

# ARCHIVED REPORT

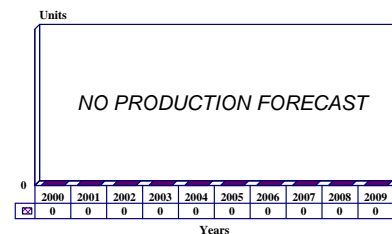
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## G6 Renoster 155 mm Self-Propelled Howitzer - Archived 4/2000

### Outlook

- Production is dormant following completion for existing contracts
- System still being heavily promoted on the export market
- Some modernization and retrofit potential in the future, especially for a 52 caliber cannon

10 Year Unit Production Forecast  
2000-2009



### Orientation

**Description.** A wheeled 155 millimeter self-propelled artillery system

**Sponsor.** The development and South African procurement of the G6 was sponsored by the South African Department of Defense.

**Contractors.** This self-propelled artillery system was developed and is manufactured by Lyttleton Engineering Works under the auspices of Denel Limited. ARMSCOR, Pretoria, Republic of South Africa, is the government procurement agency and international marketing agent. Major subcontractors include GEC Marconi, Magirus Deutz (under license), Kentron and Reumech OMC.

**Licensees.** Industrias Cardoen of Chile had a license for the marketing and manufacturing rights for the G6; this agreement terminated many years ago.

**Status.** The serial production of the G6 is dormant following the completion of the latest order. The system is in service with the Republic of South Africa's armed forces as well as in two export nations. Development of the system continues.

**Total Produced.** As of January 1, 2000, a total of 153 G6 systems had been manufactured by Denel Limited. In addition, one pre-prototype had been completed by Metalnor (formerly Industrias Cardoen of Chile).

**Application.** General mobile artillery support for the field army at the battalion level.

**Price Range.** In equivalent 2000 United States dollars, the unit price of the G6 is \$3.272 million.

### Technical Data

**Design Features.** The G6 is a wheeled system (only the second modern system of this type) of exceptional mobility and is especially suited for rugged environments. The 45 caliber cannon was long

unmatched in terms of ballistic performance for 155 millimeter systems.

**Crew.** Five: commander, layer, loader, driver and ammunition handler

**Muzzle Brake.** Single baffle; modified multi-baffle tested

**Recoil System.** Hydropneumatic

**Breech Mechanism.** Interrupted screw stepped thread

**Ammunition.** The G6 is compatible with all types of M1 series Extended Range Full Bore and Extended

**Dimensions.** The following data is for the latest production serially manufactured G6 from the Republic of South Africa. The height figure is with the machine gun mounted.

	<u>SI units</u>	<u>US units</u>
Length overall	10.34 meters	33.92 feet
Width	3.41 meters	11.19 feet
Height	3.79 meters	12.43 feet
Combat weight	36.49 tonnes	40.22 tons
Fuel capacity	705 liters	187.5 gallons
Ordnance caliber	155 millimeters	6.10 inches
Ordnance length	45 calibers/6.98 meters	45 calibers/22.88 feet

**Performance.** The vehicle maximum range and speed are on hard earth; the cannon range is with the Extended Range Full Bore/Base Bleed (non-assisted) projectile. A new family of Extended Range Full Bore ammunition based on the Velocity Enhanced Long Range Artillery Projectile has been developed that offers a further increased range performance (50,000 meters - 54,680 yards) with the standard 45 caliber cannon of the G6 and even greater performance with the new 52 caliber cannon.

	<u>SI units</u>	<u>US units</u>
Maximum speed	90 kilometers per hour	55.89 miles per hour
Maximum range	700 kilometers	434.7 statute miles
Step	52 centimeters	1.71 feet
Trench	1.0 meters	3.28 feet
Slope	30%	30%
Gradient	42%	42%
Fording	1.0 centimeters	3.28 feet
Elevation	+75°	+75°
Depression	-5°	-5°
Traverse (total)	180°	180°
Maximum ordnance range	39.0 kilometers	42,650.4 yards
Maximum rate of fire	5 rounds per minute	5 rounds per minute
Sustained rate of fire	3 rounds per minute	3 rounds per minute

**Engine.** The G6 uses a license-produced Magirus Deutz FL 413 F/FR air-cooled diesel engine. This engine is rated at 391.49 kilowatts (525 horsepower) at an unspecified engine speed. The power to weight ratio is 10.73 kilowatts per tonne (13.05 horsepower per ton). An auxiliary power unit, called the Turret Power Unit, is mounted in the turret bustle to charge batteries and operate the air conditioning system. The type and designation of the engine powering this unit is not known. A 24 volt electrical system with two 24 volt/175 ampere hour batteries in the hull and two 24 volt/370 ampere hour batteries in the turret is the standard electrical fit.

**Gearbox.** The G6 uses an unspecified unit with six forward and two reverse gear ratios. Gear selection is

automatic or manual as per the driver's choice. This unit is positioned parallel to the engine in order not to protrude into the fighting compartment. The G6 uses permanent six wheel drive with differential locks. A hydraulically assisted steering system is fitted.

**Suspension and Running Gear.** The G6 was originally equipped with a walking beam type suspension. A torsion bar type suspension with hydraulic shock dampers and bump stops on all six wheels has since been adopted. The 21.00x25 tires are the run flat type and a central tire pressure regulating system is standard.

**Fire Control.** The G6 is normally used for indirect fires with the targeting data provided by a forward observer

through a fire direction center command post. When firing orders are relayed to the G6 through the Very High Frequency band frequency hopping radio, the crew then lays the cannon in the appropriate manner. Laying can be through the automatic gun laying system or manually. The gunner is provided with an optical-mechanical indirect type sighting system. This system is a digital type mounted directly on the trunnions; a

telescopic sight is used for direct firing. As described below, other fire control components are being integrated into the G6 system; these components include a laser rangefinder, fire control computer, passive night sights for the commander and driver and the FIN 3110G land navigation equipment incorporating ring laser gyroscope technology (provided by GEC Marconi).

## Variants/Upgrades

**Variants.** The G6 has been fitted with a 52 caliber cannon and is now in an extended test and evaluation program. An enhanced charge system and projectiles have also been developed; among these, the Modular Charge System offers easier handling and a more rapid firing rate. The 52 caliber cannon is a key component of the T6 program (see below). It will also be possible to retrofit this cannon with the existing G6 systems or integrate it with any new production systems. Firing the latest pattern Velocity Enhanced Long Range Artillery Projectile at the maximum charge, the 52 caliber cannon can achieve a range of 52.5 kilometers (57,414 yards).

**T6.** In 1992, Denel/Lyttleton Engineering Works began a program to integrate the turret of the G6 with a tank chassis. This program, designed for the export market, was most likely driven by the Indian requirement for 600 new 155 millimeter turrets for integration with the T-72 tank chassis. This is the reason that the T-72 was selected as the initial T6 platform chassis.

The integration and contractor (including firing) trials ran into April 1994 using the new 52 caliber cannon. This integration has represented an additional technical problem that had to be addressed, at least in relation to the Indian requirement. This was due to the fact that India is mandating a 52 caliber cannon. However, as noted above, Denel/Lyttleton Engineering Works was already engaged in the development of such a cannon, although there is some evidence that the program has been delayed for some reason. In any event, the outcome of the initial trials verified the concept with the T-72 proving to be a stable firing platform. However, some integration problems were encountered; for example, the G6 turret is somewhat heavy for the T-72. As in the purpose designed G6, ammunition storage was also a problem, and the turret had to be redesigned for the T-72 application.

In the T6, a total of 46 complete 155 millimeter rounds with 40 projectiles and 36 charges are stored in the four

electrically operated carrousel. The contractor continued the development of the T6, with the T-72 and has subsequently integrated a number of improvements related to both the new cannon and turret. Among these is the installation of an auxiliary power unit in the turret bustle. The cannon, with a 23 liter chamber, has a barrel temperature monitoring unit with an associated cooling fan, redesigned recoil system and cradle. In addition to the range of Extended Range Full Bore ammunition and the new Modular Charge System, the 52 caliber cannon of the T6 can fire all NATO standard 155 millimeter ammunition. In 1995, a T6 turret of the latest design was delivered to India for trials; the turret was fitted with the advanced fire control, features as noted above.

**Modernization and Retrofit Overview.** Aside from the potential to retrofit the new 52 caliber cannon, a number of other product improvements have been developed for the G6 and have been incorporated as production cut-ins. These improvements can also be retrofitted to earlier production G6 systems; they include: an upgraded auxiliary power unit rated at 38 kilowatts; an integrated overpressure type biological and chemical protection system; an improved air conditioning system (with environmentally friendly R-134A refrigerant); a separate air conditioning for the driver's compartment; an upgraded recoil system; blow-down (fan cooled) type barrel cooling system; improved vision components; improved rust and corrosion protection; a new automatic gun laying and navigation system (the FN23110G from GEC-Marconi) with its own fire control computer (and integrated with a ring laser type gyroscope, touch screen display and sensors, provided by Kentron); and other chassis/hull improvements to ease maintenance and improve serviceability. The fire suppression system is now filled with FM200 gas, an environmentally friendly suppressant. With the incorporation of these improvements, the South Africans call the system GV6.

## Program Review

**Background.** The G6 self-propelled artillery system has its origins in Dr. Gerald Bull's Space Research Corporation design integrating its unique GC-45 ordnance with a rugged six-wheel vehicle. For a full description of the GC-45 and its GHN-45 derivative, we refer the reader to the separate reports in Tab B. We also refer the reader to the G5 report in the same tab for a description of how the unique Extended Range Full Bore technology reached the Republic of South Africa.

More than pleased with the G5 Extended Range Full Bore technology, the Republic of South Africa soon decided to adapt the original Space Research Corporation idea for a self-propelled artillery system to a vehicle suited to the specialized South African requirements. In 1979, the Lyttleton Engineering Works, under the auspices of ARMSCOR, began the development of this vehicle with the first prototype completed in October of 1981. Initially, four complete G6 systems were fabricated; four additional units were more recently completed, integrating the latest changes dictated by the testing of the first prototype and development vehicles. The system is designated G6 and called Renoster.

**Description.** The G6 is a 6x6 wheeled design which has deleted the optional selection for 6x4 operation in the first prototypes. The choice of wheels over tracks was dictated by the long distances that will probably have to be covered in service; wheeled vehicles are considered more suitable for the South African terrain. Additionally, the advantages of lower fuel consumption and reduced maintenance inherent in wheeled vehicles was considered.

The hull is fabricated from welded steel alloy armor which is proof against small arms projectiles and ballistic fragments. The floor of the vehicle is of double layered construction affording enhanced protection from the effects of landmines. The driver is seated at the forward section of the vehicle in the middle. The driver's access is via a hatch in the roof of the vehicle. The driver has large bullet-proof windows, the center of which can be covered by an armored shutter which is raised by a simple mechanism. With the shutter in place, the driver uses a periscope. As a production cut-in, the driver's station was completely redesigned in 1989; among the new components is a comprehensive engine monitoring system. Two of the roadwheels are situated just behind the driver. Behind the driver is the powerpack. To the rear, above the rear two axles, is the ordnance within the turret. It should be noted that the turret is mounted directly on the vehicle hull. A total of 44 projectiles, 50 charges, 64 primers and 64 fuses are

carried in racks at the rear of the chassis on each side. An access hatch for crew entrance/exit of the turret is on the rear. Additionally, two ammunition hatches, one to each side of the main hatch, are provided for replenishment of the ammunition supply.

The turret is fabricated from all steel armor which is proof against 23 millimeter Armor Piercing projectiles. Four crew members operate in the turret which is fitted with vision ports, a dial sight and telescope. Turret traverse is power assisted, while the ordnance is hydraulically controlled. Originally, the same power ramming system as on the G5 was used, but a semi-automatic loading system was subsequently developed and incorporated on the production systems. A semi-automatic flick rammer is fitted in order to enhance the rate of fire. The vehicle commander is seated under one of the two roof hatches. He is provided with rudimentary driving controls should the driver become incapacitated. On the roof of the turret at the left cupola, a 7.62 or 12.7 millimeter machine gun (usually the latter) can be mounted. Eight launchers for High Explosive and smoke grenades are mounted on the turret, four per side. The G6 has three firing ports for close-in defense with the crew's R4 rifles.

The 45 caliber autofrettaged cannon is only slightly modified from that of the G5. The main changes are the addition of a fume extractor and minor modifications to the cradle. Although firing can be done while the vehicle is on its wheels, better stability is achieved when the four hydraulically operated stabilizer legs are lowered.

**License Manufacture.** In late 1987, the then Industrias Cardoen of Chile concluded a license agreement with ARMSCOR for the license marketing and manufacture of the G6 in Chile. By mid-1989, when the formal announcement was made, the first prototype had already been manufactured and was involved in a test program. The CC-SP-45, as the G6 was designated by Cardoen, was to be fabricated from a combination of locally and internally manufactured components. In 1990 or thereabouts, the licensing agreement was terminated.

## Funding

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The South African Department of Defense provided funding for the development and South African procurement of the G6.

## Recent Contracts

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Not available as contractual information is not released.

## Timetable

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This timetable is for the G6 only and not for the G5 or GC-45/GHN-45.

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
Early	1970s	Extended Range Full Bore technology begins testing
	1977-1979	GC 45 tested
	1979	Lyttleton Engineering Works under the auspices of ARMSCOR begins G6 development
November	1981	First G6 prototype completed
	1982-1986	Extended operational testing of four prototype/development vehicles
Late	1987	Four final development G6 systems fabricated
	1987	License agreement with Industrias Cardoen concludes
	1988	Final testing and evaluations made; preparation for serial production begins
Early	1990	First export sale to Abu Dhabi made
	1992	Development of T6 begins
January	1994	Sale to Oman made
Early	2000	Serial production dormant; marketing and development continues

## Worldwide Distribution

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**Export Potential.** With the Republic of South Africa now in the mainstream of the Western world, the export of the G6 is doing much better in terms of marketability. Now that the sanctions against the Republic of South Africa are largely lifted, further export of the G6 is much more likely; the early 1994 order from Oman is evidence of this. But now Denel has to contend with the new Zuzana 155 millimeter system from the Slovak Republic, another wheeled system also employing the Extended Range Full Bore technology. Only time will tell which system becomes favored on the market.

**Countries.** **Republic of South Africa** (43), **Chile** (one prototype with Metalnor), **Oman** (24) and **United Arab Emirates** (78).

## Forecast Rationale

As of early 2000, our research into the G6 program finds that the serial production of this system remains dormant following the completion of the latest export order in early 1999. However, the further development of the system (including the T6 turret) is ongoing, although the T6 program is not included in our forecast chart below. One T6 turret has been in India for evaluation. However, the latest data in relation to the

Indian requirement prompts us to forecast that India will select the Russian 2S19 for at least an interim modernization of the self-propelled portion of its park.

Our latest forecast for the G6 is somewhat less than sanguine; in fact, we can find no distinct interest in the system on the export market, at least for the present. In addition, no further procurement for South Africa is

expected. Therefore, we are forecasting no additional production of the G6 in the immediate future.

However, since the arms trading restrictions against the Republic of South Africa are now a thing of the past and the G6 is still being heavily promoted on the export market, we must hold out the caveat of some nation coming in for this highly effective artillery system. In point of fact, the G6 is still in contention for a 350-unit

order from Saudi Arabia, but this drawn-out competition is so intense it is impossible to call. In relation to this, the enhanced ballistic performance of the new 52 caliber cannon with the latest pattern ammunition is noteworthy, and could possibly lead to an unexpected sale. Of course, we will continue to monitor this important program and update this report on an interim basis if required.

## Ten-Year Outlook

### ESTIMATED CALENDAR YEAR PRODUCTION

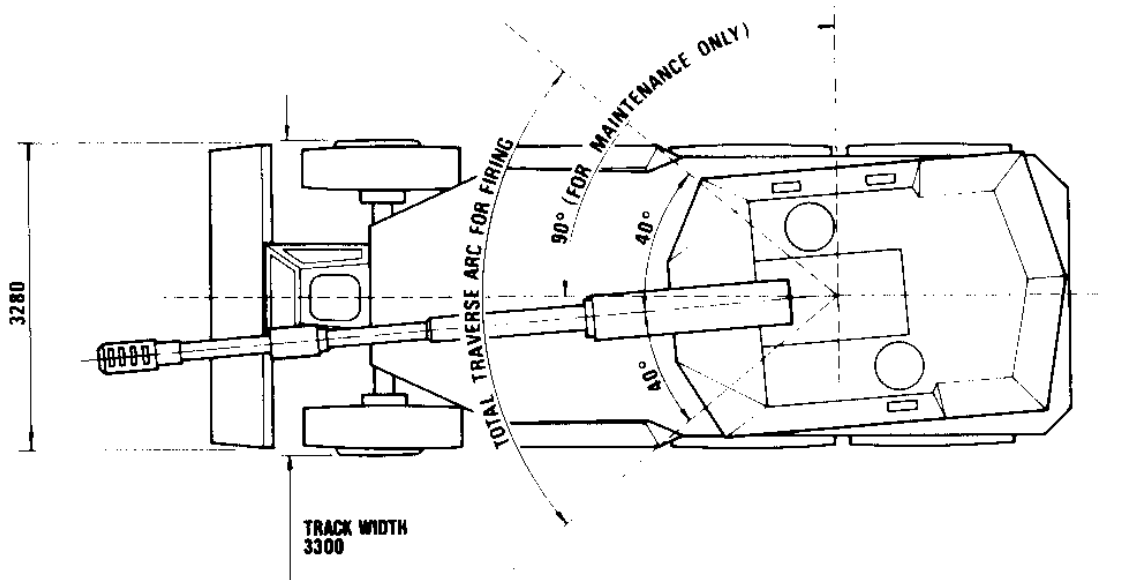
Ordnance	(Engine)	through 99	High Confidence Level			Good Confidence Level			Speculative			Total 00-09	
			00	01	02	03	04	05	06	07	08		09
DENEL LIMITED/LYTTELTON ENGINEERING WORKS													
G6 <sup>(a)</sup>	FL14F/FR	51	0	0	0	0	0	0	0	0	0	0	0
G6 <sup>(b)</sup>	FL14F/FR	24	0	0	0	0	0	0	0	0	0	0	0
G6 <sup>(c)</sup>	FL14F/FR	78	0	0	0	0	0	0	0	0	0	0	0
Subtotal - DENEL LIMITED/LYTTELTON ENGINE		153	0	0	0	0	0	0	0	0	0	0	0
METALNOR S.A. (Licensee)													
CC-SP-45 <sup>(d)</sup>	FL14F/FR	1	0	0	0	0	0	0	0	0	0	0	0
Subtotal - METALNOR S.A. (Licensee)		1	0	0	0	0	0	0	0	0	0	0	0
Total Production		154	0	0	0	0	0	0	0	0	0	0	0

(a) The through 1999 production includes two prototypes (one of mild steel), two advanced development systems and four engineering development systems. Production on this line is for the domestic requirement only.

(b) Production in this line is for export to Oman only.

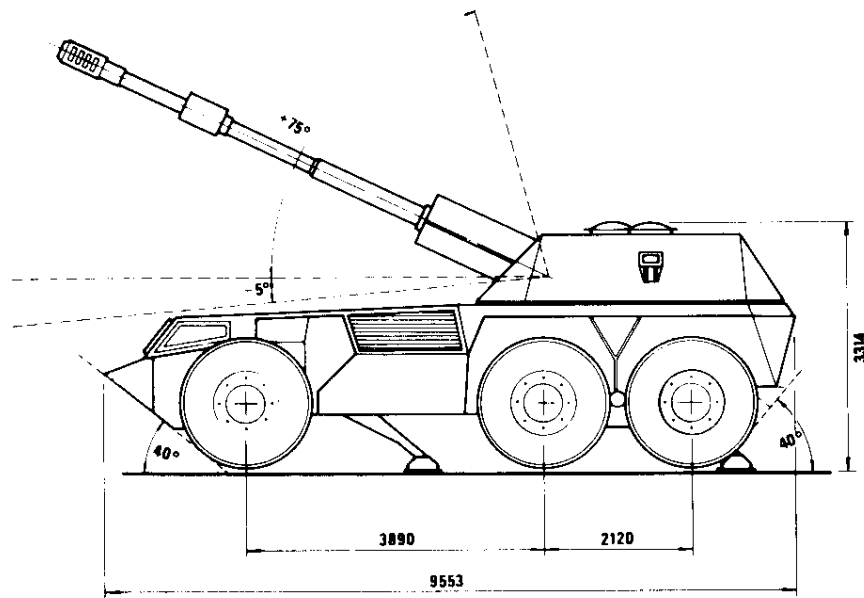
(c) This line is for export to the United Arab Emirates only.

(d) The licensing agreement terminated in 1989 or 1990 with one pre-prototype fabricated.



G6 Renoster (overhead view)

Source: ARMSCOR



G6 Renoster (side view)

Source: ARMSCOR