 Mark 2. This model was developed to meet the needs of customers desiring more sophistication in sighting and fire control equipment. The new fire control system is designated the High Efficiency Laser Integrated Optronic Self-Stabilized Fire Control System. This much-advanced system is suitable for day or night operation in all types of weather. A fully stabilized day/night sight is provided for the commander, a low-light-level electro-optic viewing system is fitted, and additional digital computer-based data processing equipment is provided. Various sensors are provided to provide inputs to the data processing section. With the new system, all the gunner has to do is to keep the target in his sights. The main armament is stabilized in both elevation and traverse. The OF 40

Mark 2 can fire on the move. All OF 40 Mark 1 tanks were subsequently brought up to this standard.

OF 40 Mark 3. In mid-June of 1988, it was learned that the contractors had developed a further version of the OF 40 tank. The OF 40 Mark 3 features the replacement of the 105 millimeter cannon with the same 120 millimeter cannon being used on the C1 Ariete tank (see separate report). The V-12 MTCA engine is also standardized on and the fire control suite further improved with as-yet unspecified components. This development is said by some observers to be promoted by the fact that Kuwait, then in need of 100 new tanks, had looked favorably on an enhanced version of the OF 40.

Italian Army Version. In mid-1984, the Italian army shelved plans to procure up to 300 Leopard 2 tanks from the Federal Republic of Germany to act as a "bridge" until the Leopard 3, which was previously desired, became available. Instead the then-OTO Melara and FIAT were requested to develop a new tank broadly based on the OF 40 Mark 2. Details of this new tank, known as the C1 Ariete, are found in the pertinent report in this tab.

Funding

The development of the OF 40 program is privately funded by the prime contractors.

Recent Contracts

Not available, as contractual information is not released.

Timetable

The following timetable relates to the OF 40 program only and not to the C1 Ariete, which is covered in a separate report.

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
	1973-1982	Licensed co-production of the Leopard 1 by OTO Melara began
Late	1977	OF 40 development began
Mid	1980	First prototype completed
	1981	First production deliveries made to the United Arab Emirates
	1982	Development of OF 40 variants began
August	1982	Fire control system updated with the Mark 2 version
Mid	1984	Italian Army development announced
April	1986	Production completed for initial export orders
June	1988	OF 40 Mark 3 announced
	1997	United Arab Emirates transfers its OF-40 tanks to Bosnia-Herzegovina
Early	1998	Production dormant, awaiting new orders

Worldwide Distribution

Export Potential. The OF 40 Mark 1 was developed without heavy armor or stabilization for the main armament and sights. This indicates that the vehicle was designed for developing countries which require simplicity of design and operation. However, due to the abundance of tanks with stabilization and more advanced fire control, the Mark 1 did not go anywhere on the export market. The Mark 1 could not fire on the move due to sighting and recoil limitations. These limitations led to the development of the Mark 2, a significantly improved tank. The introduction of the new FIAT engine did much to improve the power-to-weight ratio (and marketability) of the OF 40, but market conditions have precluded any further sales of this tank. The advent of the Mark 3, while a further great enhancement over the Mark 2, has not been expected to breathe new life into this production program and as of late 1997, no sales had yet been made.

Countries. **Italy** (3 developmental tanks with the contractor), **Bosnia-Herzegovina** (36).

Forecast Rationale

As of late 1997, our latest review of the OF 40 program finds that it is still dormant. The sales of this tank have long been and continue to be stymied by the ever increasing glut of both new and used tanks on the market. With so many new production as well as used but often as-new tanks of every level of sophistication available, it is a buyer's market. Also, the OF 40 never attained a reputation as a desired tank in the market. This was undoubtedly due to the fact that the only direct sale customer, the United Arab Emirates, was never

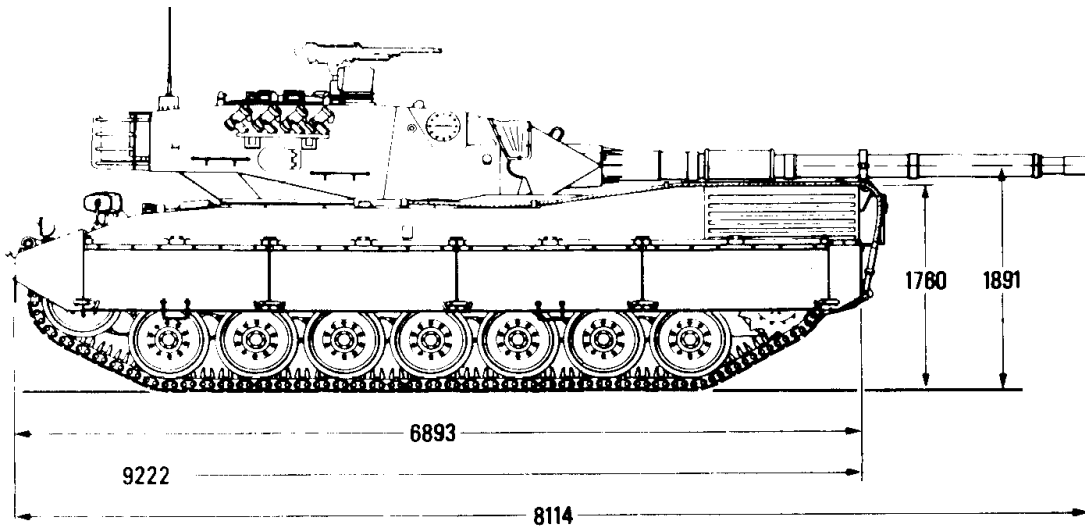
satisfied with the tank, even in the improved Mark 2 version. This fact, plus the aforementioned market conditions, forces us to continue our forecast of no further production of the OF 40. However, the world armored-vehicle market is full of surprises and, as the OF 40 is still being offered, we will continue to monitor this program for further events, and will update this report on an interim basis if warranted. If, however, no new action takes place in the coming year, this report will be dropped.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR PRODUCTION													
Vehicle (Engine)	through	High Confidence Level			Good Confidence Level			Speculative			Total 97-06		
		96	97	98	99	00	01	02	03	04		05	06
OTOBREDA/FIAT													
OF 40 MARK 2(a) MB 838 CA M 500		38	0	0	0	0	0	0	0	0	0	0	0
OF 40 MARK 3(b) V-12 MTCA		1	0	0	0	0	0	0	0	0	0	0	0
Total Production		39	0	0	0	0	0	0	0	0	0	0	0

(a) Production shown includes two prototypes. Originally, 18 Mark 1 and 18 Mark 2 units of the OF 40 were produced. Subsequently, all Mark 1 tanks were converted to Mark 2 status. Production does not include the armored recovery vehicle version.

(b) The initial prototype completed in 1988.



OF 40

Source: OTO Breda