

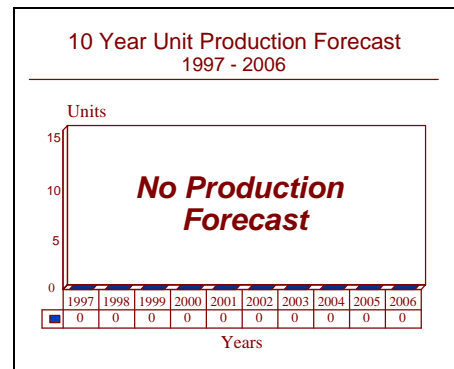
ARCHIVED REPORT

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FH-77A/FH-77B 155 mm Howitzers - Archived 5/98

Outlook

- Production of both pieces dormant; no further production forecast
- No further license production expected
- Only a minimal modernization and retrofit potential exists for these artillery systems



Orientation

Description. Towed 155 millimeter artillery systems

Sponsor. The initial development and Swedish procurement of the FH-77 was sponsored by the Swedish Army Materiel Department of the Defence Materiel Administration for the Swedish Army.

Contractors. These artillery systems were developed and are manufactured by AB Bofors; Bofors, Sweden. Major subcontractors include Volvo AB.

Licensees. The March, 1986 contract concluded with India contains a clause allowing India to license-produce the FH-77B following the initial major procurement from Sweden. As of early 1997, this clause has not been exercised and is not expected to be exercised.

Status. The FH-77A production for the Swedish Army is complete. The FH-77B has been in parallel production for export and a follow-on contract for Sweden; these

requirements have been met and production went dormant in 1994 but the line remains warm for new orders. Bofors has developed a coastal defense version of the FH-77B; designated CD-77, the manufacture of this system has yet to begin.

Total Produced. As of January 1, 1997, a total of 203 FH-77A, 508 FH-77B and two CD-77 prototypes had been manufactured.

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

Price Range. The FH-77A unit price was put at \$601,200 by reliable sources based on the Swedish procurement. The FH-77B unit price, based on the Swedish contract, is \$606,800 and CD-77 unit cost is essentially the same. All prices are in equivalent 1993 United States dollars but are essentially the same in 1997.

Technical Data

FH-77A

Crew. Ten

Muzzle Brake. Originally pepperpot, now a double-baffle type has been fitted to most pieces

Recoil System. Hydropneumatic

Breech Mechanism. Vertical sliding block

Carriage Type. Split trail with auxiliary power unit

Shield. None

Dimensions. The FH-77A was designed to specifications unique to Sweden. The length is when firing; the traveling length is 11.6 meters (38.05 feet).

Ammunition. The chamber of the FH-77A is designed to accept special Swedish pattern semi-fixed 155 millimeter ammunition in the following types: M/77B High Explosive/High Capacity, M/77 High Explosive, M54/77 High Explosive practice, Illuminating and Smoke.

	<u>SI units</u>	<u>US units</u>
Caliber	155 millimeters	6.10 inches
Length overall	11.2 meters	36.75 feet
Barrel length	38 calibers/5.89 meters	38 calibers/19.32 feet
Traveling width	2.64 meters	8.66 feet
Firing width	7.18 meters	23.56 feet
Traveling height	2.75 meters	9.02 feet
Firing height	2.75 meters	9.02 feet
Traveling weight	11.5 tonnes	12.68 tons
Firing weight	11.45 tonnes	12.62 tons

Performance. The maximum range figure is with the non assisted M/77 projectile with Charge 6. In Swedish service, the FH-77A is normally towed at 70 kilometers per hour (43.5 miles per hour) behind a Saab-Scania SBAT 111S 6x6 truck.

Elevation	+50°	+50°
Depression	-3°	-3°
Traverse	30°left/30°right	30°left/30°right
Maximum range	22,000 meters	24,059 yards
Maximum rate of fire	6 rounds in 25 seconds	6 rounds in 25 seconds
Sustained rate of fire	2 rounds per minute	2 rounds per minute

FH-77B

Crew. Six

Muzzle Brake. Originally pepperpot, now a double-baffle type has been fitted to most pieces

Recoil System. Hydropneumatic

Breech Mechanism. Interrupted screw, stepped thread

Dimensions. The FH-77B is compatible with NATO production standards.

Carriage Type. Split trail with auxiliary power unit

Shield. None

Ammunition. The FH-77B is designed for standard NATO pattern separate/bagged 155 millimeter ammunition plus Extended Range Full Bore/Base Bleed types and rocket assisted projectiles.

	<u>SI units</u>	<u>US units</u>
Caliber	155 millimeters	6.10 inches
Length overall	11.6 meters	38.05 feet
Barrel length	39 calibers/6.05 meters	39 calibers/19.83 feet
Traveling width	2.65 meters	8.69 feet
Firing width	7.21 meters	23.65 feet
Traveling height	2.81 meters	9.22 feet
Firing height	2.79 meters	9.15 feet
Traveling weight	11.99 tonnes	13.22 tons
Firing weight	11.98 tonnes	13.21 tons

Performance. The maximum ordnance range is with the Extended Range Full Bore/Base Bleed projectile and Charge 9. The FH-77B is normally towed at 70 kilometers per hour (43.5 miles per hour) behind a Saab-Scania SBAT 111S 6x6 or similar class truck.

Elevation	+70°	+70°
Depression	-3°	-3°
Traverse	30°left/30°right	30°left/30°right

Maximum range	30,000 meters	32,808 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

Auxiliary Power Unit. Volvo supplies the B20 spark ignition engine which is rated 59.68 kilowatts (80 horsepower).

Variants/Upgrades

Variants. Although no specific variants of the FH-77 have been developed, in a program that saw the first prototype completed in late 1995, the FH-77A has been integrated with the chassis of the VME 825B 6x6 truck. This system is now undergoing company and Swedish Army trials. In addition, two other artillery systems using the FH-77 technology or portions thereof have been developed to production status.

CD-80 Karin. In 1972, the Swedish Ministry of Defense requested that Bofors develop a new mobile coastal defense gun, Sweden being one of the last holdouts possessing a dedicated coastal defense artillery organization. In order to save time and money, the new system, designated CD-80 Karin, was designed using the carriage of the FH-77A, which was then under development. The ordnance caliber is 120 millimeters instead of 155 millimeters, a revised laying system applicable to moving targets at sea, and a new ammunition feed system are the main differences between CD-80 Karin and the FH-77. The naval standard ammunition is fixed and available in all the common types.

The CD-80 Karin is a highly mobile system, using a Saab-Scania SBAT 111S 6x6 truck. Once the weapon is in place, fire control data are provided by the PEAB system housed in a nearby van. The PEAB consists of a search and tracking radar, fire control computers and an optronic director. Data relay is an automatic process. Weight of the CD-80 Karin system is 11.3 tonnes (12.45 tons) and elevation/depression are +45° and -3° respectively; traverse is 30° left and right. The 120 millimeter ordnance

is 55 calibers in length and is equipped with a multi-baffle muzzle brake. The rate of fire is about 10 rounds per minute. The production for Sweden's order is complete.

CD-77. In mid-1986, it was learned that Bofors was developing a new coastal defense system based on the FH-77B but compatible with NATO pattern ammunition and other standards. The CD-77 is essentially the same as the FH-77B but is compatible with the CD-80 Karin fire control system.

Modernization and Retrofit Overview. As of early 1997, only two significant modernization and retrofit programs have been developed for the FH-77; in point of fact, these two programs were developed as options for new production pieces.

Autonomous FH-77B. In late 1987, Bofors demonstrated a new optional feature for the FH-77. Demonstrated with the FH-77B but apparently applicable to all FH-77 models, the option consists of a Ferranti Defence Systems FIN 1150 gyroscope stabilized land navigation system which is linked to the sight and fire control system. This equipment eliminates the time consuming survey and alignment processes needed after every movement before a fire mission can commence, since the weapon can now be moved, fire a mission and moved again, reducing the chance of hits from counter-battery fires.

In a related development, Sweden ordered the FH-77B equipped with the Honeywell Modular Azimuth Position System land navigation system.

Program Review

Background. In the mid-sixties, the Swedish Government initiated design studies for the future requirements of the Swedish Army in the area of field artillery. The consensus was for a 155 millimeter artillery piece with auxiliary power. The tactical needs were stated as being long range, a high degree of mobility, high rate of fire, and the ability to handle standard NATO as well as the new types of ammunition then being developed.

Bofors Ordnance was awarded a development contract in the late sixties and the new weapon was designated FH-77A (Field Howitzer Model 77). The first prototype was fabricated in 1973 and following operational tests, the

initial production order was given in 1975. The first production units were delivered to the Swedish Army in late 1978 and the production run was completed in 1984.

FH-77A Description. The FH-77A is very similar to the FH 155-1 in configuration. It has a split-trail carriage with the legs hinged to the body unit which carries the main carriage wheels and the auxiliary power unit. All controls are hydraulically powered, thereby eliminating any problems with mechanical linkages to control systems. The unique feature of the FH-77A auxiliary power unit is that it can be remotely controlled from the towing vehicle. This allows auxiliary power to be used to assist the towing

vehicle in getting the piece over difficult terrain. Auxiliary power unit assistance automatically cuts out when the towing vehicle reaches a speed of eight kilometers per hour.

The ordnance runs through a box cradle with the hydropneumatic recoil system lying along the barrel. A pepperpot muzzle brake dampens the recoil while the vertical sliding breech opens downward. Obturation is by the cartridge case base, and a percussion firing lock inside the block drives a firing pin into the percussion primer fitted into the cartridge case.

The ammunition for the FH-77A is of Swedish pattern developed especially for the gun; the standard projectile is a thin-walled, hollow-base shell designated M/77, weighing 43 kilograms (94.6 pounds) and filled with 7.8 kilograms (17.16 pounds) of TNT. Smoke and illuminating shells have also been developed. For long-range firing, the Extended Range Full Bore Mark 10 Base Bleed projectile extends the maximum range of the piece to 30 kilometers, although this projectile works a little better with the 39 caliber FH-77B. A rocket-assisted projectile has also been developed.

The FH-77A went into service with the totally new multi-function Zelar fuse for its ammunition. This unprecedented fuse combines within one casing proximity and impact action with seven options: impact, long delay; impact, short delay; instantaneous, normal and high sensitivity; proximity, low burst; proximity, high burst and proximity, normal. One fuse has replaced five separate

fuses that were formerly used by the Swedish Army. It has been offered to NATO, but the fuse will not function at low charges with existing M109 howitzers. This deficiency means that it probably has not been adopted by NATO.

Loading the FH-77A is done hydraulically by a crane which lifts three shells at a time from a pallet of 12 and places them on a loading table. The projectiles are transferred mechanically to the loading tray as needed. A cartridge case is manually placed behind each shell and the complete round is hydraulically rammed into the chamber.

Firing is done electromechanically by the gun-layer. The breech is automatically opened upon run-out, and the cartridge case is ejected.

FH-77B. The FH-77B was originally developed for the export market; it has several improvements over the FH-77A, the original model, especially the ability to fire standard NATO bag-type ammunition. Basically, the FH-77B has a slightly longer ordnance, the introduction of an interrupted screw breech mechanism, and a modified hydraulic loading system. The mechanized ammunition handling system allows three rounds to be fired in 10-12 seconds, even when the gun is at its maximum elevation of +70°. Significantly, the piece can fire the Extended Range Full Bore/Base Bleed and standard NATO M549 rocket-assisted projectile to a range of 30 kilometers. Conventional ammunition averages some 24 kilometers for all types of rounds.

Funding

The development of the FH-77 was funded by the Swedish Ministry of Defense through the Swedish Army Materiel Department of the Defence Materiel Administration for the Swedish Army.

Recent Contracts

In June of 1990, it was announced that Sweden was procuring the FH-77B in a contract worth \$162 million. A total of 48 pieces were procured.

Timetable

Table is for the FH-77 in all its versions only and not for the FH 155-1 in any manner.

	1965-1968	Design studies initiated, conducted
	1970	Bofors awarded developmental contract
	1973	First pre-production prototype completed
	1973-1975	Testing and evaluation took place
	1975	Production go-ahead granted
Late	1978	First deliveries made to Swedish Army
	1981	Field operation in Sweden developed
	1982-1984	Limited export market developed with Nigerian sale

	1984	Swedish Army requirements for FH-77A filled
	1985	Swedish Navy requirement for CD-80 filled
Mar	1986	FH-77B won Indian contract
Aug	1986	First FH-77B pieces shipped to India
Late	1986	CD-77 unveiled
Oct	1977	Autonomous FH-77 unveiled
Jun	1990	Sweden placed first order for FH-77B
Early	1997	Production dormant but available for new orders; development continues

Worldwide Distribution

Export Potential. Although Bofors is a world-renowned name in the armament industry, Swedish arms export policy of the last three decades or so has limited the impact of Swedish weapons around the world. Previous to early 1986, the FH-77B had only one confirmed sale of 48 pieces to Nigeria. As is the norm with many types of military hardware today, the glutted market conditions are hindering the sales effort.

Indian Order. After seven years of negotiations, and a competition involving four other competitors, India selected the FH-77B for its next 155 millimeter howitzer on March 24, 1986. The details of the order remain sensitive, but the number of systems involved would have potentially involved around 1,500 pieces worth the equivalent of about \$3.52 billion 1987 United States dollars. The sale represents the largest-ever export for a Swedish firm.

The deliveries from Sweden commenced in August of 1986 and were completed in early 1991; this order was for 410 units. India has had a right to license-manufacture additional pieces as well as the ammunition and spare parts since 1990. However, as of early 1997, the license manufacture of the FH-77B had not begun and it is forecast that the option will not be exercised.

Countries. **India** (410 FH-77B); **Nigeria** (48 FH-77B); **Sweden** (292 FH-77A, 2 CD-77, 48 FH-77B).

Forecast Rationale

Our latest review of the FH-77 program finds that, as of early 1997, the production program remains dormant, as it has been for some time now. The only news regarding the program has been in relation to the integration of the FH-77A with the 6x6 wheeled chassis; the developmental testing of this system is ongoing.

Due to the fact that it is a 39 caliber system, the FH-77, even in the latest B version, is difficult to market in this day of 45 and 52 caliber systems with much better performance. This, plus the intense market competition prompt us to forecast no additional production of the FH-77A or B.

Regarding the CD-77, it is now generally felt that anti-ship missiles offer a better means of coastal defense; only a few nations still actively embrace coastal artillery. If it ever

commences (which we do not forecast), production of the CD-77 should be limited to Sweden. The caveat is that Sweden is now moving toward self-propulsion for this mission area; the nation is even looking at a special version of the new Panzerhaubitze 2000 for this purpose.

Bofors made headlines in 1986 by pulling off a major coup: landing the Indian contract for a new towed artillery system. Contracts similar to this are extremely rare in this era of glut in towed ordnance systems. The 1,500-odd units originally forecast to be procured would have assured the continued manufacture of the FH-77B in India at a high level through most of the forecast period. However, for various political reasons, India has yet to begin manufacturing the FH-77B and, due to the advent of the 600-unit 155 millimeter self-propelled program, no production is forecast.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR PRODUCTION

Ordnance	(Engine)	through 96	<u>High Confidence</u>				<u>Good Confidence</u>			<u>Speculative</u>			Total 97-06
			97	98	99	00	01	02	03	04	05	06	
BOFORS AB													
CD 77(a)	NO ENGINE	2	0	0	0	0	0	0	0	0	0	0	0
FH-77A(b)	NO ENGINE	203	0	0	0	0	0	0	0	0	0	0	0
FH-77B(c)	NO ENGINE	508	0	0	0	0	0	0	0	0	0	0	0
Subtotal - BOFORS AB		713	0	0	0	0	0	0	0	0	0	0	0
INDIAN ORDNANCE FACTORIES (Licensee)													
FH-77B(d)	NO ENGINE	0	0	0	0	0	0	0	0	0	0	0	0
Subtotal - INDIAN ORDNANCE FACTORIES (Licensee)		0	0	0	0	0	0	0	0	0	0	0	0
Total Production		713	0	0	0	0	0	0	0	0	0	0	0

(a)The through 1996 production is the initial prototype pieces.

(b)The production includes three prototype/development pieces.

(c)The through 1996 production figure contains two prototype/developmental and contractor demonstration pieces.

(d)No production is forecast.