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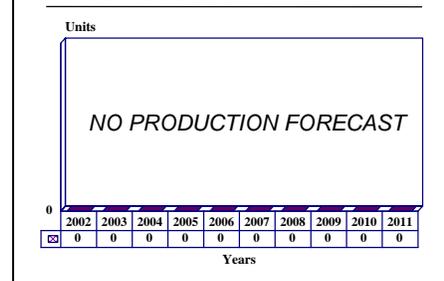
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FH 155-1 (FH-70) 155 mm Howitzer - Archived 3/2003

Outlook

- Production by original contractors dormant, but weapon is available for new orders; no production forecast
- Production by Japanese licensee complete
- Some potential to retrofit the new 52 caliber cannon to the FH 155-1 systems

10 Year Unit Production Forecast
2002 - 2011



Orientation

Description. A towed 155 millimeter artillery system.

Sponsor. The development and initial procurement of this artillery piece was sponsored by the United Kingdom (the towed program leader) Ministry of Defence Procurement Executive/Ordnance Board and Ministry of Defence Army Department, the Federal Republic of Germany (the self-propelled program leader) Federal Ministry of Defense, the Rüstungsabteilung (Armament Department) through the Bundeswehrverwaltungsamt (Federal Office of Defense Administration) and the Bundesamt für Wehrtechnik und Beschaffung (Federal Office for Military Technology and Procurement), and the Italian Ministry of Defense.

Contractors. This system was developed and manufactured through European trilateral cooperation among Rheinmetall DeTec GmbH; Dusseldorf, Federal Republic of Germany (formerly the prime for the Panzerhaubitze 155-1 self-propelled version); BAE Systems (RO Defence - formerly Marconi Marine and Land Systems and before that Vickers Shipbuilding and Engineering); Cumbria, England (prime for the towed FH 155-1); and Otobreda, La Spezia, Italy.

Licensees. Japan Steel Works, Tokyo, Japan, has manufactured the FH 155-1 under license. This firm is also manufacturing the ordnance component for the Type 99 155 millimeter self-propelled howitzer.

Status. The manufacture of the FH 155-1 in Europe is dormant but can be resumed upon the receipt of new orders; the marketing effort continues. The license manufacture of the FH 155-1 towed system is also dormant in Japan. The development and integration with a 52 caliber cannon has been completed and the upgrade is available as a new production item or for retrofit to existing pieces.

Total Produced. As of January 1, 2002, a total of 1,007 FH 155-1 systems had been manufactured.

Application. Fire support for the field army at the battalion level.

Price Range. If production were resumed today, the field howitzer FH 155-1 with the 39 caliber barrel would have a unit price of \$594,000 for a 10-unit buy in equivalent 2002 United States dollars.

Technical Data

Crew. Eight
 Muzzle Brake. Double baffle.
 Recoil System. Hydropneumatic
 Breech Mechanism. Semi-automatic, vertically sliding wedge.
 Carriage Type. Split trail with auxiliary power unit.
 Shield. None

standard 155 millimeter ammunition, including the Improved Conventional Munitions types. The M712 Copperhead cannon-launched guided projectile can also be fired.

Ammunition. The FH 155-1 artillery piece can fire all present United States/NATO standard 155 millimeter ammunition along with the newer range of NATO

Dimensions. The following data are for the last production standard from the European consortium. A 46 caliber (7.13 meter or 23.39 foot) barrel, developed by Rheinmetall DeTec, is an option as is a 52 caliber barrel. The traveling length is 9.8 meters (32.15 feet). The FH 155-1 is towed at a maximum speed of 100 kilometers per hour (62.5 miles per hour) behind a 6x6 seven ton payload class truck.

	<u>SI units</u>	<u>US units</u>
Caliber	155 millimeters	6.10 inches
Length overall	12.43 meters	40.78 feet
Barrel length	39 calibers/6.02 meters	39 calibers/19.75 feet
Traveling width	2.58 meters	8.46 feet
Firing width	7.51 meters	24.64 feet
Traveling height	2.45 meters	8.04 feet
Firing height	2.19 meters	7.18 feet
Traveling weight	9.30 tonnes	10.25 tons
Firing weight	9.30 tonnes	10.25 tons

Performance. The maximum range is with the Extended Range Projectile (a High Explosive projectile) with base bleed.

	<u>SI units</u>	<u>US units</u>
Elevation	+70°	+70°
Depression	-4.5°	-4.5°
Traverse	28° left and right	28° left and right
Maximum range	31.5 kilometers	34,448.4 yards
Maximum rate of fire	6 rounds per minute	6 rounds per minute
Sustained rate of fire	2 rounds per minute	2 rounds per minute
Muzzle velocity	827 meters per second	2,713.25 feet per second

The barrel life of the 39 caliber barrel is 2,500 equivalent full charges.

Auxiliary Propulsion Unit. Volkswagen provides the Model 127 1,800-cubic-centimeter, four-stroke, four-cylinder, air-cooled, spark ignition engine which is rated at 53 kilowatts (71 horsepower) at 80 revolutions per second (4,800 revolutions per minute). The fuel capacity is 55 liters (14.62 gallons).

Variants/Upgrades

Variants. The only specific variant of the FH 155-1 that has been developed is an export model. This version of the FH 155-1 is fitted with a simplified sighting system based on that of the L118 Light Gun.

This equipment is fitted with an adapter mounted on the left trunnion.

The ordnance of the FH 155-1 is the basis of two self-propelled howitzer programs, one of them long dead.

Panzerhaubitze 155-1. Full development of the originally designated SP-70 155 millimeter self-propelled artillery system project began in 1973 under the overall management of Rheinmetall DeTec. MaK System Gesellschaft (formerly Krupp Maschinenbau Kiel) was responsible for the chassis and powerpack, while Royal Ordnance designed the turret, including the ammunition handling system. The OTO Melara was designated the prime contractor for Italy's contribution, which would have included the cradle, recoil system, elevating equipment, auxiliary power unit, and fuel system.

The automotive components for the Panzerhaubitze 155-1 were similar to those of the Leopard 1 tank chassis. Trials with the first 12 prototypes were started in 1976, with production originally slated to start in 1985; this schedule slipped over three years. The US Army requested funds for prototypes in 1980 and 1981 under the Division Support Weapon System program, but Congress cut the request from some \$8 million to \$2 million. The US Army Research and Development Command eventually received one prototype for evaluation as a possible replacement for aging M109 inventories under this now defunct program.

In late 1985, the long-rumored troubles in the Panzerhaubitze 155-1 program came to a head when the first of several program reviews was conducted. The Germans, concerned over the escalating costs, had been instrumental in requesting an engineering audit of the program; the Federal Republic had a 50 percent share in development costs and the United Kingdom and Italy each had 25 percent. While the Germans were disenchanted, the British pressed to go ahead with the program and carry out in-service modifications at a later date. This was because Britain had a more urgent need for a new 155 millimeter self-propelled system than the other two countries. This need was such that the British had even mentioned a fall-back Panzerhaubitze 155-1 with manual loading.

The main trouble was with the ammunition handling and loading system which was the responsibility of the United Kingdom and was being developed by Vickers. This system had a reliability rating of only 51 percent, far below the 90 percent figure the Germans considered the minimum acceptable. This and several other relatively minor technical problems led to the delay in the program and sent costs skyward.

Due to the expensive cancellation clauses in the contract, observers believed that the Germans would not pull out of the program. In 1986, despite strong criticism of the program in the German Parliament, a

decision was made to continue the Panzerhaubitze 155-1 program but with major redesign of the ammunition handling system. However, less than a year later, the British and Germans threw in the towel, citing the already high development costs as well as the projected costs to get the system fielded. Later, each nation went its own way to meet its self-propelled artillery inventory modernization requirements.

Type 99. The ordnance of the FH 155-1 system is the basis for the new Type 99 self-propelled artillery system; this program is covered in a separate report in Tab A of this book.

Retrofit and Modernization Overview. The only retrofit and modernization programs developed for the FH 155-1 to date have been related to a flick ramming system, an ammunition hoist device, and a longer barrel.

Flick Rammer. Rheinmetall DeTec developed and manufactured a flick ramming system for the FH 155-1. This system automatically positions the projectile in the piece; this reduces loading time and enhances the firing rate. This loader also enables the gun crew to be reduced by one man. The designation of the system with this ordnance is FH 155-1R or FH-70R. This option has not been offered since 1989.

Ammunition Hoist. BAE Systems/RO Defence (formerly Marconi Marine and Land Systems and before that Vickers Shipbuilding and Engineering) has developed a new ammunition hoist system that greatly eases the handling of the 155 millimeter projectiles. The hoist system is suspended from a steel joist gantry that is mounted on the right side of the carriage forward of the breech mechanism. This device is offered as an option to new-production FH 155-1 systems or as a retrofit to existing pieces.

New Auxiliary Propulsion Unit. The Italian firm Applicazioni Rielaborazioni Impianti Speciali has developed a new auxiliary propulsion unit to replace the original Volkswagen spark ignition unit used on the FH 155-1. This new unit is based on a diesel engine and is a direct replacement for the original unit. This enhancement results in improved automotive performance and lower operating costs. In 2001, the new auxiliary propulsion unit began to be evaluated on one of Italy's FH 155-1 pieces.

46 and 52 Caliber Barrels. In 1984, it was learned that Rheinmetall DeTec was developing a 46 caliber barrel for the FH 155-1. This ordnance would have been compatible with the Panzerhaubitze 155-1. As a result of the quadrilateral ballistics agreement, however, Rheinmetall shelved the 46 caliber barrel and developed a 52 caliber barrel that conforms to the agreement. The testing and integration of this barrel has been

completed. The maximum range with the standard unassisted L15A1 projectile is 30 kilometers (32,808.33 yards), which increases to 40 kilometers (43,744 yards)

with base bleed projectiles. As of early 2002, no user of the FH 155-1 had selected this option.

Program Review

Background. During the early 1960s, the Federal Republic of Germany, the United Kingdom and the United States agreed that a new 155 millimeter field howitzer was needed for the 1970s and beyond. Germany and the United States wanted to replace their operational M114 howitzers while the British needed to replace their 5.5 inch guns. The Germans and British agreed to jointly develop a weapon originally designated FH-70 (Field Howitzer 1970) with an auxiliary propulsion unit. The United States decided to pursue the development of its indigenous M198 155 millimeter piece, since US Army doctrine demands air-portability of towed artillery which the Western Europeans feel is unnecessary due to the extensive European road network and the number of towing vehicles available.

The Anglo-German alliance continued through 1966 when agreement was reached on the operational characteristics of the howitzer. They were as follows:

- Continuous high rate of fire with burst capability.
- High mobility with minimum effort for deployment.
- Increased range and lethality with a new family of ammunition.

The United Kingdom was designated the project leader for the FH-70, and Germany was given the leadership of the self-propelled variant of the weapon originally designated SP-70. The first six prototypes of the towed howitzer were completed in early 1970, and early trials compelled Italy to join the developmental program that year.

A second group of eight prototypes was completed by the end of 1973, and the first trial battery firing (six FH-70 pieces) was conducted during 1975. A total of 19 pieces were fabricated for evaluation. The FH-70 155 millimeter howitzer was accepted for service in 1976 following testing. The first production weapons were delivered in 1978. In 1983, the FH-70 and SP-70 were redesignated FH 155-1 and Panzerhaubitze 155-1, respectively. The British call the weapon the L121.

Description. The carriage is a traditional split-trail pattern with spades at the ends of the legs. Small

wheels are fixed to each leg to steer the vehicle when it is propelled by auxiliary power and to assist operations going into or out of action. The trail legs are hinged at the front to a body section which houses the soleplate. The saddle rides on a roller race on top of the body which contains the elevating and traversing gears plus the gunlayer's seat. Hydropneumatic cylinders linked to the trailing suspension arms act as shock dampers and are coupled to the hydraulic system in order to be able to lower and raise the wheels. This allows the gun carriage body to be lowered to the ground so that it rests on the soleplate when the piece is in action.

The auxiliary power unit is mounted on a space frame ahead of the body, and the driver's seat and gun controls are on top of the frame. The elevating mass, carried on the trunnions, consists of a trough cradle in which the hydropneumatic recoil system is located. This is a variable-length system which shortens the recoil stroke as the gun is elevated to prevent the breech from striking the ground. The maximum length of recoil at zero elevation is 140 centimeters (4.59 feet).

Attached to the recoil system and riding on rails formed in the cradle is the barrel. This is a 39 caliber autofrettaged barrel with a semi-automatic vertical sliding breech block which opens upward. Charge ignition is by means of a percussion primer operating in a firing lock inside the block. A primer magazine, holding 11 primers, automatically reloads the lock every time the breech is opened. The muzzle carries a double-baffle muzzle brake of 32 percent efficiency.

The piece is fired by opening the breech by hand and ramming home the first shell and propelling charge(s), and placing a second shell on the loading tray. The breech is closed, and an ignition tube is automatically loaded from the incorporated 11-tube magazine. The FH 155-1 is then ready for firing by pulling the firing handle, after which the operation becomes semi-automatic, apart from any readjustment for laying the gun. Upon firing, when the gun reaches the run-out position, the breech is automatically opened by a cam, and the shell is ejected while the next round is lifted to the breech and aligned in the chamber prior to manual ramming.

Funding

Funding for the development and initial procurement of the FH 155-1 was provided by the United Kingdom, and the German and Italian Ministries of Defense.

Recent Contracts

None

Timetable

The following timetable also relates to the Panzerhaubitze 155-1 program.

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
	1962	Design conceived
	1964	United Kingdom and Germany form consortium; United States drops out
Early	1966	Initial FH 155-1 prototypes fabricated
	1969	Prototype FH 155-1 units tested
August	1970	Italy joins developmental program
	1976	Nineteen FH 155-1 prototypes manufactured; evaluation completed
February	1977	Production of FH 155-1 commenced; initial Panzerhaubitze 155-1 prototypes fabricated
January	1978	First operational deliveries of FH 155-1
June	1979	Initial trials of Panzerhaubitze 155-1
	1980	FH 155-1 deemed operational in the United Kingdom and Germany
July	1982	FH 155-1 production completed for the United Kingdom, Germany and Italian active artillery units
November	1985	Major Panzerhaubitze 155-1 program review begins
January	1987	Panzerhaubitze 155-1 program terminated
	1989	FH 155-1 production in Europe goes dormant
	1997	Production of FH 155-1 piece terminated in Japan
Early	2002	Available for further production orders

Worldwide Distribution

Export Potential. In the late 1990s, the FH 155-1 continued to compete unsuccessfully in a glutted market. While Norway expressed the most recent interest, no sale has yet been made and none are forecast. At least 25 other new-production/retrofit towed 152 and 155 millimeter artillery systems are available in the world. The extremely stiff competition in this market is expected to increase as the players compete for an increasingly smaller pie.

In addition to the United Kingdom, Federal Republic of Germany, and Italy, Saudi Arabia has received the FH 155-1. In early 1988, Malaysia ordered nine pieces but eventually received 12 refurbished pieces from the United Kingdom. Japan, a licensee for the piece, has also selected the FH 155-1 ordnance for its new self-propelled howitzer. In addition, Canada, Nigeria, Norway and Oman have shown interest in the FH 155-1, but no sales agreements have been reached.

Countries. **Federal Republic of Germany** (192), **Italy** (164), **Japan** (474), **Malaysia** (12), **Morocco** (35), **Netherlands** (15), **Saudi Arabia** (37) and **United Kingdom** (35).

In addition, the contractor BAE Systems/RO Defence holds 24 ex-British Army pieces which have been refurbished and are now being marketed.

Forecast Rationale

The most recent development in the FH 155-1 program is the advent of the Italian auxiliary propulsion unit. The serial production of the piece remains dormant. However, the marketing effort continues, especially by RO Defence, which is pushing the 24 refurbished ex-British Army pieces. Due to the existence of these 24 pieces plus the glut of competing systems on the market, we forecast no additional orders for new-production FH 155-1 pieces. But the marketing

effort will continue, and, despite our forecast, the piece is still available for new-production orders.

The licensed production of the FH 155-1 as a complete system has ended in Japan. Of the total of 454 pieces that were procured, the first 20 came directly from the European consortium.

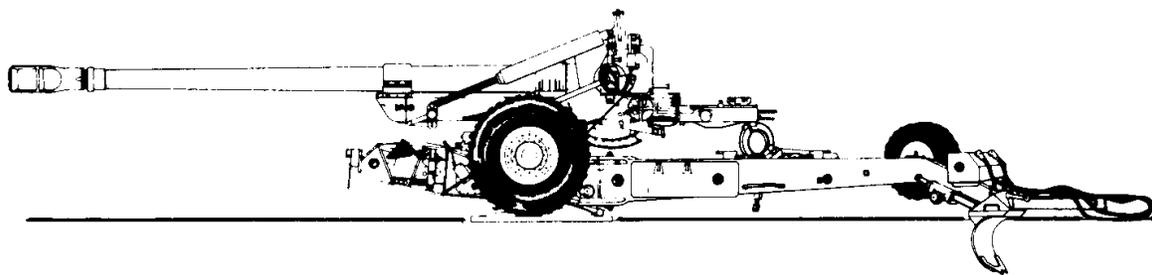
While the new 52 caliber cannon can easily be retrofitted to the FH 155-1 systems, this program has yet to be embraced by any of the users of this piece.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR PRODUCTION

Ordnance	(Engine)	High Confidence Level				Good Confidence Level				Speculative			Total 02-11	
		through 01	02	03	04	05	06	07	08	09	10	11		
JAPAN STEEL WORKS (Licensee)														
FH 155-1 (a)	NO ENGINE	454	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal - JAPAN STEEL WORKS (Licensee)		454	0	0	0	0	0	0	0	0	0	0	0	0
RHEINMETALL/RO DEFENCE/OTOBREDA (Consortium)														
FH 155-1 (b)	NO ENGINE	553	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal - RHEINMETALL/VICKERS/OTOBREDA (Consortium)		553	0	0	0	0	0	0	0	0	0	0	0	0
Total Production		1007	0	0	0	0	0	0	0	0	0	0	0	0

- (a) The through 2000 production includes no prototypes. The first 20 pieces of the Japanese requirement came from the European production line. Production does not include the ordnance for the Type 99 155 millimeter self-propelled howitzer application.
- (b) The through 2000 production includes 19 prototype/developmental pieces, some of which were used for operational evaluations and contractor demonstrations. More recently, Rheinmetall has fitted a 52 caliber ordnance to one of these pieces.



FH 155-1

Source: Rheinmetall