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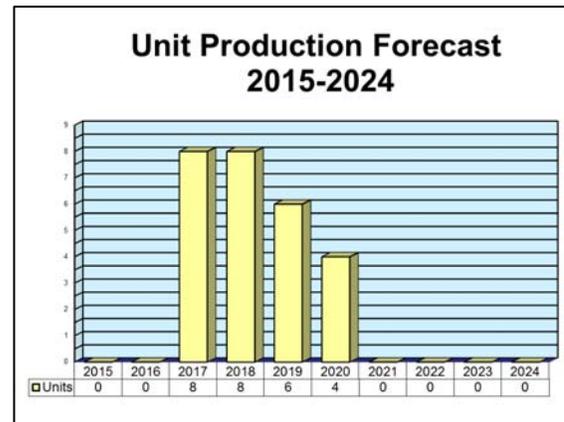
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G6 Renoster 155mm Self-Propelled Howitzer

Outlook

- Modernization and retrofit programs for SANDF continue to be the only significant activity for the G6
- Production forecast reflects Denel's lingering hopes for future export sales of the G6



Orientation

Description. A wheeled 155mm self-propelled artillery system.

Sponsor. The South African Department of Defence sponsored the development and procurement of the G6.

Licensees. None.

Status. Development through serial production. The G6 production line remains available for export orders.

Total Produced. Through 2014, we estimate Denel produced 169 G6 systems. Metalnor completed one pre-prototype system.

Application. Mobile indirect fire artillery support for maneuver forces at the battalion through division levels.

Price Range. In 2015 U.S. dollars, the G6 Renoster reportedly maintains a unit price of \$3.719 million.

Contractors

Subcontractor

BAE Systems OMC	http://www.baesystems.com , 12 Barnsley Rd, Benoni, 1501 South Africa, Tel: + 27 011 747 3300, Fax: + 27 011 749 8277, Email: omc.marketingemail@baesystems.com (G6 Renoster Vehicle Chassis)
BAE Systems plc	http://www.baesystems.com , 6 Carlton Gardens, Stirling Square, London, SW1Y 5AD United Kingdom, Tel: + 44 1252 373232, Fax: + 44 1252 383991 (FIN 3110G Land Navigation Equipment)
Denel Dynamics	http://www.deneldynamics.co.za , PO Box 7412, Nellmapius Dr, Centurion, 0046 South Africa, Tel: + 27 12 671 1911, Fax: + 27 12 671 1779, Email: communications@deneldynamics.co.za (Fire Control System Sensors)

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Michelin	http://www.michelin.com , Place des Carmes Dechaux, Clermont-Ferrand, 63040 Cedex 9, France, Fax: + 33 1 45 66 15 53 (21.00x25 Run-Flat Radial Tires)
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Technical Data

Design Features. The G6 is a 6x6 wheeled system of exceptional mobility in rugged environments. Until the introduction of 52-caliber ordnance, the 45-caliber cannon represented the state-of-the-art in terms of 155mm ballistic performance.

Crew. Five: commander, gunner, loader, driver, and ammunition handler.

Muzzle Brake. Single-baffle. Denel has also tested a modified multi-baffle design.

Recoil System. Hydro-pneumatic.

Breech Mechanism. Interrupted screw stepped-thread.

Dimensions. The following data reflect the G6M1A3 with the original 45-caliber barrel. The height includes the roof-mounted machine gun.

	<u>SI Units</u>	<u>U.S. Units</u>
Length overall	10.34 m	33.92 ft
Width	3.41 m	11.19 ft
Height	3.79 m	12.43 ft
Combat weight	47.92 tonnes	52.82 tons
Fuel capacity	705 liters	187.5 gal
Ordnance caliber	155mm	6.10 in
Ordnance length	45-cal/6.98 m	45-cal/22.88 ft

Performance. The maximum range and speed data reflect use on hard earth. The 45-caliber ordnance range is with the ERFB-BB (non-assisted) projectile.

	<u>SI Units</u>	<u>U.S. Units</u>
Maximum speed	90 km/h	55.89 mph
Maximum range	700 km	434.7 stat mi
Step	52 cm	1.71 ft
Trench	1.0 m	3.28 ft
Slope	30%	30%
Gradient	42%	42%
Fording	1.0 m	3.28 ft
Elevation	+75 deg	+75 deg
Depression	-5 deg	-5 deg
Traverse (total)	180 deg	180 deg
Maximum ordnance range	39.0 km	42,650.4 yd
Maximum rate of fire	5 rpm	5 rpm
Sustained rate of fire	3 rpm	3 rpm

Engine. Magirus Deutz FL 413 F/FR air-cooled diesel engine, produced under license in South Africa. This powerplant generates 391.49 kilowatts (525 hp), with a power-to-weight ratio of 8.17 kilowatts per tonne (9.94 hp/ton) in the G6M1A3 application.

Ammunition. In addition to all NATO-standard 155mm ammunition, the G6 ordnance is compatible with the following ammunition types:

- All types of M1-series Extended Range Full Bore (ERFB) and Extended Range Full Bore-Base Bleed (ERFB-BB) ammunition
- The M50 and M64 Modular Charge System
- The Assegai projectile and the M9703 Velocity-enhanced Long-range Artillery Projectile (V-LAP)

A 28-kilowatt (37.52-hp) auxiliary power unit mounts in the turret bustle. The 24-volt electrical system features two 24-volt/175-ampere-hour batteries in the hull and two 24-volt/370-ampere-hour batteries in the turret.

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Gearbox. An unspecified BAE Land Systems OMC unit, with six forward and two reverse gear ratios. Gear selection is automatic or manual, at the driver's discretion. The G6 features permanent six-wheel drive with differential locks. The steering is hydraulically assisted.

Suspension and Running Gear. Torsion bar suspension, with hydraulic shock dampers and bump stops on all six wheels. A central tire-pressure regulating system controls the Michelin 21.00x25 run-flat radial tires.

Fire Control. As the G6 is an indirect fire system, targeting data originate with the forward observer, passing through a fire direction center command post before reaching the individual G6 via the very high frequency (VHF) frequency-hopping radio. The gunner can lay (aim) the ordnance either through the automatic gun-laying system or manually with an optical-mechanical indirect sighting system. The G6 also mounts a telescopic sight for direct-fire missions.



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Source: SANDF

Variants/Upgrades

Variants. With technology developed under the Losvoor technology base program, Denel integrated a 52-caliber barrel with the existing G6 system to offer the G6-52 variant. Firing the M9703 V-LAP projectile with the maximum M90 charge, the 52-caliber 155mm ordnance reportedly can achieve a range of 52.5 kilometers (57,414 yd).

T6 Turret. In 1992, Denel/Lyttelton Engineering Works began work on a program to integrate the G6 turret with a T-72 tank chassis. This program was a response to the Indian requirement for 600 new 155mm turrets for integration with the T-72 tank chassis.

Integration and contractor trials with the 52-caliber ordnance ran through April 1994; the trials prompted a redesign of the T6 turret for the T-72 application.

In 1998, Denel delivered a redesigned T6 turret to India for trials under the Kingfisher Project, which integrated the T6 turret with the Arjun tank chassis. Although various reports surfaced in 2000 that India had selected the T6, the status of this program remains unclear. In any event, the T6 turret with the 52-caliber ordnance remains available for retrofit to existing chassis, including the G6.

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Modernization and Retrofit Overview. Denel has developed a number of product improvements for the G6. These are entering the G6 program as retrofits to existing systems; they are also available for integration with new-production systems.

Chassis-Related Improvements. Product improvement components related to the basic vehicle and chassis include:

- A 38-kilowatt (50.92-hp) turret-mounted auxiliary power unit
- An integrated overpressure nuclear, biological, and chemical (NBC) protection suite
- An improved air conditioning system (with environmentally friendly R-134A refrigerant)
- A separate air conditioning system for the driver's compartment

Overall, chassis improvements serve to ease maintenance and extend vehicle serviceability. The G6M1A3 model also incorporates changes to the engine

to increase fuel efficiency. It has a water cooler and an improved central tire inflation system. The fire-suppression system uses environmentally friendly FM200 gas.

Ordnance Improvements. Denel is integrating an upgraded recoil system, a blow-down (fan-cooled) barrel cooling system, and a new steel fume extractor. An additional firing safety interlock prevents firing unless the howitzer is plus or minus five mils of the target. An upgraded rammer raises the rate of fire to five rounds per minute.

Fire Control Improvements. Denel is incorporating the new AS2000 automatic fire-control suite with an automatic gun-laying and navigation system (the FIN 3110 RLG from BAE Systems) into the G6. The new Launcher Management Computer fire-control computer from African Defence Systems integrates a Global Positioning System (GPS) receiver and ring-laser gyroscope with a touch-screen display and Kentron sensors. Improved fire control software permits multiple-round simultaneous impact fires.

Program Review

Background. The G6 self-propelled artillery system has its origins in the late Dr. Gerald Bull's Space Research Corporation design, integrating its unique 155mm GC-45 ordnance with a rugged six-wheeled vehicle. In 1979, the Lyttelton Engineering Works (then under the auspices of ARMSCOR) began development of a complete weapon system based on the Space Research Corporation work. The first prototype G6 Renoster vehicle was rolled out in October 1981.

Description. The 6x6 wheeled design of the G6 chassis is optimized for the distances and terrain covered in South African National Defence Force (SANDF) service. Compared with tracked vehicles, wheeled vehicles also have the advantage of lower fuel consumption and maintenance requirements.

Optimized for Its Environment

The vehicle hull features a welded steel-alloy armor suite capable of defeating small arms fire and ballistic fragments. The floor of the vehicle is double-layered, for enhanced protection from land mines. The driver sits at the forward section of the vehicle, between the front wheel wells. The driver's station features a roof hatch, and large bulletproof windows with armored shutters. With the shutters in place, the driver uses a periscope. Denel completely redesigned the driver's station in 1989. Among the new components is a comprehensive engine-monitoring system. The powerpack and gearbox mount immediately behind the driver's station.

The turret mounts at the rear of the vehicle, directly above the two rear axles. The all-steel armor of the turret is capable of defeating 23mm armor piercing rounds. Four crew members operate in the turret, which features vision ports, a dial sight, and a telescope. The commander and gunner sit to the right of the ordnance; the loader and ammunition handler sit to the left.

The commander's station features a cupola and roof hatch, as well as rudimentary driving controls should the driver become incapacitated. A roof hatch on the left side provides access to a pintle-mounted 7.62x51mm NATO (.308 Winchester) machine gun or 12.7x99mm (.50 cal) machine gun. Four electrically operated grenade launchers (HE/Smoke) mount on each side of the turret. The G6 also features three firing ports for close-in defense with the crew's R4 battle carbines.

The G6 carries a total of 44 projectiles, 50 charges, 64 primers, and 64 fuzes in racks at the rear of the chassis on each side. The rear of the turret features a hatch for crew access and two ammunition hatches, one to each side of the rear crew hatch.

Production models of the G6 feature a semi-automatic loading system with a semi-automatic flick rammer. Turret traverse is power-assisted; ordnance movement is hydraulically controlled. The 45-caliber autofrettaged cannon features a fume extractor. Although the G6 can fire from its wheels, the four hydraulically operated stabilizer legs can provide enhanced stability.

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Related News

Cuba to Aid with South African Military Technical Development – A military team from Cuba has recently arrived in South Africa to help the military improve its technical capabilities.

The Cubans are acting as part of a technical deal signed by the two armed forces under an existing military-to-military agreement, said the South African Defense Department on March 2, 2015.

The technicians are supposed to help South African personnel to service and maintain military vehicles and develop their technical capabilities. The South Africa National Defence Force (SANDF) has had numerous problems in the maintenance of its military vehicles. (Military Periscope, 3/15)

South African Government Clears Denel, BAE Systems Land Systems Merger – South Africa's Competition Commission has approved the acquisition of BAE Systems' Land Systems South Africa (LSSA) by state-owned Denel.

In August 2014, BAE Systems made the decision to sell off its LSSA division. An agreement was signed to proceed with the sale, which was valued at ZAR855 million (\$79.85 million) and was anticipated to conclude during the fourth quarter of 2014 after receiving regulatory and other approvals.

The transaction includes BAE Systems' sale of its 75 percent interest in LSSA, as well as DGD Technologies (2001) Proprietary Limited's sale of its 25 percent stake in LSSA, as LSSA is a joint venture between the two companies.

LSSA has comprised three business segments employing approximately 500 people. The LSSA business specializes in the design and manufacture of military tactical-wheeled vehicles, mechanical driveline products, precision-machined components and gears, fire directing systems, and remote weapon launching platforms, subsystems and products.

While Denel has not yet announced its intentions for LSSA, it seems probable that it will be grouped with Denel Land Systems (DLS), which is the group's weapons and turret systems house and which has the contract to manufacture the Badger infantry combat vehicle (ICV) for the South African Army. (Defenceweb.co.za, 12/14)

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Funding

The South African Department of Defence funded the development and SANDF procurement of the G6 Renoster.

Timetable

<u>Month</u>	<u>Year</u>	<u>Major Development</u>
	1979	Lyttelton Engineering Works begins G6 development
Nov	1981	First G6 prototype rolled out
	1982-86	Extended operational testing of four prototype/development vehicles
Late	1987	Industrias Cardoen secures license agreement for G6
	1988	Final testing and evaluations; preparation for serial production
	1990	First export sale to Abu Dhabi
Early	1992	Development of T6 begins
Jan	1994	G6 sale to Oman
	1999	Denel completes last export order; production line falls dormant
May	2005	India's MoD suspends all negotiations and business with Denel over corruption allegations
	2015	Development and marketing continue

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Worldwide Distribution/Inventories

Export Potential. The G6 has benefited from South Africa's status as an emerging player in the international market. However, as wheeled self-propelled artillery designs become more common, South Africa will no longer enjoy the market advantage it once had. The G6 must now compete on the international market with wheeled 155mm systems such as the Zuzana from the Slovak Republic, Nexter's CAESAR, and the General Dynamics M1128 Stryker Mobile Gun System. Only time will tell which systems survive.

Countries. Republic of South Africa (67), Chile (one prototype with Metalnor), Oman (24), and United Arab Emirates (78).

Forecast Rationale

The G6 Renoster has yet to score any new sales since Denel completed an export order for Oman in 1999. Modernization and retrofit of the 43 systems remaining in active South African National Defence Force service constitute the only significant activity for this weapon system program.

In Search of Relevance

Denel continues to promote the G6 Renoster as relevant to the modern battlefield. In 2012, Denel partnered with Raytheon for a live-fire demonstration of Raytheon's Excalibur 155mm precision-guided artillery projectile

from a G6. Despite the successful firing demonstration, the effort garnered little more than yawns from the international market.

Clinging to Hope

Denel still clings to hopes for export of complete G6 Renoster systems, despite the lack of any firm commitments for export sales of the G6 or the T6 turret system. Without export sales, the G6 Renoster production line will remain limited to the production of components and spares in support of sporadic modernization and retrofit work.

Ten-Year Outlook

ESTIMATED CALENDAR YEAR UNIT PRODUCTION												
Designation or Program	Thru 2014	High Confidence				Good Confidence			Speculative			Total
		2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	
Denel SOC Ltd												
G6												
	169	0	0	8	8	6	4	0	0	0	0	26
Total	169	0	0	8	8	6	4	0	0	0	0	26