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476th VIRTUAL FIGHTER GROUP

24 January 2018

476th vFG TACTICS, TECHNIQUES, AND PROCEDURES

476TTP3-1.Threat Guide

THREAT GUIDE

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476TH VIRTUAL FIGHTER GROUP

476TTP3-1. Threat Guide
EFFECTIVE DATE: 24 January 2018

Tactical Operations
THREAT GUIDE

This handbook provides DCS pilots a comprehensive document containing technical and operational details of all surface to air and air to air threat systems that are encountered on the DCS battlefield. Some real world technical details are provided for informational purposes only and where such information is included it does not imply that DCS units match with 100% accuracy.

The threat characteristics and threat assessments in this publication are presented for pilot information and development and are not for regulatory or directive purposes. Due to the nature of the content and the testing methods used to derive data used the material is not exhaustive and will not cater for all possible eventualities within DCS.

All information contained within this publication is subject to continuous review and revision should threat characteristics change. It is the responsibility of all pilots to ensure they regularly review this publication to ensure they have the most up to date threat data when planning tactical sorties.

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Approved by:	476th vFG Command Staff

Contents

1 PREFACE

1.1 Scope

This publication describes the performance and specifications of land, sea, and airborne threat systems in DCS World. While real world background data is used where applicable, all system performance statistics are taken direct from DCS and are gathered by in sim test and evaluation assisted by Tacview data analysis.

Some real-world background data is included for informational purposes where it does not adversely impact the validity of the document as a whole, and especially where it is possible that such information/capabilities will become applicable within DCS in the future, and where it is relevant to describing the tactics used to counter the subject threat system.

All data used to compile threat range tables/graphs is obtained "in-sim" and is based on the maximum "first shot" range against a non-manoeuvring, zero aspect target traveling at 400 KTAS with the threat system AI set to "expert'.

1.2 Definitions

"First Shot" as used in this publication is refers to the first shot taken by the threat system against the target and does not take into consideration the accuracy or effectiveness of the shot, or the target's ability to evade the shot were defensive action taken.

Where stated "Maximum Effective Range" refers to the maximum horizontal range at which the system can fire upon a non-manoeuvring target and does not consider altitude.

Where stated "Minimum Effective Range" refers to the shortest horizontal range at which the system can fire upon a non-manoeuvring target and does not consider altitude.

Where stated, "Maximum Effective Altitude" refers to the highest altitude **above ground level** at which the subject system can engage a target.

Where stated, "Minimum Effective Altitude" refers to the lowest altitude at which the subject system can engage a target at any slant range in relation to **ground level**.

1.3 Instructions for Use

This publication is intended to be used as a general threat system overview for awareness purposes only in conjunction with other data sources and is not to be used as a standalone tactical reference. Individual aircraft avionics and tactical manuals should be consulted for specific systems, tactical, and/or defensive considerations.

1.4 Public Release Notes

While this version of the 476TTP3-1.Threat Guide has been made available for the benefit of the DCS community and will be maintained and updated as further data is gathered, certain sections and data elements have been redacted to preserve information that may present a significant tactical advantage to the 476th vFG.

Major sections that have been redacted are annotated as such, however smaller details throughout the document may not be marked.

2 ANTI-AIRCRAFT ARTILLERY (AAA)

2.1 Introduction

The classic role of anti-aircraft artillery (AAA) is point defence. AAA systems provide close-in defence for high-value targets. AAA systems are deployed to defend cities, airfields, bridges, industrial centres, lines of communications, command and control centres, infantry/tank units, and SAM sites. There are two types of AAA systems: towed and mobile. Towed AAA is normally deployed in fixed sites around key targets. Mobile AAA systems are deployed to provide air defence for army units and to protect mobile SAM sites.

The effectiveness of AAA systems, towed or mobile, depends on the ability of the system to predict an aircraft's future position to fire its unguided ballistic projectile to intercept the aircraft and destroy it. To accomplish this objective, AAA systems employ two primary tactics, aimed fire and sector/barrage fire.

2.1.1 Aimed AAA Fire

Aimed AAA fire requires very accurate aircraft position information and an accurate prediction of future position. For aimed AAA fire, this information can be derived by using an optical sighting system on the gun or by employing a radar system coupled with a fire control computer. Smaller calibre AAA guns generally rely on optical target acquisition and firing. The high rate of fire, short range, and short projectile time of flight (TOF) simplifies the prediction and aiming problem for these systems. Smaller calibre AAA can also use tracer ammunition to help the gunner in correcting his optical firing solution.

Larger calibre AAA systems, with slow rates of fire, long range, and long projectile TOF, generally use a target tracking RADAR and a fire control computer to solve the problems associated with aimed fire.

The typical engagement sequence for an aimed AAA engagement employing a TTR and fire control computer begins with initial target data from an acquisition radar. The guns and TTR are pointed toward the target. The TTR initiates search and lock-on to the target. The TTR associated with large calibre AAA is usually a conical scan radar to provide accurate target positioning information. Target information is fed into the fire control computer which calculates the aim point, points the guns, and initiates firing. The fire control computer uses the target kinematic data, gun ballistics, wind, air density, and projectile dispersion pattern to compute the required aim point. All these computations are based on the assumption that the target will continue on the same heading, at the same altitude, and at the same airspeed during the projectile TOF.

The typical engagement sequence for an aimed AAA engagement, employing optical target tracking begins with initial target information from an acquisition radar to the fire director. The fire director gives gross aiming commands to the individual guns. The gunners then visually search for the target and use the on-carriage gun sights to predict the required lead angle and initiate firing.

2.1.2 Sector/Barrage fire

Sector or barrage fire tactics are employed when the aircraft cannot be accurately tracked. Acquisition information suggests an aircraft will traverse a volume of airspace or a specific sector. The fire director instructs the gunners to fire randomly into this sector in an effort to hit the aircraft with the barrage of AAA fire or have the aircraft fly into a “curtain” of AAA fire. This tactic is especially effective for point defence for a fixed target. Attacking aircraft may have to fly a predictable flight path during weapons delivery. Sector/barrage fire can be directed to cover the expected attack directions and altitudes.

2.2 ZPU-1/2/4

Originators Designation: ZPU-1/2/4

FIRE CONTROL SYSTEM: None
NATO REPORTING NAME: N/A

2.2.1 Description

Development of the ZPU-2 and ZPU-4 began in 1945, with development of the ZPU-1 starting in 1947. All three were accepted into service in 1949. Improved optical predicting gunsights were developed for the system in the 1950s.

All weapons in the ZPU series have air-cooled quick-change barrels and can fire a variety of 14.5mm ammunition. Each barrel has a maximum rate of fire of around 600 rounds per minute, though this is practically limited to about 150 rounds per minute.

The quad-barrel ZPU-4 uses a four-wheel carriage similar to that once used by the obsolete 25 mm automatic anti-aircraft gun M1940. In firing position, the weapon is lowered onto firing jacks. It can be brought in and out of action in about 15 to 20 seconds and can be fired with the wheels in the traveling position if needed.

The double-barrel ZPU-2 was built in two different versions; the early model has large mud guards and two wheels that are removed in the firing position, and the late model has wheels that fold and are raised from the ground in the firing position.

The single-barrel ZPU-1 is carried on a two-wheeled carriage and can be broken down into several 80-kilogram pieces for transport over rough ground.

All versions of the ZPU can be mounted on trucks.

NOTE

This unit is added to DCS as part of Lilkiki's Light AAA Pack v5.7.

2.2.2 Threat Analysis

The ZPU series of AAA guns represent a very low threat to all fixed wing aircraft operating at low level providing standard contracts and tactics are adhered to. At altitudes below 500 feet the system's effectiveness is reduced when engaging high speed aircraft due to the high LoS rate causing targeting difficulties. Similar targeting difficulties are encountered against targets flying at altitudes greater than 4000 feet and only small variations in flight path are enough to defeat the system entirely provided incoming fire is detected early. In addition to targeting limitations, the comparatively low calibre ammunition means that the ZPU series are unlikely to achieve a critical hit against modern fixed wing aircraft.

The system represents a low threat to rotary wing aircraft operating in close proximity to hostile forces providing proper tactics and mutual support contracts are employed. As with fixed wing aircraft, the low calibre of the ZPU series limits their effectiveness, however a ZPU successfully ambushing a rotary wing aircraft may be able to achieve multiple hits and therefore cause significant damage.

Ammunition Qty:	ZPU-1 50 ZPU-2 2400 ZPU-4 4800
Reloading Time	ZPU-1 20 Seconds ZPU-2 N/A ZPU-4 N/A
Acquisition Time:	3.5 seconds
Minimum Effective Range:	Zero
Maximum Effective Range:	0.7 nautical miles
Minimum Effective Altitude:	Zero
Maximum Effective Altitude:	4,500 feet
Countermeasures:	Optical system, not applicable
Defensive Manoeuvre:	“ZSU” Break Vertical Jink

Recognition Images (ZPU-4)

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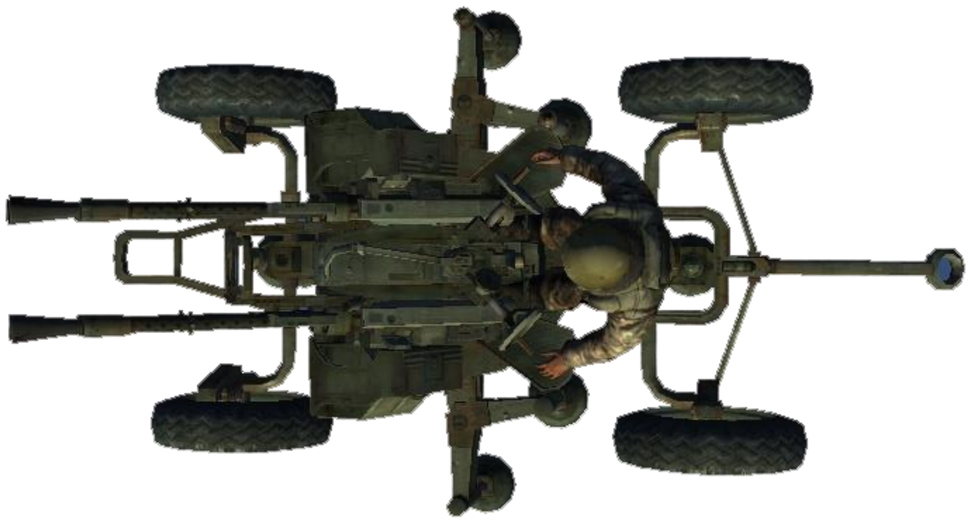
Side

Top



2.3 ZU-23-2

Originators Designation: ZU-23-2 Sergey

FIRE CONTROL SYSTEM: N/A
NATO REPORTING NAME: N/A

2.3.1 Description

The ZU-23-2 is a towed anti-aircraft artillery gun system. It is armed with two 2A14 23mm automatic cannon which fire a 23x152mm cartridge. Each gun is fed from a separate ammunition box containing 50 rounds which, combined with the 2A14's high RoF of 2000 RPM, gives the weapon a short firing time and a practical RoF of only 400 RPM.

The weapon system can be prepared to fire from the march in approximately 30 seconds and is directed manually with the help of the ZAP-23 optical-mechanical sight which using manually entered target parameters to provide a firing solution, or when used against ground targets, the T-3 telescopic optical sight.

In addition to being used as a towed AAA system, the ZU-23-2 can also be mounted on a variety of vehicles thanks to its relatively small size, including "Ural" utility trucks.

2.3.2 Threat Analysis

The ZU-23-2 is a low-level threat to any fixed wing aircraft operating at low altitude providing standard tactics and wingman contracts are employed. At altitudes below 500 feet the system's effectiveness is reduced when engaging high speed aircraft due to the high LoS rate causing targeting difficulties. Similar targeting difficulties are encountered against targets flying at altitudes greater than 5000 feet.

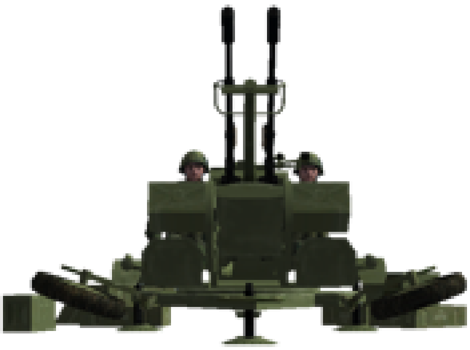
The system represents a medium-level threat to rotary wing aircraft operating in close proximity to hostile forces and can be deadly if unseen. Its small size and lack of RADAR or LASER signature allows it to engage slow moving aircraft with deadly accuracy at close range.

Although an individual ZU-23-2 does not represent a significant threat, they are normally employed in groups to provide overlapping coverage. This combined with difficultly in detecting them, can lead to both fixed and rotary wing aircraft being ambushed, and sheer volume of fire can potentially lead to an effective hit despite the low accuracy of the individual system, therefore exposure to the threat envelope should be kept to a minimum where practical.

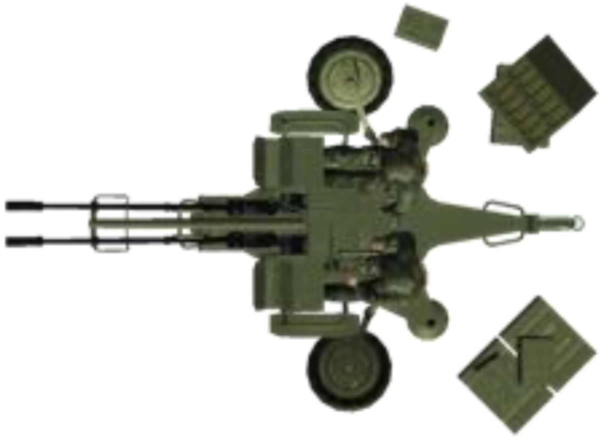
Ammunition Qty:	50 rounds per gun
Reloading Time	10 seconds
Acquisition Time:	4 Seconds
Minimum Effective Range:	Zero nautical miles
Maximum Effective Range:	1.3 nautical miles
Minimum Effective Altitude:	Zero ft.
Maximum Effective Altitude:	6,500 ft.
Countermeasures:	Optical system, not applicable
Defensive Manoeuvre:	"ZSU" Break Vertical Jink

Recognition Images

Front



Top



Side

2.4 ZSU-23-4 ZEUS

Originators Designation: ZSU-23-4 Shilka

FIRE CONTROL SYSTEM: RPK-2 "Tobol"
NATO REPORTING NAME: Gun Dish

2.4.1 Description

The ZEUS is a self-propelled, RADAR directed, anti-aircraft gun system (SPAAG). It is armed with four 23-millimetre water cooled 2A7 fully automatic cannon which fire the same 23x152mm ammunition as the ZU-23-2 Sergey. It has an ammunition capacity of 2000 rounds, 520 rounds for each upper cannon, and 480 for each lower cannon with a combined RoF of 4000 RPM. Ammunition is a mix of API and HEI in a 4-1 ratio, with the API rounds acting as tracer.

The guns are directed with the aid of the RPK-2 “Tobol” RADAR (NATO Reporting Name “Gun Dish”). The RADAR is able to detect targets at approximately 12 nautical miles in optimum conditions and effectively track targets within 5 nautical miles, however the system is plagued by ground clutter problems when attempting to engage targets at altitudes below 200 feet.

2.4.2 Threat Analysis

The Zeus represents a low to moderate threat to all fixed wing aircraft operating at low level providing standard contracts and tactics are adhered to. Much like the ZU-23-2 “Sergey”, at altitudes below 500 feet the system’s effectiveness is reduced when engaging high speed aircraft due to the high LoS rate causing targeting difficulties. Similar targeting difficulties are encountered against targets flying at altitudes greater than 5000 feet and only small variations in flight path are enough to defeat the system entirely provided incoming fire is detected early. Despite this, due to the nature of the ammunition fired by the system, and the addition of RADAR direction, its presence on the battlefield must be respected as only a few hits are enough to bring down most aircraft and failure to detect and react to the system early can be deadly.

The system represents a significant threat to rotary wing aircraft operating in close proximity to hostile forces and can be deadly if not detected early.

The Zeus is typically employed in batteries of four vehicles and is embedded with armoured forces. An armoured battalion will typically have 2 batteries of ZSU-23-4, or one battery of ZSU-23-4 and one of SA-9 Gaskin/SA-13 Gopher.

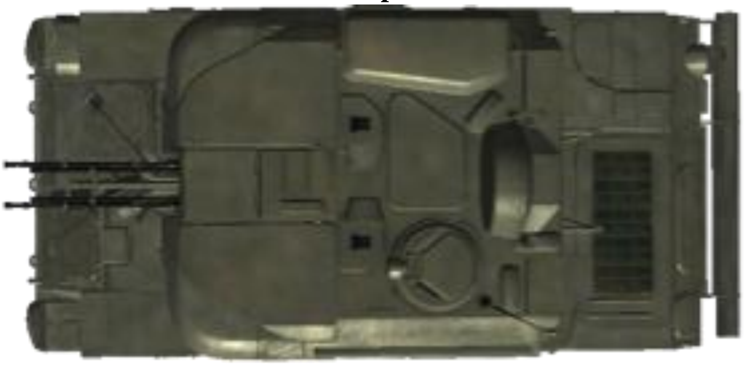
Ammunition Qty:	500 rounds per gun
Reloading Time	N/A
Acquisition Time:	8 seconds
Minimum Effective Range:	Zero
Maximum Effective Range:	1.3 nautical miles
Minimum Effective Altitude:	Zero
Maximum Effective Altitude:	6,500 ft.
Countermeasures:	None Effective in DCS
Defensive Manoeuvre:	“ZSU” Break Vertical Jink

Recognition Images

Front

Side

Top



2.5 ZSU-57-2 SPARKA

Originators Designation: ZSU-57-2 Sparka

FIRE CONTROL SYSTEM: None
NATO REPORTING NAME: N/A

2.5.1 Description

The ZSU-57-2 is armed with twin S-68 57mm autocannon built on a light-weight T-54 tank chassis. The first prototype ZSU-57-2 was built in June 1950 and officially entered service in the Soviet Army on 14 February 1955. The ZSU-57-2 has a maximum road speed of 50 kilometres per hour, which is reduced to around 30 km/h off-road. The vehicle has better acceleration compared with the T-54 because of its better power-to-weight ratio (18.6 bhp per tonne). It has an operational range of 420 km on roads and 320 km across country. The vehicle can cross 0.8 m high vertical obstacles, 2.7 m wide trenches, ford 1.4 m deep water obstacles and climb 30° gradients.

The main weakness of the ZSU-57-2 was the lack of a search or fire-control radar; the vehicle was equipped with an optical mechanical computing reflex sight as the sole fire control system, so it could engage visible targets only. Night firing was also impractical. Also, the manual gun laying and manual clip loading was not good enough, the rate of fire is not high enough, particularly considering that air-cooled barrels require quite long pauses for cooling at high rates of fire and the turret traverse is not fast enough to effectively intercept high-speed attack jet aircraft at low altitudes. The vehicle cannot perform aimed fire on the move.

Although the ZSU-57-2 had the highest firepower among production SPAAGs of its time, the anti-aircraft fire efficiency of a battery of four vehicles was even lower than that of a battery of six towed 57 mm S-60 anti-aircraft guns controlled by the PUAZO-6 anti-aircraft artillery director with the SON-9 fire control radar or later by the RPK-1 Vaza radar.

The ZSU-57-2 still retained some of the features of its predecessor, the ZSU-37. One of them was the lack of an armoured roof on the turret. The advantages of an open turret for SPAAGs, such as very high elevation angle for AA autocannons, excellent visibility of the combat situation by the gunners and no need for induced ventilation of the fighting compartment during intense fire were significantly over-shadowed by the disadvantages. The open turret of the ZSU-57-2 made it vulnerable from above and prevented operations under NBC conditions.

NOTE

This unit is added to DCS as part of Lilkiki’s Light AAA Pack v5.7.

2.5.2 Threat Analysis

The ZSU-57-2 represents a low threat to all fixed wing aircraft operating at low level providing standard contracts and tactics are adhered to. Much like the ZU-23-2 and ZSU-22-4, at altitudes below 500 feet the system’s effectiveness is reduced when engaging high speed aircraft due to the high LoS rate causing targeting difficulties. Similar targeting difficulties are encountered against targets flying at altitudes greater than 5000 feet and only small variations in flight path are enough to defeat the system entirely provided incoming fire is detected early. However due to the large calibre of the ammunition fired by the system its presence on the battlefield must be respected as only a single hit is capable of bringing down any tactical aircraft and failure to detect and react to the system early can be deadly.

The system represents a moderate threat to rotary wing aircraft operating in close proximity to hostile forces and can be deadly if not detected early. As with fixed wing aircraft the large calibre rounds can cause catastrophic damage to any helicopter with only a single hit, even if the round impacts a non-critical area due to their high explosive nature.

The ZSU-57-2 is typically employed in batteries of four vehicles and is embedded with armoured forces and/or located around expected avenues of approach to high value targets.

Ammunition Qty:	4 round clip per gun (264 rounds total)
Reloading Time	3 seconds
Acquisition Time:	5 seconds
Minimum Effective Range:	Zero
Maximum Effective Range:	2 Nautical miles
Minimum Effective Altitude:	Zero
Maximum Effective Altitude:	14,000 feet
Countermeasures:	Optical system, not applicable
Defensive Manoeuvre:	"ZSU" Break Vertical Jink

Recognition Images

Front

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Top

2.6 FLAKPANZER GEPARD

Originators Designation: N/A

FIRE CONTROL SYSTEM: S Band Search & Ku Band TTR
NATO REPORTING NAME: N/A

2.6.1 Description

The Flakpanzer Gepard is a heavily armoured, autonomous and mobile air defence system based on the chassis of the Leopard main battle tank. The Gepard Self-Propelled Anti-Aircraft Gun (SPAAG) was manufactured by Krauss-Maffei Wegmann (KMW), based in Munich, Germany, and was delivered to the armed forces of Belgium, Germany and the Netherlands.

The Gepard is equipped with twin Oerlikon GDF 35-mm guns. These guns are belt-fed and have a maximum rate of fire of 550 rounds per minute per gun. The standard ammunition load of the Gepard consists of a mix of 640 armour-piercing-incendiary rounds for firing against air targets and 40 armour-piercing rounds designed for use against ground targets.

A rotating search radar is located at the rear of the turret roof and target tracking radar is located between the guns. The search RADAR of the Gepard has a range of 15 km/8 nm. It provides all-round scanning with simultaneous target tracking and is capable of searching for targets while the vehicle is on the move. The fire control RADAR provides automatic target tracking and lead computation.

2.6.2 Threat Analysis

The Gepard represents a moderate threat to all fixed wing aircraft operating at low level providing standard contracts and tactics are adhered to. At altitudes below 500 feet the system's effectiveness is reduced when engaging high speed aircraft due to the high LoS rate causing targeting difficulties. Similar targeting difficulties are encountered against targets flying at altitudes greater than 5000 feet and only small variations in flight path are enough to defeat the system entirely provided incoming fire is detected early. Despite this, due to the large calibre of the ammunition fired by the system, and the effectiveness of its fire control system, its presence on the battlefield must be respected as failure to detect and react to the system early can be deadly as a hit by just a single round can bring down even the most survivable aircraft.

The system represents a very high threat to rotary wing aircraft operating in close proximity to hostile forces and can be deadly if not detected early.

The Gepard is typically employed in batteries embedded with armoured forces. And will advance in close proximity to them, in order to provide effective defence against air attack.

Ammunition Qty:	330 rounds per gun
Reloading Time	N/A
Acquisition Time:	4 seconds
Minimum Effective Range:	Zero
Maximum Effective Range:	2 nautical miles
Minimum Effective Altitude:	Zero
Maximum Effective Altitude:	9,500 ft.
Countermeasures:	None Effective in DCS
Defensive Manoeuvre:	"ZSU" Break Vertical Jink

Recognition Images

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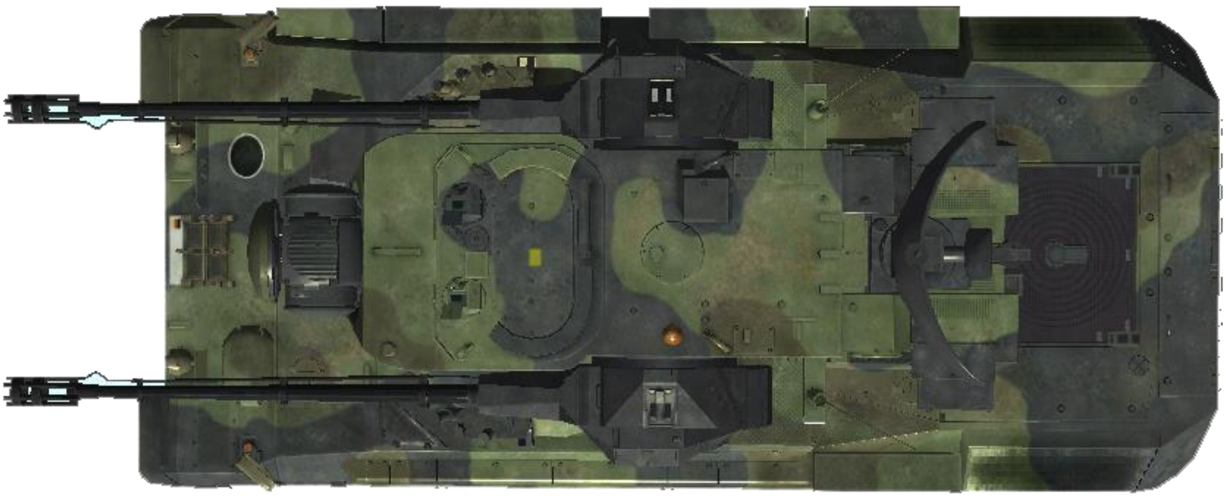
Top



2.7 M163 Vulcan Air Defence System (VADS)
Originators Designation: N/A

FIRE CONTROL SYSTEM: Optical with AN/VPS-2 Range Finder RADAR
NATO REPORTING NAME: N/A

2.7.1 Description

The M163 Vulcan Air Defence System is a self-propelled anti-aircraft gun originating from the United States of America and is equipped with a single M168 gun. The M168 gun is a variant of the General Dynamics 20 mm M61 Vulcan rotary cannon, the standard cannon in most U.S. combat aircraft since the 1960s.

The weapon is mounted on a modified M113 vehicle. The system was designed to complement the M48 Chaparral missile system. The M163 uses a small, range-only radar, the AN/VPS-2, and an M61 optical lead-calculating sight. The system is suitable for night operations with the use of AN/PVS series night vision sights that can be mounted to the right side of the primary sight.

The gun fires at 3,000 rounds per minute in short bursts of 10, 30, 60, or 100 rounds, or it can fire in continuous fire mode at a rate of 1,000 rounds per minute. A link less feed system is used.

The main drawback of the M163 was its small calibre and lightweight shells, which limited its effective range. Early ammunition exacerbated the situation, but the M163 was still comparable with the Soviet ZSU-23-4; although the Russian ZSU-23 fired a larger shell (23 mm rather than 20 mm) and had a higher rate of fire, the M163 had a higher muzzle velocity giving a flatter trajectory, shorter ToF and therefore greater accuracy.

Unlike the ZSU-23-4 the M163 has no search radar and has a limited engagement capability against aircraft at night. The gunner is exposed in an open turret, whereas in the ZSU-23-4 the gunner is in a fully enclosed armoured turret; this gives the M163 gunner much better situational awareness and field of view at the cost of losing protection against rifle-calibre weapons. This is important, especially since the M163 has no search radar.

In US and Israeli service, the VADS has rarely been needed in its intended purpose of providing defence against aerial threats and consequently the Vulcan gun system was in use throughout the late 1980s and early 1990s primarily as a ground support weapon. The last combat action the VADS participated in was Operation Desert Storm in 1991.

2.7.2 Threat Analysis
The VADS represents a low threat to all fixed wing aircraft operating at low level providing standard contracts and tactics are adhered to. Only small variations in flight path are enough to defeat the system provided incoming fire is detected early. Additionally, the small calibre of the ammunition fired by the system, and limited fire control system, further limits the effectiveness of the system. Although it can bring down most fixed wing aircraft, doing so requires absolute surprise and essentially relies on aircraft running into a wall of fire.

The lack of any RWR indications does give the system a high chance of gaining the element of surprise against individual aircraft operating without effective mutual support.

The system represents a moderate threat to rotary wing aircraft operating in close proximity to hostile forces although it relatively small calibre ammunition may struggle to cause significant damage in small volumes.

Ammunition Qty:	1180 Rounds
Reloading Time	N/A
Acquisition Time:	6 seconds
Minimum Effective Range:	Zero
Maximum Effective Range:	1 nautical mile
Minimum Effective Altitude:	Zero
Maximum Effective Altitude:	4,500 ft.
Countermeasures:	Optical System - Not Applicable
Defensive Manoeuvre:	"ZSU" Break Vertical Jink

Recognition Images

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2.8 SA-19 GRISON

Originators Designation: 2K22M Tunguska (2S6M)

FIRE CONTROL SYSTEM: 1RL144M E-band Search & J-band Monopulse TTR
NATO REPORTING NAME: Hot Shot

2.8.1 Description

The 2S6 Tunguska was designed to replace and improve on the observed shortcomings of the ZSU-23-4 (short range and no early warning) and as a counter to new ground attack aircraft in development as the time, such as the A-10, which was designed to be highly resistant to 23 mm cannons. Studies were conducted and demonstrated that a 30 mm cannon would require from a third to a half of the number of shells that the 23 mm cannon of the ZSU-23-4 would need to destroy a given target with a kill probability 1.5 times greater than that of 23 mm projectiles. There is also an increase in the maximum engagement altitude from 7000 feet to 10000 feet and increased effectiveness when engaging lightly armoured ground targets.

After a limited production run of the original 2K22, an improved version designated 2K22M/2S6M entered service in 1990. The 2K22M featured several improvements with eight ready-to-fire missiles (four on each side) as well as modifications to the fire control programs, missiles and the general reliability of the system.

An electromechanically scanned E-band target acquisition radar is mounted on the rear top of the turret that when combined with the turret front mounted J-band (150 kW power) monopulse tracking radar forms the 1RL144M (NATO: Hot Shot) radar system with detection range of 18 km and tracking range of 16 km. The mechanically scanned target acquisition radar offers a 360-degree field of view and can detect targets flying as low as 15 m, the target acquisition radar can be stowed when in transit. Its tracking radar has a range of 16 km the radar system is highly protected against various types of interference, including terrain if mountains/hills give a terrain background to a given target. The system is able to fire on the move using 30 mm cannons, although it must be stationary to fire missiles.

The gun system uses RADAR system to provide lead computation as with other SPAAG systems. The missiles use the SACLOS guidance system, and therefore fly a lag pursuit course to their target which means they are relatively easy to defeat kinetically.

2.8.2 Threat Analysis

The Grison represents a moderate/high threat to all fixed wing aircraft operating at low level, the combination of missiles and high calibre guns gives the SA-19 the ability to effectively engage targets at ranges from zero to 5.5 nautical miles. Within 2 nautical miles, guns are the preferred weapon system, outside of 2 nautical miles the missiles are used. While the guns are highly effective with their calibre allowing a small number of hits to cause significant damage to their target, the SACLOS guidance used by the missiles makes them only moderately effective against fixed wing aircraft as their maximum LOSR and ability to manoeuvre is quickly reached by a crossing/manoeuvring target.

The system represents a very high threat to rotary wing aircraft operating in close proximity to hostile forces and can be deadly if not detected early, the SA-19 missiles are highly effective against slow moving targets at up to 4 nautical miles while at closer ranges the 30mm cannons high RoF and large calibre make them extremely deadly.

The Grison is typically employed in batteries of 4-6 units embedded with armoured forces. And will advance with them in close proximity to provide effective defence against air attack. It has largely replaced the ZSU-23-4 in Russian service.

Ammunition Qty:	968 Rounds per Gun + 8 SA-19 Missiles
Reloading Time	N/A
Acquisition Time:	4 seconds
Minimum Effective Range:	Zero (Guns) / 1 nautical mile (Missiles) - Typical (varies by LOSR).
Maximum Effective Range:	2 nautical miles (Guns) / 4 nautical miles (Missiles)
Minimum Effective Altitude:	Zero (Guns) / 100 feet (Missiles)
Maximum Effective Altitude:	10000 ft. (Guns) / 16000 ft. (Missiles)
Countermeasures:	None Effective in DCS
Defensive Manoeuvre:	Missiles – Beaming Missile Defence + maximise LOSR Guns - “ZSU” Break or Vertical Jink

Recognition Images

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3 MAN PORTABLE AIR DEFENCE SYSTEMS (MANPADS)

3.1 Introduction

MANPADS are small, lightweight, shoulder launched surface to air missile systems designed to be operated by a single soldier, often with a minimum of training. While some MANPADS utilise CLOS or LASER beam riding guidance, the majority of models in service today across the world utilise infrared homing guidance, although the specific seeker type and sophistication varies greatly between models and generations.

Dedicated MANPADS teams and/or personnel trained and equipped to use them are usually embedded with any significantly sized mechanised force. Although the number of units readily available and specific reaction times will vary greatly between units, the presence of MANPADS should always be assumed when operation in the vicinity of hostile ground forces.

Some MANPADS have also been adapted for use as part of more complex air defence system. Examples include the US M6 Line-backer and M1097 Avenger, both of which utilise the Stinger system.

3.1.1 Infrared

Infrared shoulder-fired missiles are designed to home-in on a heat source on an aircraft, typically the engine exhaust plume, and detonate a warhead in or near the heat source to disable the aircraft. These missiles use passive guidance, meaning that they do not emit signals to detect a heat source, which makes them difficult to detect by targeted aircraft employing countermeasure systems.

3.1.2 Command line-of-sight

CLOS missiles, such as the British Javelin, use a solid-state television camera to present the target to the operator who then steers the missile to the target either by keeping it centred in the crosshairs or my using a controller to steer the missile. The Javelin's manufacturer, Thales Air Defence, claims that their missile is virtually impervious to countermeasures. Even more advanced CLOS versions, such as the British Starburst, use a laser data link in lieu of earlier radio guidance links to fly the missile to the target.

3.1.3 LASER Beam Riding

Laser guided shoulder-fired SAMs use lasers to guide the missiles to the target. The missile flies along the laser beam and strikes the aircraft where the missile operator or gunner aims the laser. Missiles such as the UK Starstreak can engage aircraft from all angles and only require the operator to continuously track the target using a joystick to keep the laser aim point on the target. Because there are no data links from the ground to the missile, the missile cannot be effectively jammed after it is launched. Future laser guided SAMs may require the operator to designate the target only once and not manually keep a continuous laser aimpoint on the aircraft.

3.2 FIM-92C Stinger

Originators Designation: N/A

FIRE CONTROL SYSTEM: N/A
NATO REPORTING NAME: N/A

3.2.1 Description

The FIM-92 Stinger is a personal portable infrared homing surface-to-air missile (SAM), which can be adapted to fire from ground vehicles or helicopters (as an AAM), developed in the United States and entered into service in 1981. Used by the militaries of the United States and by 29 other countries, it is manufactured by Raytheon Missile Systems, under license by EADS in Germany and by Roketsan in Turkey with 70,000 missiles produced.

Light to carry and easy to operate, the FIM-92 Stinger is a passive surface-to-air missile, that can be shoulder-fired by a single operator (although standard military procedure calls for two operators, spotter and gunner). The FIM-92B missile can also be fired from the M-1097 Avenger and the M6 Line-backer. The missile is also capable of being deployed from a Humvee Stinger rack, and can be used by airborne troops.

The missile is 5.0 ft. (1.52 m) long and 2.8 in (70 mm) in diameter with 10 cm fins. The missile itself weighs 22 lb (10.1 kg), while the missile with launcher weighs approximately 34 lb (15.2 kg). The Stinger is launched by a small ejection motor that pushes it a safe distance from the operator before engaging the main two-stage solid-fuel sustainer, which accelerates it to a maximum speed of Mach 2.54 (750 m/s). The warhead is a 3 kg penetrating hit-to-kill warhead type with an impact fuse and a self-destruct timer.

There are three main variants in use: The Stinger basic, STINGER-Passive Optical Seeker Technique (POST), and STINGER-Reprogrammable Microprocessor (RMP). These correspond to the FIM-92A, FIM-92B, and FIM-92C and later variants respectively.

3.2.2 Threat Analysis

Stinger presents a low threat to low flying fixed wing aircraft due to its high susceptibility to flare and other IRCM systems, the missiles high smoke motor permits fast visual acquisition of a launch and early defensive reaction provide standard visual lookout contracts are adhered to. The short range of the system combined with the acquisition time allows low flying aircraft to fly through the MEZ of a single system before a shot can be taken.

Rotary wing aircraft should consider the Stinger a moderate threat due to their lower speed allowing a higher chance for a shot to be taken against them however given the high effectiveness of IRCM early detection of a launch should allow successful evasion

Ammunition Qty:	3 per operator
Reloading Time	16 seconds
Acquisition Time:	6 seconds
Minimum Effective Range:	0.1 Nautical Miles
Maximum Effective Range:	2.0 Nautical Miles
Minimum Effective Altitude:	Zero
Maximum Effective Altitude:	11,000 feet
Countermeasures:	Flare/AIRCM
Defensive Manoeuvre:	High speed break turn to hold on beam Aggressive out of plane break turn Orthogonal roll

Recognition Images

Front

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3.3 SA-18 GROUSE

Originators Designation: 9K38 Igla

FIRE CONTROL SYSTEM: N/A
NATO REPORTING NAME: N/A

3.3.1 Description

The SA-18 GROUSE is a Russian/Soviet man-portable infrared homing systems. "9K38" is the Russian designation of the system.

The full-capability GROUSE was finally accepted into service in the Soviet Army in 1983. The main improvements over the SA-16 GIMLET included much improved resistance against flares and jamming, a more sensitive seeker, expanding forward-hemisphere engagement capability to include straight-approaching fighters (all-aspect capability) under favourable circumstances, a slightly longer range, a higher-impulse, shorter-burning rocket with higher peak velocity (but approximately same time of flight to maximum range).

The missile weighs 24 pounds / 10.8 KG, with 2.6 pounds / 390 gram being the directed blast fragmentation warhead. A contact / grazing fuse is used.

The GROUSE is equipped with a nitrogen cooled indium antimonite IR seeker with moderate CCM resistance.

3.3.2 Threat Analysis

The Grouse is a moderate threat for all aircraft at low altitude and has reasonably high countermeasures rejection of approximately 75%. The CM rejection rate means that early detection of and reaction to a launch is critical, a long salvo duration low release interval single flare string CM pattern is most effective (1/0.25/8).

The Grouse has a high smoke output motor with a 6 second burn time allowing a launch to be quickly detected and reacted to providing visual lookout contracts are in place. Should a hit be suffered the comparatively low yield warhead means that a single missile impact is unlikely to cause catastrophic cascading system failures, however and damage suffered may leave the aircraft more susceptible to follow on launches.

The SA-16 Gimlet, SA-18 Grouse, and SA-24 Grinch appear to be somewhat merged and confused within DCS and therefore values for each system is difficult to derive with acceptable accuracy. The SA-24 GRINCH should therefore be treated as the assumed threat for all IGLA series MANPADS within DCS.

It should also be noted that the SA-18 Grouse (IGLA) operated by Georgia is not controllable by Combined Arms users while the SA-24 (IGLA-S) operated by Russia is. Again, adding to the doubt of the implementation of the systems within the sim.

Ammunition Qty:	3 per single operator
Reloading Time	12 seconds
Acquisition Time:	6 seconds
Minimum Effective Range:	0.25 Nautical Miles
Maximum Effective Range:	2.5 Nautical Miles
Minimum Effective Altitude:	Zero
Maximum Effective Altitude:	12,000 feet
Countermeasures:	Flare/AIRCM
Defensive Manoeuvre:	High speed break turn to hold on beam Out of plane break turn Orthogonal roll

Recognition Images

Front

Side

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3.4 SA-24 GRINCH

Originators Designation: 9K338 Igla-S

FIRE CONTROL SYSTEM: N/A
NATO REPORTING NAME: N/A

3.4.1 Description

The SA-24 GRINCH is a Russian/Soviet man-portable infrared homing systems. "9K338" Igla-S is the Russian designation of the system.

The GRINCH entered service with the Russian armed forces in 2004. The main improvements over the SA-18 GIMLET are improved resistance against IRCM, a higher effective altitude ceiling, and slightly improved range.

The missile weighs 24 pounds / 10.8 KG, with 2.6 pounds / 390 gram being the directed blast fragmentation warhead. A contact / magnetic / grazing fuse is used.

3.4.2 Threat Analysis

The Grinch is a high threat for all aircraft at low altitude and has reasonably high countermeasures rejection of approximately 85%. The CM rejection rate means that early detection of and reaction to a launch is critical, a long salvo duration low release interval single flare string CM pattern is most effective (1/0.25/8).

The Grinch has a high smoke output motor with a 6 second burn time allowing a launch to be quickly detected and reacted to providing visual lookout contracts are in place. Should a hit be suffered the comparatively low yield warhead means that a single missile impact is unlikely to cause catastrophic cascading system failures, however and damage suffered may leave the aircraft more susceptible to follow on launches.

The SA-16 Gimlet, SA-18 Grouse, and SA-24 Grinch appear to be somewhat merged and confused within DCS and therefore values for each system are difficult to derive with acceptable accuracy. The SA-24 GRINCH should therefore be treated as the assumed threat for all IGLA series MANPADS within DCS.

It should also be noted that the SA-18 Grouse (IGLA) operated by Georgia is not controllable by Combined Arms users while the SA-24 (IGLA-S) operated by Russia is. Again, adding to the doubt of the implementation of the systems within the sim.

Ammunition Qty:	3 per single operator
Reloading Time	16 seconds
Acquisition Time:	6 seconds
Minimum Effective Range:	0.25 Nautical Miles
Maximum Effective Range:	2.5 Nautical Miles
Minimum Effective Altitude:	Zero
Maximum Effective Altitude:	12,000 feet
Countermeasures:	Flare/AIRCM
Defensive Manoeuvre:	High speed break turn to hold on beam Out of plane break turn Orthogonal roll

Recognition Images

Front

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4 SHORT RANGE AIR DEFENCE SYSTEMS (SHORAD)

4.1 Introduction

SHORAD systems are typically single vehicle contained mobile systems designed to provide the inner ring of air defence to tactical ground forces and high value assets. Their mobility and self-contained nature allows them to quickly reach a position, fire, and relocate rapidly to increase their survivability and ability to ambush enemy aircraft.

SHORAD systems employ a variety of missile guidance methods, however the most commonly used are IR homing and COLOS (radio command).

4.1.1 IR Homing

Passive infra-red homing depends only on the target as a source of tracking energy. In IR homing systems this energy takes the form heat sources such as aircraft engine exhaust and skin friction heating, and for modern imaging infra-red seekers contrast with the temperature or visible light environment. As in the other homing methods, the missile generates its own correction signals on the basis of energy received from the target rather than from a control point. The advantage of passive homing is that the counter detection problem is reduced, and a wide range of energy forms and frequencies are available. Its disadvantages are its susceptibility to decoy or deception.

4.1.2 Command Off Line-Of-Sight (COLOS)/Radio Command

The guidance system ensures the interception of the target by the missile by locating both in space. This means that they will not rely on the angular coordinates like in CLOS systems. They will need another coordinate which is distance. To make it possible, both target and missile trackers have to be active. They are always automatic and use RADAR as their source of guidance data. Some COLOS surface to air missiles system employ INS navigation during their mid-course phase and then switch to COLOS guidance during the terminal phase of flight. This enables them to fly a more energy efficient flight path, and also helps ensure the target is not alerted to the inbound missile(s) until the last minute.

4.2 SA-8 GEKO

Originators Designation: 9A33 OSA

FIRE CONTROL SYSTEM: 1S51M3-2
NATO REPORTING NAME: **LAND ROLL**

4.2.1 Description

The SA-8 was the first mobile air defense missile system incorporating its own engagement radars within a single vehicle.

All versions of the 9K33 feature all-in-one 9A33 transporter erector launcher and radar (TELAR) vehicles which can detect, track and engage aircraft independently or with the aid of regimental surveillance radars. The six-wheeled transport vehicles BAZ-5937 are fully amphibious and air transportable. The road range is about 500 km.

The 1S51M3-2 radar system on the SA-8 TELAR received the NATO codename Land Roll. It was derived from the naval `Pop Group' radar system but is smaller since it does not require the elaborate stabilisation system. An improved system designated the SA-8B `Gecko' Mod 1, was first seen in Germany in 1980. It had improvements added to the launcher configuration, carrying six missiles in ribbed containers. The system is reported to be of the frequency-agile monopulse type. It consists of an elliptical rotating surveillance antenna mounted on top of the array, operates in H band (6 to 8 GHz) and has a 30 km acquisition range against most targets. The large pulsed J band (14.5 GHz) engagement antenna is mounted below it in the centre of the array and has a maximum tracking range of around 20 km.

Mounted on either side of the tracking radar antenna is a small J band parabolic dish antenna to track the missile. Below that is a small circular antenna which emits an I band uplink capture beam to aquire the missile shortly after launch. The final antennas in the array are two small white rectangular ones, one on either side of the array mounted alongside the I band. These are used for command uplink to the missile. This twin antenna system permits the 'Land Roll' radar to control up to two missiles simultaneously against a single target. Furthermore, the two missiles can be guided on different frequencies to further complicate ECM. There is also a tubular device fitted to and above the tracking radar; this is a 9Sh33 electro-optical tracker. It can be used to track the target when the main tracking radar is jammed by ECM.

A standard SA-8 battery comprises four TELAR vehicles and two transloader vehicles with reload missiles and a crane.

4.2.2 Threat Analysis

The GEKO represents a moderate threat to fixed wing aircraft operating at low altitude, the short-range nature of the system combined with its relatively long acquisition time allow aircraft employing terrain masking techniques to approach and engage any targets within the GEKO's MEZ while avoiding the threat providing standard TTPs are adhered to.

For aircraft at medium altitude the GEKO represents a moderate threat. The MEZ can be easily avoided and provided any RWR indication is swiftly reacted to, however if fired upon terrain masking will not be available therefore sufficient airspeed/altitude to allow rapid manoeuvring is essential.

Chaff is highly effective against the GEKO when combined with beam aspect manoeuvring.

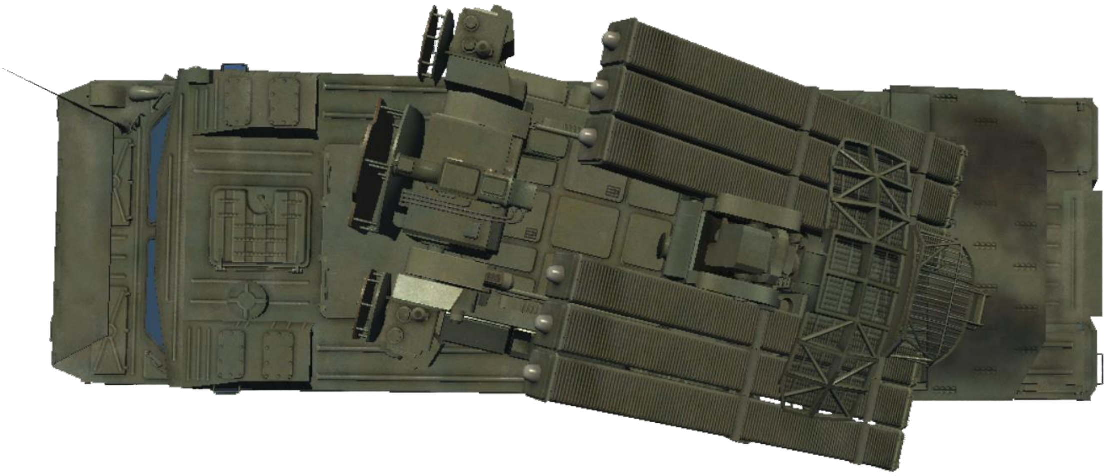
Ammunition Qty:	6 Missiles per TELAR
Reloading Time	N/A (3 seconds between each missile launch)
Acquisition Time:	26 seconds
Minimum Effective Range:	0.8 nautical miles
Maximum Effective Range:	7.5 nautical miles
Minimum Effective Altitude:	50 feet
Maximum Effective Altitude:	21,000 feet
Countermeasures:	Chaff
Defensive Manoeuvre:	High speed break turn to hold on beam Orthogonal roll

Recognition Images

Front

Side

Top



4.3 SA-9 GASKIN
Originators Designation: Strela-1 9P31

FIRE CONTROL SYSTEM: N/A
NATO REPORTING NAME: N/A

4.3.1 Description

The SA-9 GASKIN is a vehicle mounted version of the SA-7 GRAIL MANPADS. Each TELAR carries 4 ready to fire missiles.

The missile warhead was primarily intended to impact the target directly, and had contact and magnetic fuses, but also contained a back-up optical proximity fuse to detonate the warhead in case of a near miss. The missile also had an unusual safety mechanism in case of a miss; rather than a self-destruct fuse, if the optical fuse didn't detect a target within 13–16 seconds, the warhead safety mechanism would be engaged to prevent its detonation upon impact.

Propulsion is by a single-stage Solid-fuel rocket motor, which is ignited at a distance of few meters from the launch tube: as the throw-out charge ejects the missile from its canister, it is trailing a wire from its rear. The main rocket ignites when missile reaches the wire's end at a few metres distance and is cut off from it.

The seeker head is an unusual construction, using uncooled lead sulphide (PbS) detector elements, but with an unusual tracking mechanism. Uncooled PbS elements are commonly used to detect radiation at only short wavelengths of less than 2 micrometres. Only very hot objects emit strongly at such short wavelengths, limiting heat-seeking systems using uncooled PbS detector elements to rear-hemisphere engagements against jet targets, although propeller-driven aircraft and helicopters can of course be engaged from any direction from which the exhaust or other very hot parts of the engine are visible.

The Gaskin is usually embedded with mechanised ground forces at company level, and often in mixed batteries of Gaskin and Zeus AAA. Up to 4 Gaskin TELs form each firing battery.

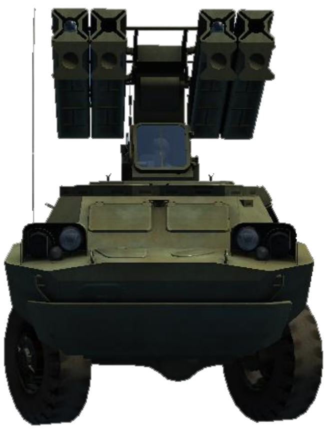
4.3.2 Threat Analysis
The GASKIN can be categorised as a low threat to fixed wing aircraft operating at low altitudes due to its short range and high (les than 20% rejection) susceptibility to IRCM. The missile's comparatively low maximum speed and very short range further limit its ability to effectively engage fixed wing aircraft. Its high smoke motor and 10 second burn time provide clear visual indication of a launch allowing timely defensive action providing standard TTPs are employed to ensure detection.

The GASKIN represents no notable threat to aircraft at medium altitude.

Ammunition Qty:	4 Missiles per TEL
Reloading Time	N/A
Acquisition Time:	2.5 seconds
Minimum Effective Range:	0.4 nautical miles
Maximum Effective Range:	2.5 nautical miles
Minimum Effective Altitude:	100 feet
Maximum Effective Altitude:	12,000 feet
Countermeasures:	Flare/AIRCM
Defensive Manoeuvre:	Break turn to place missile on beam Orthogonal roll

Recognition Images

Front



Side

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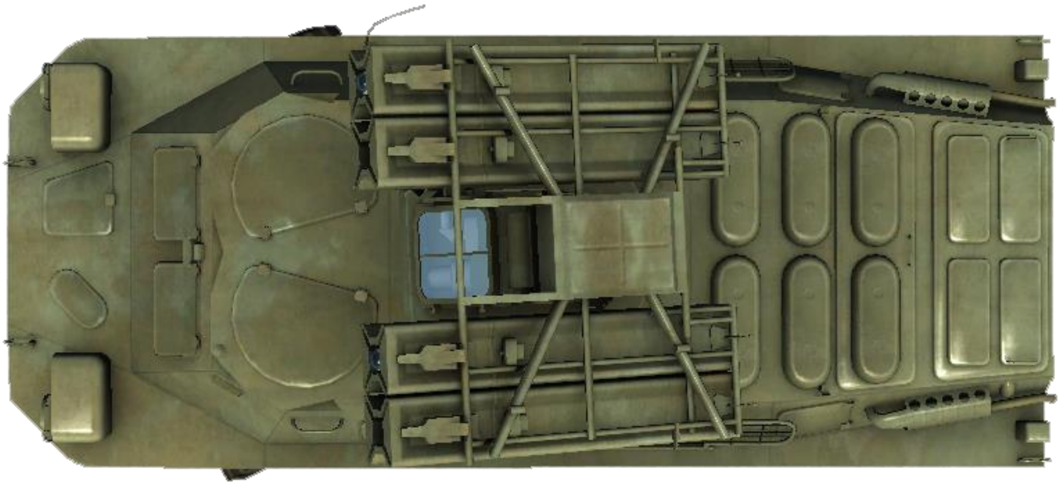


4.4 SA-13 GOPHER

Originators Designation: 9K35 Strela-10

FIRE CONTROL SYSTEM: N/A in DCS
NATO REPORTING NAME: N/A in DCS

4.4.1 Description

The SA-13 GOPHER is the successor of the SA-9 GASKIN.

Development of the SA-13 system was initiated July 24, 1969. The decision to begin the development of a new non-all-weather system was taken despite the simultaneous development of an all-weather hybrid gun/missile system SA-19 GRISON mainly as an economical measure. It was also seen as advantageous to have a system capable of fast reaction times and immunity to heavy radio-frequency jamming.

Rather than being mounted on an amphibious but lightly armoured BRDM chassis like the 9K31, the 9K35 is mounted on a more mobile tracked, modified MT-LB, with more room for equipment and missile reloads. Provision for amphibious capability is provided in some variants in the form of polyurethane-filled floats.

The SA-13 system was originally designed to use the 9M37 missile as its primary weapon, but its launch system was designed to be also backwards compatible with the 9M31M missile of the earlier SA-9 GASKIN system.

Each missile is 2.2 m (7.2 ft) long, weighs 40 kg (88 pounds) and carries a 3.5 kg (7-15 pound) warhead. The maximum speed of the missile is near Mach 2, engagement range is from 500...800 to 5000 m (0.3–3 miles) and engagement altitude is between 10 and 3500 m (33-11,500 ft). (The ranges define the zone of target intercept, minimum and maximum launch distances are longer for approaching and shorter for receding targets, depending on the target's speed, altitude and flight direction.)

The Gopher is usually embedded with mechanised ground forces at company level and also at the regimental level to defend significant locations. In the regimental role it is often supported by the Dog Ear early warning and acquisition RADAR system . Up to 4 Gopher TELs form each firing battery

4.4.2 Threat Analysis

The GOPHER represents a moderate threat to fixed wing aircraft operating at low altitudes due to its short range and medium susceptibility to IRCM. The missile’s comparatively low maximum speed and very short range further limit its ability to effectively engage fixed wing aircraft. Its high smoke motor provides clear visual indication of a launch allowing timely defensive action providing standard TTPs are employed to ensure detection.

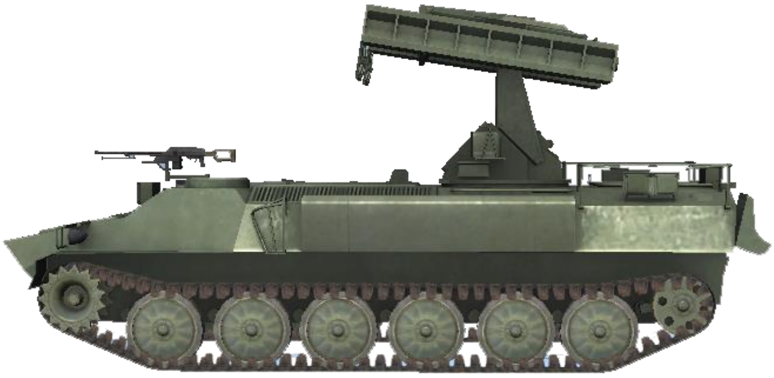
The GOPHER represents a low threat to aircraft at medium altitude, while its ceiling allows it to engage aircraft in the low portion of the medium altitude block, its low IRCM rejection leaves it capable of little more than harassing fire at such altitudes. Although caution should still be employed to ensure the Gopher does not cause aircraft to trespass higher threat systems while evading and shots that are taken.

Ammunition Qty:	4 Missiles per TEL
Reloading Time	N/A (2.5 seconds between missile firings)
Acquisition Time:	2.5 seconds
Minimum Effective Range:	0.4 nautical miles
Maximum Effective Range:	2.8 nautical miles
Minimum Effective Altitude:	75 feet
Maximum Effective Altitude:	15,000 feet
Countermeasures:	Flare/AIRCM
Defensive Manoeuvre:	Break turn to place missile on beam Orthogonal roll

Recognition Images

Front

Side



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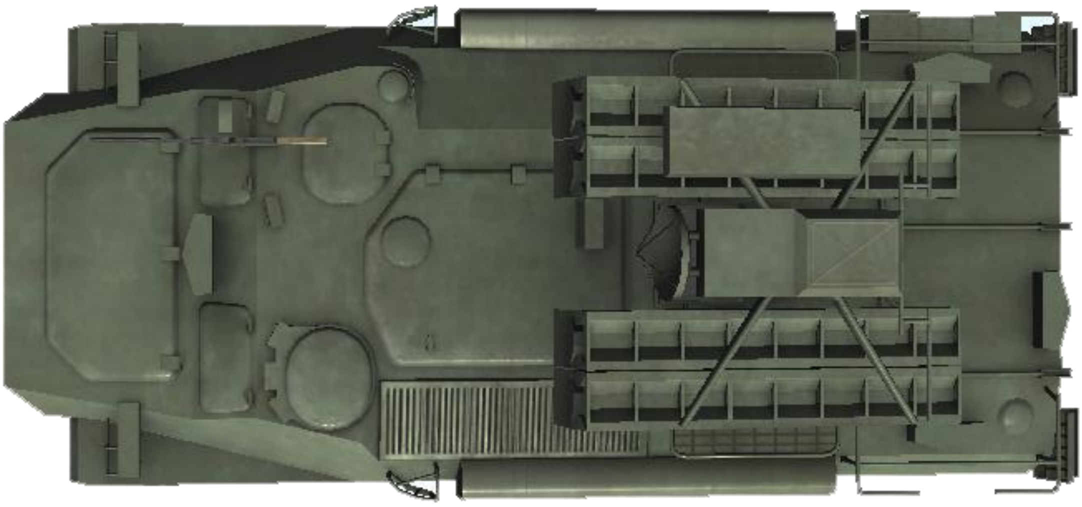


4.5 SA-15 GAUNTLET

Originators Designation: 9K331 Tor

FIRE CONTROL SYSTEM: TOR-M G/H Band
NATO REPORTING NAME: SCRUM HALF

4.5.1 Description

The SA-15 GAUNTLET missile system is an all-weather low to medium altitude, short-range surface-to-air missile system designed for engaging fixed wing aircraft, helicopters, cruise missiles, precision guided munitions, unmanned aerial vehicles and short-range ballistic threats (Anti-Munitions). A navalized variant was developed under the name 3K95 "Kinzhal", also known as the SA-N-9 GAUNTLET. The SA-15 was also the first air defence system in the world designed from the start to shoot down precision guided weapons like the AGM-86 ALCM day and night, in bad weather and jamming situation. The SA-15 can also detect targets while on the move, however the vehicle must stop when firing.

Arranged in a similar fashion to the previous SA-8 and SA-19 air defense systems, SA-15's TLAR features a turret with a top mounted target acquisition radar, and frontal tracking radar, with 8 ready to fire missiles stored vertically between the two radars. The target acquisition radar is a 3D F band pulse doppler radar, equipped with a truncated parabolic antenna, and a mechanically, later electronically, scanned in azimuth with a 32 degree sector view, and has an average power output of 1.5 kW, which provides a maximum detection range of 25 km/16 mi. The electronic 'heart' of the system is a digital fire control system, which allows detection of up to 48 targets and the tracking of ten at any one time, and integrates IFF functionality; the IFF antenna being mounted above the search radar.

A standard SA-15 battery contains 4 to 6 TELARs plus associate support vehicles.

4.5.2 Threat Analysis

The GAUNTLET represents a significant threat to all aircraft operating at low and medium altitudes. It is highly resistant to chaff (greater than 90% rejection) and the SA-15 missile is highly manoeuvrable and able to deal with most kinetic defensive manoeuvring. The SA-15 system will typically employ salvos of two missiles per target to further enhance its Pk and, due to its 8 ready to fire missile capacity, is able to quickly launch follow on salvos should the first salvo be defeated.

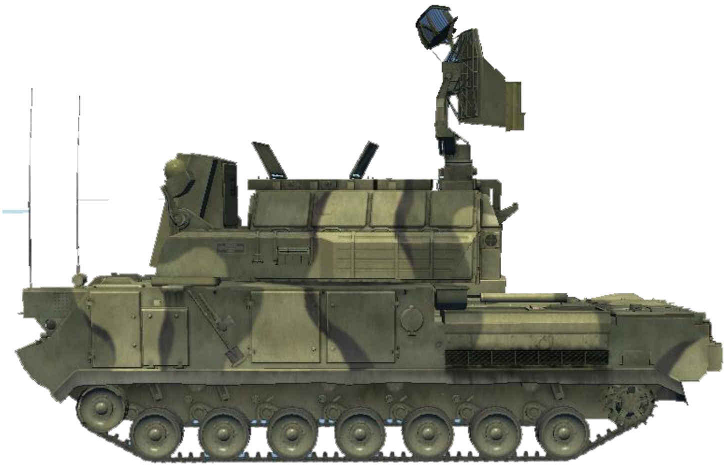
Further enhancing the GAUNLET's lethality is its ability to engage low RADAR cross section targets, including cruise missiles and air to surface missiles such as AGM-88 and AGM-65, giving it the ability to defend itself against attack. The standard battery size of 4-6 TELARs leave the GAUNTLET a significant tactical challenge for any SEAD/DEAD package tasked against it, and a major threat for any strike package having to negotiate its MEZ.

Ammunition Qty:	8 Missiles per TELAR
Reloading Time	4 seconds between missile launches
Acquisition Time:	9 Seconds
Minimum Effective Range:	0.8 nautical miles
Maximum Effective Range:	6.5 nautical miles
Minimum Effective Altitude:	60 feet
Maximum Effective Altitude:	26,000 feet
Countermeasures:	Chaff
Defensive Manoeuvre:	Terrain Mask
	Break turn to place missile on beam
	High Speed Split-S (>M0.9) into extending S-Turns

Recognition Images

Front

Side



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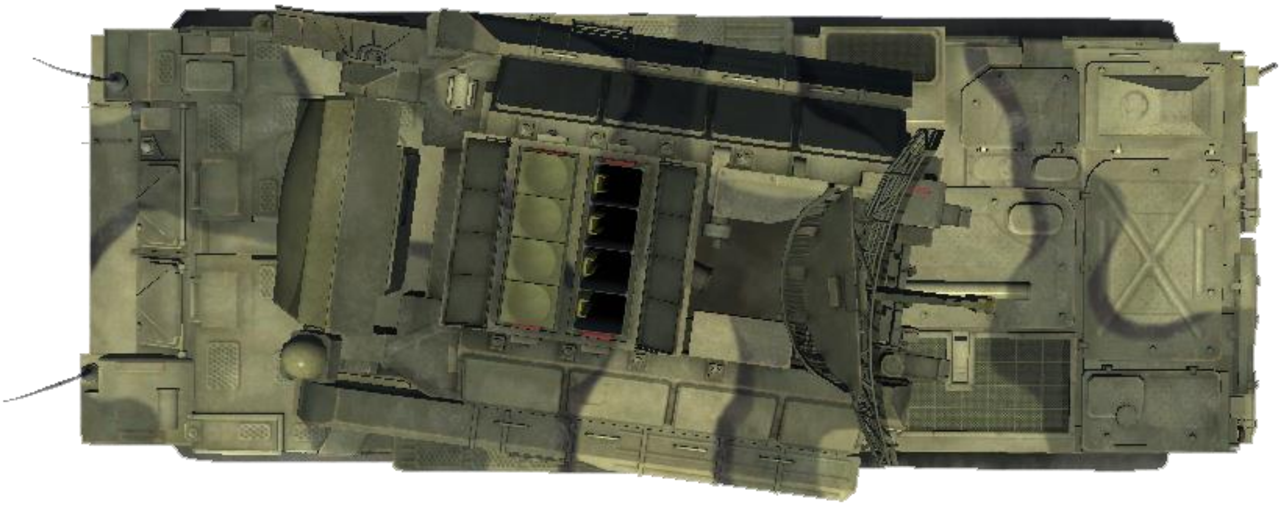

4.6 Roland ADS
Originators Designation: N/A

FIRE CONTROL SYSTEM: Thomson-CSF J-Band monopulse Doppler tracking radar
NATO REPORTING NAME: N/A

4.6.1 Description
Roland was designed to a joint French and German requirement for a low-level mobile missile system to protect mobile field formations and fixed, high-value targets such as airfields. Development began in 1963 as a study by Nord Aviation of France and Bölkow of Germany with the system then called SABA in France and P-250 in Germany. The first guided launch of a Roland prototype took place in June 1968, destroying a CT-20 target drone and fielding of production systems was expected from January 1970. The test and evaluation phase took much longer than originally anticipated with the clear-weather Roland I finally entering operational service with the French Army in April 1977, while the all-weather Roland II was first fielded by the German Army in 1978 followed by the French Army in 1981.

The Roland SAM system was designed to engage enemy air targets flying at speeds of up to Mach 1.3 at altitudes between 50 feet and 18,000 feet with a minimum effective range of 1500 feet and a maximum of 3.5 nautical miles. The system can operate in optical or radar mode and can switch between these modes during an engagement. A pulse-doppler search radar with a range of 10 nautical miles detects the target which can then be tracked either by the tracking radar or an optical tracker. The optical channel would normally be employed only in daylight against very low-level targets or in a heavy jamming environment.

The Roland missile is a two-stage solid propellant unit 2.4 meters long with a weight of 66.5 kg including the 6.5 kg multiple hollow-charge fragmentation warhead which contains 3.5 kg of explosive detonated by impact or proximity fuses. The 65 projectile charges have a lethal radius of 6 meters. Cruising speed is Mach 1.6. The missile is delivered in a sealed container which is also the launch tube. Each launcher carries two launch tubes with 8 more inside the vehicle or shelter with automatic reloading in 10 seconds.

For defense of fixed sites such as airfields the shelter Roland can be integrated in the CORAD (Co-ordinated Roland Air Defense) system which can include a surveillance radar, a Roland Co-ordination Center, 8 Roland fire units and up to 8 AAA guns.

4.6.2 Threat Analysis
The Roland is a moderate threat to aircraft at both low and medium altitude. The missile is both moderately manoeuvrable and has a countermeasures resistance of approximately 60%. The Roland system is only able to support a single missile in flight at one time which does improve the chances of evasion father provided defensive action is taken shortly after launch.

The high smoke motor of the Roland missile makes visual detection of a launch highly likely, this combined with the target tracking RADAR providing clear RWR track and launch warnings further enhances survivability of aircraft equipped with modern defensive aids when faced with the Roland.

Ammunition Qty:	10 Missiles
Reloading Time	N/A
Acquisition Time:	11 seconds
Minimum Effective Range:	0.5 nautical miles
Maximum Effective Range:	5.1 nautical miles
Minimum Effective Altitude:	<500 feet
Maximum Effective Altitude:	19,500 feet
Countermeasures:	Chaff
Defensive Manoeuvre:	Terrain Mask
	Break turn to place missile on beam

Recognition Images

Front

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4.7 M1097 AN/TWQ-1 Avenger Air Defence System

Originators Designation: N/A

FIRE CONTROL SYSTEM: N/A
NATO REPORTING NAME: N/A

4.7.1 Description

The Avenger comes mainly in three configurations, the Basic, Slew-to-Cue, and the Up-Gun.

The Basic configuration consists of a gyro-stabilized air defense turret mounted on a modified heavy Humvee. The turret has two Stinger missile launcher pods, each capable of firing up to 4 fire-and-forget infrared/ultraviolet guided missiles in rapid succession. The Avenger can be linked to the Forward Area Air Defense Command, Control, Communications and Intelligence (FAAD C3I) system, which permits external radar tracks and messages to be passed to the fire unit to alert and cue the gunner.

The Slew-to-Cue (STC) subsystem allows the commander or gunner to select a FAAD C3I reported target for engagement from a display on a Targeting Console. Once the target has been selected, the turret can be automatically slewed directly to the target with limited interaction by the gunner.

In addition to its primary missile armament the Avenger is equipped with a M2 .50 HMG also mounted on the turret. The HMG is primarily used for defending against ground threats however it can be employed against close air targets with limited effectivness.

4.7.2 Threat Analysis

Stinger presents a low threat to low flying fixed wing aircraft due to its high susceptibility to flare and other IRCM systems, the missiles high smoke motor permits fast visual acquisition of a launch and early defensive reaction provide standard visual lookout contracts are adhered to. The short range of the system combined with the acquisition time allows low flying aircraft to fly through the MEZ of a single system before a shot can be taken.

Rotary wing aircraft should consider the Stinger a moderate threat due to their lower speed allowing a higher chance for a shot to be taken against them however given the high effectiveness of IRCM early detection of a launch should allow successful evasion.

Ammunition Qty:	8 Missiles/180 rounds .50
Reloading Time	N/A
Acquisition Time:	2.5 seconds
Minimum Effective Range:	0.1 nautical miles
Maximum Effective Range:	2.0 nautical miles
Minimum Effective Altitude:	ZERO feet
Maximum Effective Altitude:	11,000 feet
Countermeasures:	Flare/AIRCM
Defensive Manoeuvre:	High speed break turn to hold on beam Aggressive out of plane break turn Orthogonal roll

Recognition Images

Front

Side

Top

4.8 M48 MIM-72G Chaparral

Originators Designation: N/A

FIRE CONTROL SYSTEM: N/A
NATO REPORTING NAME: N/A

4.8.1 Description

The first generation MIM-72A missile was based on the AIM-9D Sidewinder. The main difference is that to reduce drag only two of the fins on the MIM-72A have rollerons, the other two having been replaced by fixed thin fins. The MIM-72's MK 50 solid-fuel rocket motor was essentially identical to the MK 36 MOD 5 used in the AIM-9D Sidewinder. The MIM-72 missile is launched from the M48 fire unit, consisting of a M730 tracked vehicle fitted with an M54 missile launcher capable of holding four missiles ready to fire. The M48 carries an additional eight missiles stowed.

The MIM-72G upgrade in 1982 used an adapted FIM-92 Stinger infra-red seeker to improve coutnermeasures rejection and add an all apect capability.

The Chaparral system is manually fired by visually tracking the targets, slewing the missile carrier into the general direction, and waiting for the missile seekers to "lock on" to the target.

Due to the vehicle design and the location of the driving compartment the missile system cannot fire at targets requiring less than 30° of elevation above the horizon to the forward axis of the vehicle.

4.8.2 Threat Analysis

The M48 Chaparral system presents only a low-level threat to low flying aircraft due to its very low countermeasures rejection. Flare and other IRCM systems are highly effective at decoying the MIM-72G missile even at close range and without significant manoeuvring by the aircraft.

Although its presence on the battlefield cannot be ignored and it can be used to drag aircraft into other, more deadly threat systems, it does not present a significant challenge to any aircraft with modern defensive aids operating under standard TTPs.

Ammunition Qty:	4 Missiles
Reloading Time	N/A
Acquisition Time:	2.5 seconds
Minimum Effective Range:	0.1 nautical miles
Maximum Effective Range:	3.0 nautical miles
Minimum Effective Altitude:	<500 feet
Maximum Effective Altitude:	9,500 feet
Countermeasures:	Flare/AIRCM
Defensive Manoeuvre:	IRCM Dispense Aggressive out of plane break turn Orthogonal Roll

Recognition Images

Front

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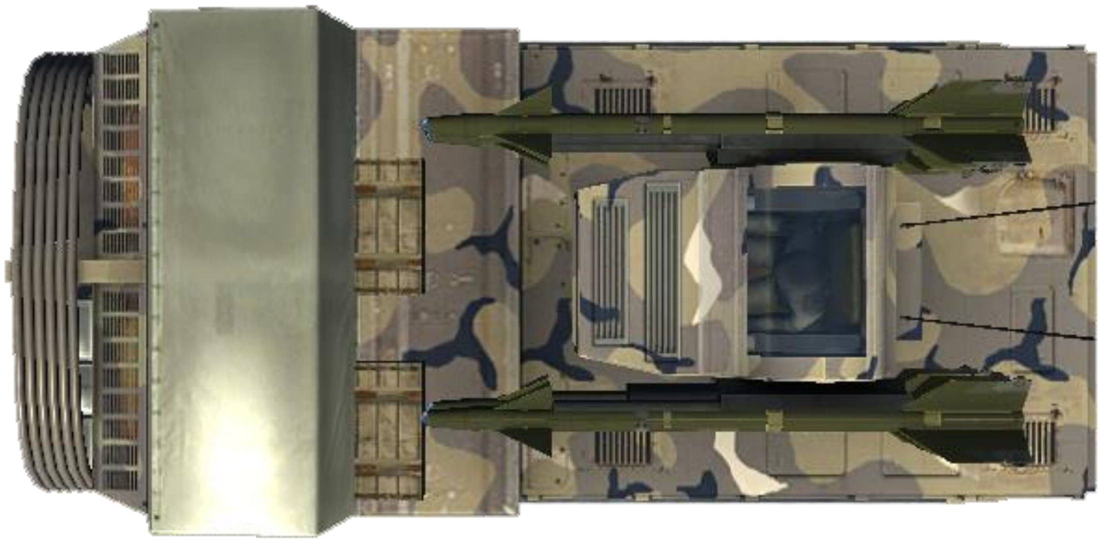

4.9 M6 Linebacker

Originators Designation: N/A

FIRE CONTROL SYSTEM: N/A
NATO REPORTING NAME: N/A

4.9.1 Description

The M6 Linebacker is an air defence variant of the M2 Bradley Infantry Fighting Vehicle, these vehicles are modified M2A2 with the TOW missile system replaced by a four-tube Stinger missile system. The performance of the M6 is identical to all other FIM-92 Stinger systems.

The notable difference is the M2 Bradley vehicle itself giving the system greater rough terrain mobility and more effective armour than the M1097 HMMWV mounted versions. In addition, the standard armament of the M2 is retained given the M6 the ability to defend itself against hostile ground vehicles and infantry.

The M6 is generally embedded in mechanised infantry units alongside M2A2 and other armoured vehicles, with their visual similarity to M2A2 making them hard to visually detect.

4.9.2 Threat Analysis

Stinger presents a low threat to low flying fixed wing aircraft due to its high susceptibility to flare and other IRCM systems, the missiles high smoke motor permits fast visual acquisition of a launch and early defensive reaction provide standard visual lookout contracts are adhered to. The short range of the system combined with the acquisition time allows low flying aircraft to fly through the MEZ of a single system before a shot can be taken.

Rotary wing aircraft should consider the Stinger a moderate threat due to their lower speed allowing a higher chance for a shot to be taken against them however given the high effectiveness of IRCM early detection of a launch should allow successful evasion.

An additional threat for rotary aircraft is the M242 25mm automatic cannon which is retained from the standard M2A2 Bradley, this high calibre weapon, while designed for use against light armour is highly effective against slow moving helicopters at close range.

Ammunition Qty:	4 Missiles
Reloading Time	N/A
Acquisition Time:	2.5 seconds
Minimum Effective Range:	0.1 Nautical Miles
Maximum Effective Range:	2.0 Nautical Miles
Minimum Effective Altitude:	Zero
Maximum Effective Altitude:	11,000 feet
Countermeasures:	Flare/AIRCM
Defensive Manoeuvre:	High speed break turn to hold on beam Aggressive out of plane break turn Orthogonal roll

Recognition Images

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5 MEDIUM RANGE AIR DEFENCE SYSTEMS (MERAD)

5.1 Introduction

MERAD systems are typically fixed or semi mobile multi-vehicle contained mobile systems designed to provide the outer layer of air defence to tactical ground forces and/or the middle layer for high value assets such as airfields. Due to their multi-vehicle nature requiring some amount of setup time they have limited mobility. Some systems while technically mobile are in effect fixed as they require significant time to de-rig and be prepared for movement, while other more modern systems mounted on vehicles and using radio datalink systems can be prepared for firing or movement in a few minutes.

MERAD systems employ a variety of missile guidance methods, however the most commonly used are COLOS (radio command) and SARH (semi-active RADAR homing).

5.1.1 Command Off Line-Of-Sight (COLOS)/Radio Command

The guidance system ensures the interception of the target by the missile by locating both in space. This means that they will not rely on the angular coordinates like in CLOS systems. They will need another coordinate which is distance. To make it possible, both target and missile trackers have to be active. They are always automatic and use RADAR as their source of guidance data. Some COLOS surface to air missiles system employ INS navigation during their mid-course phase and then switch to COLOS guidance during the terminal phase of flight. This enables them to fly a more energy efficient flight path, and also helps ensure the target is not alerted to the inbound missile(s) until the last minute.

5.1.2 Semi-Active RADAR Homing (SARH)

In semi-active homing, the target is illuminated by a tracking radar at the launching site or other control point. The missile is equipped with a radar receiver (no transmitter) and by means of the reflected radar energy from the target, formulates its own correction signals as in the active method. However, semi-active homing uses bistatic reflection from the target, meaning that because the illuminator platform and weapon receiver are not co-located, the returning echo follows a different path than the energy incident to the target. Due to its shape and composition, the target may not reflect energy efficiently in the direction of the weapon. In extreme cases the weapon may lose the target entirely, resulting in a missed intercept. This disadvantage is compensated for by the ability to use greater power and more diverse frequency ranges in an illumination device in a ship, aircraft, or ground station.

5.2 SA-3 GOA
Originators Designation: S-125 Pechora

FIRE CONTROL SYSTEM: SNR-125
NATO REPORTING NAME: **LOW BLOW**

5.2.1 Description

The S-125 Neva/Pechora NATO reporting name SA-3 Goa system was designed to complement the SA-1 and SA-2. It has a shorter effective range and lower engagement altitude than either of its predecessors and also flies slower, but due to its two-stage design it is more effective against more maneuverable targets. It is also able to engage lower flying targets than the previous systems, and being more modern it is much more resistant to ECM than the SA-2. The 5V24 (V-600) missiles reach around Mach 3 to 3.5 in flight, both stages powered by solid fuel rocket motors. The SA-3, like the SA-2, uses radio command guidance. The naval version of this system has the NATO reporting name SA-N-1 GOA.

The S-125 is somewhat mobile, an improvement over the S-75 system. The missiles are typically deployed on fixed turrets containing two or four but can be carried ready-to-fire on ZIL trucks in pairs. Reloading the fixed launchers takes a few minutes.

The S-125 system uses 2 different missile versions. The V-600 (or 5V24) had the smallest warhead with only 60 kg of high explosive. It had a range of about 15 km.

The later version is named V-601 (or 5V27). It has a length of 6.09 m, a wing span of 2.2 m and a body diameter of 0.375 m. This missile weighs 953 kg at launch, and has a 70 kg warhead containing 33 kg of HE and 4,500 fragments. The minimum range is 3.5 km, and the maximum is 35 km (with the Pechora 2A). The intercept altitudes are between 100 m and 18 km.

5.2.2 Threat Analysis

The GOAs relatively limited altitude envelope and especially its high minimum engagement altitude make it a low to moderate thereat for aircraft in the low-level environment. Its 700 ft. AGL limitation allows aircraft to easily fly beneath its MEZ, even well within its range envelope. However extreme caution must be employed when doing so as should the MEZ be entered unexpectedly the GOAs reasonable chaff rejection will make it difficult to evade, especially at low airspeed and close range.

In the medium altitude environment, the GOA presents a moderate threat, it is highly lethal to any aircraft with low energy and any descending evasive manoeuvre is likely to force the defending aircraft in to the WEZ of SHOARD/AAA systems. It is highly recommended to plan to fly around any SA-3 MEZ at medium altitude, or where possible transit at high altitude above its ceiling which is comparatively low for the MERAD system.

The GOA countermeasures rejection is surprisingly high given its age and as such is must be respected when it is encountered. A rapidly dispensing high-volume chaff program, combined with beaming/dragging turns will be required to decoy any incoming missiles.

Ammunition Qty:	4 Missiles per launcher
Reloading Time	N/A
Acquisition Time:	TBC
Minimum Effective Range:	TBC
Maximum Effective Range:	11.2 nautical miles
Minimum Effective Altitude:	700 feet
Maximum Effective Altitude:	20,500 feet
Countermeasures:	Chaff
Defensive Manoeuvre:	Break turn to place missile on beam
	Terrain Mask
	High Speed Split-S into extending S-Turns

Recognition Images

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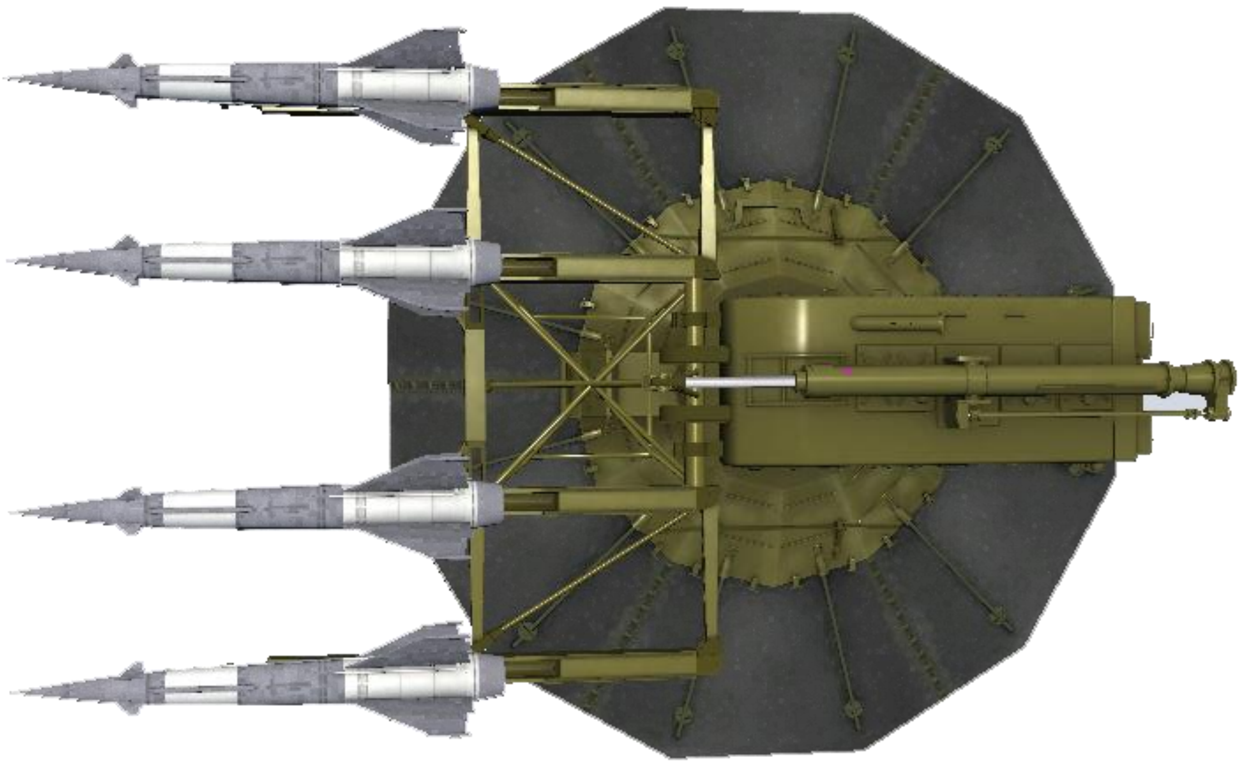

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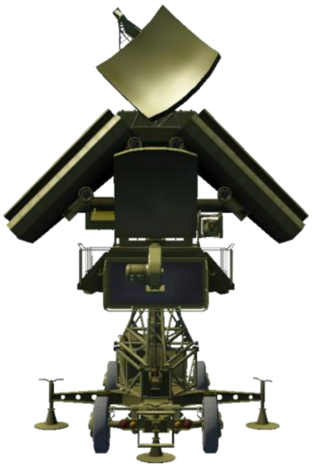

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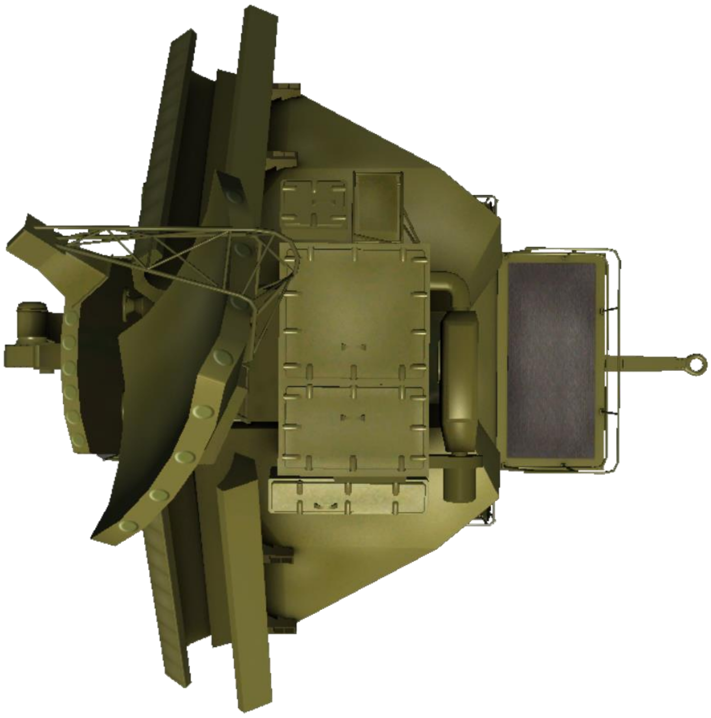

5.3 SA-6 GAINFUL

Originators Designation: 2K12 KUB

FIRE CONTROL SYSTEM: 1S91
NATO REPORTING NAME: **STRAIGHT FLUSH**

5.3.1 Description

The 2K12 "Kub" NATO reporting name: SA-6 Gainful mobile surface-to-air missile system is a Soviet era Russian low to medium-level air defence system designed to protect ground forces from air attack. "2K12" is the GRAU designation of the system.

Each SA-6 battery consists of a number of similar tracked vehicles, one of which carries the Straight Flush 25 kW G/H band radar (with a range of 75 km (47 mi)) equipped with a continuous wave illuminator, in addition to an optical sight. The battery usually also includes four triple-missile transporter erector launchers (TELs), and four trucks, each carrying three spare missiles and a crane. The TEL is based on a GM-578 chassis, while the 1S91 radar vehicle is based on a GM-568 chassis.

The fairly large missiles have an effective range of 2.5–20 miles and an effective altitude of 150–26,000 ft The missile weighs 599 kg (1,321 lb) and the warhead weighs 56 kg (123 lb). Top missile speed is approx. Mach 2.2. The combined propulsion system 9D16K comprises a solid fuel rocket motor which, when burned out, forms the combustion chamber for a ramjet putting the SA-6 missile far ahead of its contemporaries in terms of propulsion.

The SA-6 can also be used at a regimental level, if used as such it can be accompanied by a number of additional radar systems for extended air search at longer range and lower altitude, to supplement the "Straight Flush".

5.3.2 Threat Analysis

The SA-6 has comparatively good capability vs a low-level aircraft with a minimum engagement altitude of approximately 100 feet AGL, however the SA-6 has a chaff rejection rate in the region of 50% which makes it only a moderate threat to low level aircraft. A combination of terrain masking and swift reaction to any RWR indication will in most cases prevent the system engaging.

At medium level the SA-6 presents a greater threat especially for aircraft with limited energy. The typical launch range of the system combined advance warning of pending engagement provided by early TTR lock-on should be sufficient to allow successful evasion. Should a missile be fired a long salvo chaff dispensing program with a .5 – 1 sec burst delay should be sufficient to decoy any incoming missiles.

The SA-6 will engage only a single target however will fire a salvo of two missiles per engagement with up to a 5 second delay between each. The high smoke motor and large size of the missile aids in visual acquisition, especially at medium altitudes and further enhances evasion probability.

Ammunition Qty:	3 Missiles per TEL
Reloading Time	N/A
Acquisition Time:	28 seconds
Minimum Effective Range:	0.5 nautical miles
Maximum Effective Range:	19.2 nautical miles
Minimum Effective Altitude:	100 feet
Maximum Effective Altitude:	26,000 feet
Missile Max Speed:	M2.2
Countermeasures:	Chaff
Defensive Manoeuvre:	Break turn to place missile on beam
	Terrain Mask
	High Speed Split-S into extending S-Turns

Recognition Images

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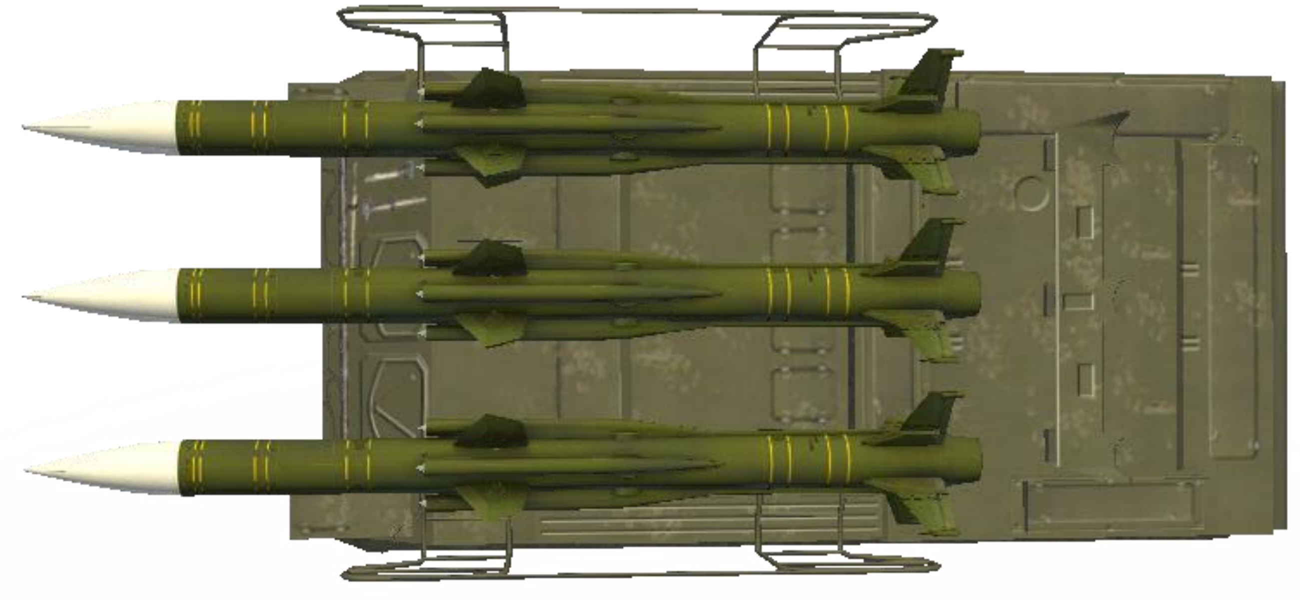

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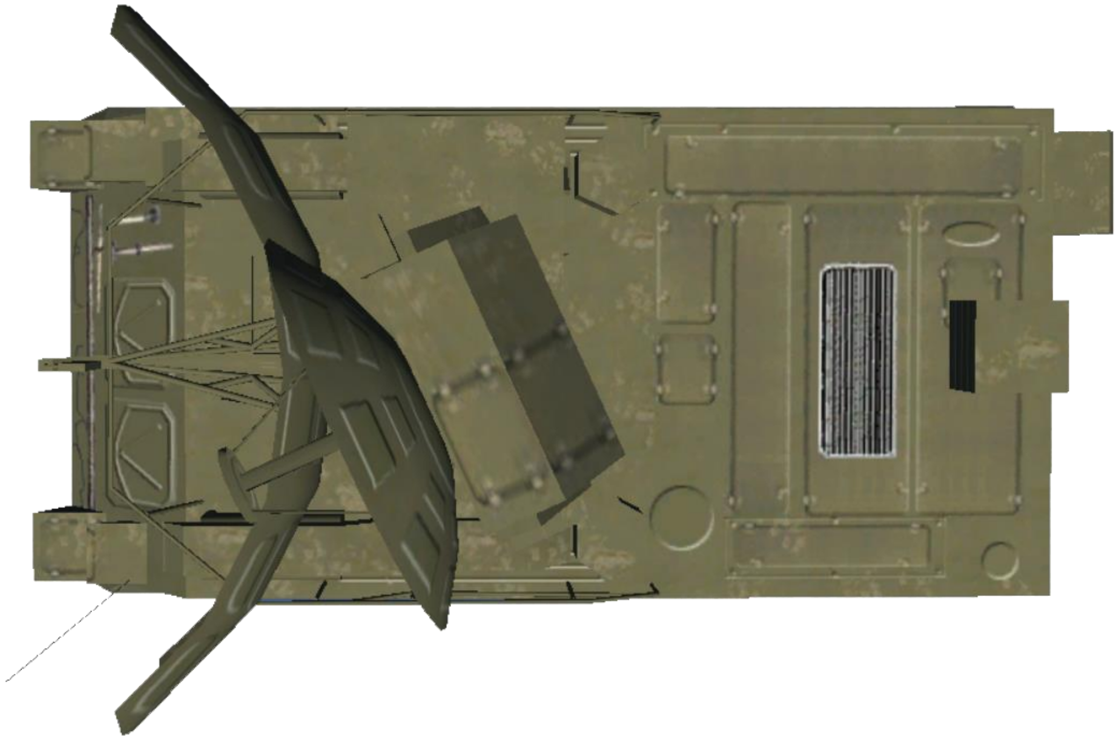

5.4 SA-11 GADFLY

Originators Designation: 9K37 BUK

FIRE CONTROL SYSTEM: BUK
NATO REPORTING NAME: **FIRE DOME**

5.4.1 Description

The SA-11 missile system is a self-propelled, medium-range surface-to-air missile system developed by the Soviet Union and its successor state, the Russian Federation, and designed to fight cruise missiles, smart bombs, fixed- and rotary-wing aircraft, and unmanned aerial vehicles.

The Buk missile system is the successor to the NIIP/Vympel SA-6 Gainful. The SA-11 is the first version of of the systrem and was adopted into service carried the GRAU designation 9K37.

Each TELAR carries 4 missiles ready to fire. A standard SA-11 battery contains 4 to 6 TELARs plus associated command and control and support vehicles.

5.4.2 Threat Analysis

The SA-11 presents a moderate to high threat to aircraft at low level, with each TELAR carrying its own TTR and being able to engage even without a supporting search RADAR low flying aircraft must ensure they mask from all units within a threat battery. The large, high speed missile, is highly manoeuvrable especially at speed and therefore any kinetic defence in the inner portion of the Gadfly's MEZ will prove difficult, especially if low on energy.

At medium and high altitudes, the Gadfly is a very high threat system, its ability to close to lethal range with a manoeuvring aircraft and high chaff rejection (greater than 90%) will leave any aircraft unable to execute a high-energy escape manoeuvre in a limited survivability situation.

The most effective method of evasion to be employed against the Gadfly is rapid terrain masking or high energy extending turn to drag the missile and cause it to lose energy. At the far limit of the Gadfly's MEZ beaming manoeuvres can be successful however are only advised if other threats and/or aircraft capability prevent a high-energy escape manoeuvre.

Ammunition Qty:	4 Missiles per TELAR
Reloading Time	N/A
Acquisition Time:	TBC
Minimum Effective Range:	TBC
Maximum Effective Range:	20.2 nautical miles
Minimum Effective Altitude:	<500 feet
Maximum Effective Altitude:	>45,000 feet
Countermeasures:	Chaff
Defensive Manoeuvre:	Terrain Mask High Speed Split-S into extending S-Turns Break turn to place missile on beam

Recognition Images

Front

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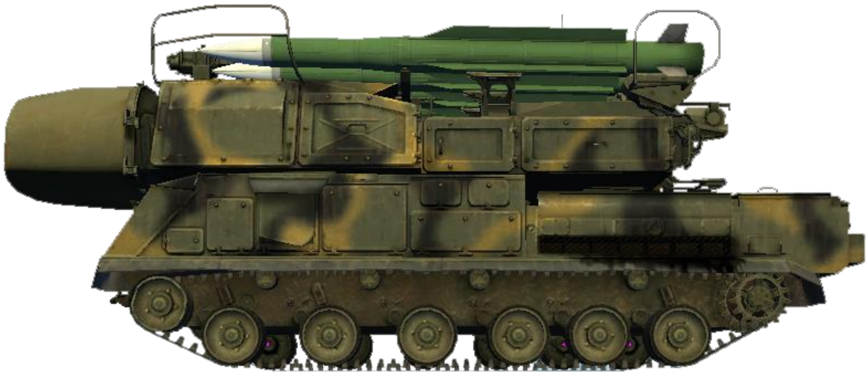

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5.5 MIM-23 HAWK

Originators Designation: N/A

FIRE CONTROL SYSTEM: AN/MPQ-46 High Power Illuminator (HPIR)
NATO REPORTING NAME: N/A

5.5.1 Description

The Raytheon MIM-23 Hawk (Homing All the Way Killer) is a U.S. medium-range surface-to-air missile. It was designed to be a much more mobile counterpart to the MIM-14 Nike Hercules, trading off range and altitude capability for a much smaller size and weight. Its low-level performance was greatly improved over Nike through the adoption of new radars and a continuous wave semi-active radar homing guidance system.

Hawk was originally intended to attack aircraft, especially those flying at medium and low altitudes. It entered service with the Army in this role in 1959. In 1971 it underwent a major improvement program as the Improved Hawk, or I-Hawk, which made several improvements to the missile and replaced all of the radar systems with new models. Improvements continued throughout the next twenty years, adding improved ECCM, a potential home-on-jam feature, and in 1995, a new warhead that made it capable against short-range tactical missiles. Jane's reported that the original system's single shot kill probability was 0.56; I-Hawk improved this to 0.85.

Hawk was superseded by the MIM-104 Patriot in US Army service by 1994. The last US user was the US Marine Corps, who used theirs until 2002.

The Hawk system consists of a large number of component elements.

- 1 Platoon Command Post (PCP)
- 1 AN/MPQ-55 Continous Wave Acquisition RADAR (CWAR) for low altitude search and aquisition
- 1 AN/MPQ-50 Pulse Acquisition RADAR (PAR) for medium/high altitude search and acquisition
- 2 AN/MPQ-46 High Power Illuminator Radar (HPIR) for target tracking and missile guidance
- 6 M192 Launchers (18 missiles)

The MIM-23 missile is propelled by a dual thrust motor, with a boost phase and a sustain phase. The MIM-23A missiles were fitted with an M22E8 motor which burns for 25 to 32 seconds. The MIM-23B and later missiles are fitted with an M112 motor with a 5-second boost phase and a sustain phase of around 21 seconds. The M112 motor has greater thrust, thus increasing the engagement envelope.

5.5.2 Threat Analysis

The HAWK presents a moderate threat to aircraft at low and medium altitudes, its chaff rejection is in the mid-range at around 60% which requires a high burst/salvo quantity dispensing program. Combined with effective manoeuvring however chaff is effective at decoying fired missiles. Evasion by manoeuvring alone is also effective against incoming HAWK missiles, especially following motor burnout as the missile will rapidly decelerate and once subsonic loses effective manoeuvring capability.

The MIM-23B will accelerate to max speed (1200 KTAS) in approx. 5 seconds from launch with motor burnout occurring after 26 seconds. An unpowered non-manoeuvring MIM-23B will lose approx. 200 KTAS every 5 seconds.

The HAWK is only able to support a single missile per TTR further increasing survivability, especially towards the outer limits of its MEZ, however it should be noted that a typical HAWK battery will have two TTRs therefore allowing it to support two missiles and/or engage two targets simultaneously.

Ammunition Qty:	3 Missiles per launcher
Reloading Time	N/A
Acquisition Time:	12 seconds
Minimum Effective Range:	TBC
Maximum Effective Range:	25.6 nautical miles
Minimum Effective Altitude:	<500 feet
Maximum Effective Altitude:	>45,000 feet
Countermeasures:	Chaff
Defensive Manoeuvre:	Break turn to place missile on beam Terrain Mask High energy out of plane break turn High Speed Split-S into extending S-Turns

Recognition Images

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6 LONG RANGE AIR DEFENCE SYSTEMS (LORAD)

6.1 Introduction

LORAD systems are multi-vehicle fixed or semi-mobile systems designed to provide the outer ring of air defence to high value assets and even entire regions. Their complex fixed nature means that even those systems that are considered to be mobile require many hours to rig/de-rig and are therefore unable to employ any form of fire and move tactics.

LORAD systems typically employ RADAR command and/or RADAR homing guidance, or Track Via Missile (TVM) guidance systems.

6.1.1 Command Off Line-Of-Sight (COLOS)/Radio Command

The guidance system ensures the interception of the target by the missile by locating both in space. This means that they will not rely on the angular coordinates like in CLOS systems. They will need another coordinate which is distance. To make it possible, both target and missile trackers have to be active. They are always automatic and use RADAR as their source of guidance data. Some COLOS surface to air missiles system employ INS navigation during their mid-course phase and then switch to COLOS guidance during the terminal phase of flight. This enables them to fly a more energy efficient flight path, and also helps ensure the target is not alerted to the inbound missile(s) until the last minute.

6.1.2 Track Via Missile

TVM guidance requires a radar ground station and a missile with a radar receiver. As with semi-active homing missiles, the ground-based radar illuminates the target with radar energy which is then reflected off the target and detected by the missile. However, unlike a SARH missile, the missile itself does not compute interception with this information. Instead, data from the radar returns is relayed back to the ground station via a data link which also serves for passing the guidance commands to the missile.

Unlike an active radar homing missile, the missile does not alert the target to the fact that it is homing in on it by illuminating it with radio waves. Typically, the target will be aware that it is being illuminated by the SAM radar, but it will not know for certain if it has been engaged. Modern phased-array radars, by virtue of their thin beams and low side lobes make detection by the aircraft even more difficult.

Unlike semi-active radar homing missiles, the electronics needed to calculate and follow an interception path do not need to be built into each missile, reducing their complexity, weight and cost. It is also possible to make the missiles more accurate by using more sophisticated algorithms for calculating interception than would be possible in the limited processor in a missile. In addition, it is possible for operators to adjust the missile's flight path throughout the engagement, even during the terminal homing phase.

Unlike radio command guided missiles, because the missile's radar receiver is much closer to the target than the ground station, more accurate tracking information can be generated for the system's computer. It is also more difficult to jam or spoof the tracking signal.

It is also possible for the ground station to receive direct radar reflections from the target (rather than the data downloaded by the missile) and combine the two sources of information to generate the interception course. This adds an extra element of ECM resistance to the system.

TVM also has some disadvantages. For example, the data link could potentially be jammed, which is not possible with an active homing or "fire and forget" missile. Additionally, this technique requires the ground-based radar to be active throughout the engagement potentially aiding aircraft equipped with anti-radiation missiles as they attempt to detect and engage the SAM radar. Another potential disadvantage compared to active radar homing is that the missile must rely on the ground-based radar for guidance, so if the target is able to put an obstacle between itself and the fixed radar system (e.g. a hill), or if it manages to get outside of the radar's tracking envelope (e.g., fly outside of the tracking "fan" of a PATRIOT radar, or fly outside the effective range of another system) then the missile will not be able to detect reflected radiation from the target and thus will be unable to continue the engagement.

6.2 SA-10D GRUMBLE D

Originators Designation: S-300PS

FIRE CONTROL SYSTEM: 30N6E H-J Band
NATO REPORTING NAME: **FLAP LID B**

6.2.1 Description

The SA-10 Grumble is the first of a series of initially Soviet and later Russian long range surface-to-air missile systems based on the initial S-300P version. The S-300 system was developed to defend against aircraft and cruise missiles for the Soviet Air Defence Forces. Subsequent variations were developed to intercept ballistic missiles.

The S-300 system was first deployed by the Soviet Union in 1979, designed for the air defence of large industrial and administrative facilities, military bases and control of airspace against enemy strike aircraft. The system is fully automated, though manual observation and operation are also possible. Components may be near the central command post, or as distant as 40 km. Each radar provides target designation for the central command post. The command post compares the data received from the targeting radars up to 80 km apart, filtering false targets, a difficult task at such great distances. The central command post features both active and passive target detection modes.

The SA-10/12/20 series is regarded as one of the most potent anti-aircraft missile systems currently fielded.

The SA-10 Grumble is the original version of the S-300 system which became operational in 1978. In 1987, over 80 of these sites were active, mainly in the area around Moscow. An SA-10 unit consists of a 36D6 (NATO reporting name TIN SHIELD) surveillance radar, a 30N6 (FLAP LID) fire control system and 5P85-1 launch vehicles. The 5P85-1 vehicle is a semi-trailer truck. Usually a 76N6 (CLAM SHELL) low altitude detection radar is also a part of the unit.

There is a degree of ambiguity regarding the variant of SA-10 featured in DCS as the various acquisition and tracking RADARs do not match any specific variant of the series.

6.2.2 Threat Analysis

The SA-10 Grumble is representing and extremely high threat to all aircraft operating within its MEZ. The system has both a long range and is able to effectively engage low flying aircraft down to very low level, only lack of line of sight due to terrain masking is effective in preventing low level engagements. The fast acquisition time of the system also means that aircraft employing pop-up tactics will find themselves being engaged shortly after unmasking.

The SA-10 also has excellent chaff rejection (>90%) meaning that once fired upon, evading incoming missiles is very challenging and may be impossible for aircraft flying at low energy states. The SA-10 system can engage 6 separate targets and support 12 missiles simultaneously

Ammunition Qty:	4 Missiles per launcher
Reloading Time	N/A
Acquisition Time:	3 seconds
Minimum Effective Range:	3 Nautical Miles
Maximum Effective Range:	40 Nautical Miles
Minimum Effective Altitude:	50 feet
Maximum Effective Altitude:	100,000 feet
Countermeasures:	Chaff
Defensive Manoeuvre:	Terrain Mask High Energy Split-S into extending S-Turns Break turn to place missile on beam (very low success chance if subsonic) High energy out of plane break turn (very low success chance)

Recognition Images

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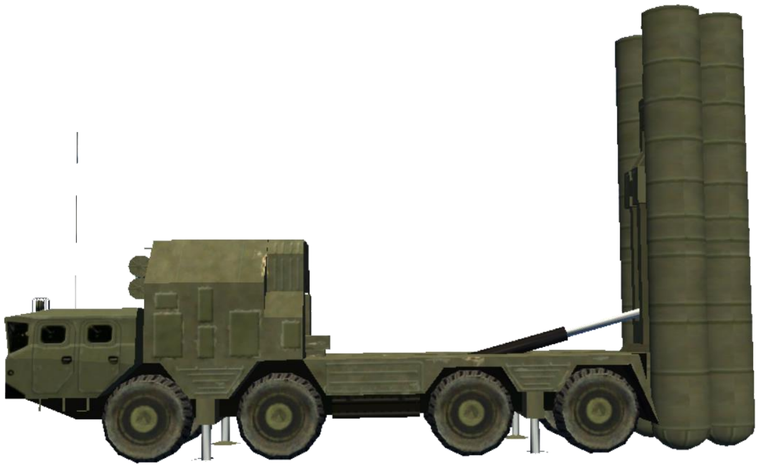

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6.3 MIM-104 PATRIOT

Originators Designation: N/A

FIRE CONTROL SYSTEM: AN/MPQ-53
NATO REPORTING NAME: N/A

6.3.1 Description

The MIM-104 Patriot is a surface-to-air missile (SAM) system, the primary of its kind used by the United States Army and several allied nations. It is manufactured by the U.S. defence contractor Raytheon and derives its name from the radar component of the weapon system. The AN/MPQ-53 at the heart of the system is known as the "Phased array Tracking Radar to Intercept on Target" or the backronym PATRIOT. The Patriot System replaced the Nike Hercules system as the U.S. Army's primary High to Medium Air Defence (HIMAD) system and replaced the MIM-23 Hawk system as the U.S. Army's medium tactical air defence system. In addition to these roles, Patriot has been given the function of the U.S. Army's anti-ballistic missile (ABM) system, which is now Patriot's primary mission. The system is expected to stay fielded until at least 2040.

Patriot uses an advanced aerial interceptor missile and high-performance radar systems. Patriot was developed at Redstone Arsenal in Huntsville, Alabama, which had previously developed the Safeguard ABM system and its component Spartan and hypersonic speed Sprint missiles.

The AN/MPQ-53 Radar Set is a passive electronically scanned array radar equipped with IFF, electronic counter-countermeasure (ECCM), and track-via-missile (TVM) guidance subsystems.

6.3.2 Threat Analysis

The Patriot represents an extremely high threat to all aircraft operating within its MEZ. The Patriot has both a long range and is able to effectively engage aircraft down to very low level, only lack of line of sight due to terrain masking is effective in preventing low level engagements. The fast acquisition time of the system also means that aircraft employing pop-up tactics will find themselves being engaged shortly after unmasking.

The Patriot’s excellent chaff rejection (greater than 90%) also enhances its lethality, once fired upon evading incoming missiles is very challenging and may be impossible for aircraft flying at low energy states.

Ammunition Qty:	4 Missiles per launcher
Reloading Time	N/A
Acquisition Time:	TBC
Minimum Effective Range:	TBC
Maximum Effective Range:	58 nautical miles
Minimum Effective Altitude:	<500 feet
Maximum Effective Altitude:	>45,000 feet
Countermeasures:	Chaff
Defensive Manoeuvre:	Terrain Mask
	High Energy Split-S into extending S-Turns
	Break turn to place missile on beam (very low success chance)

Recognition Images

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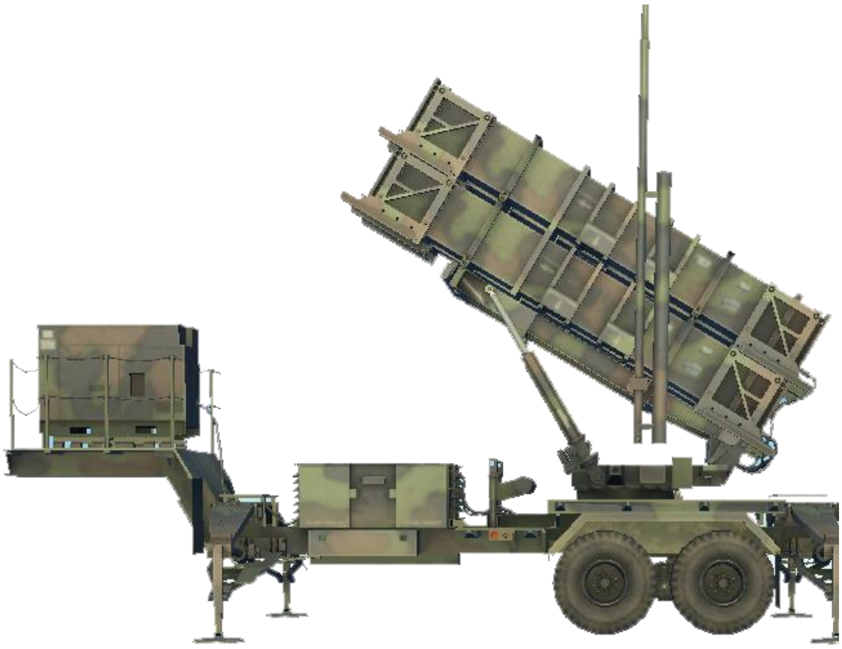

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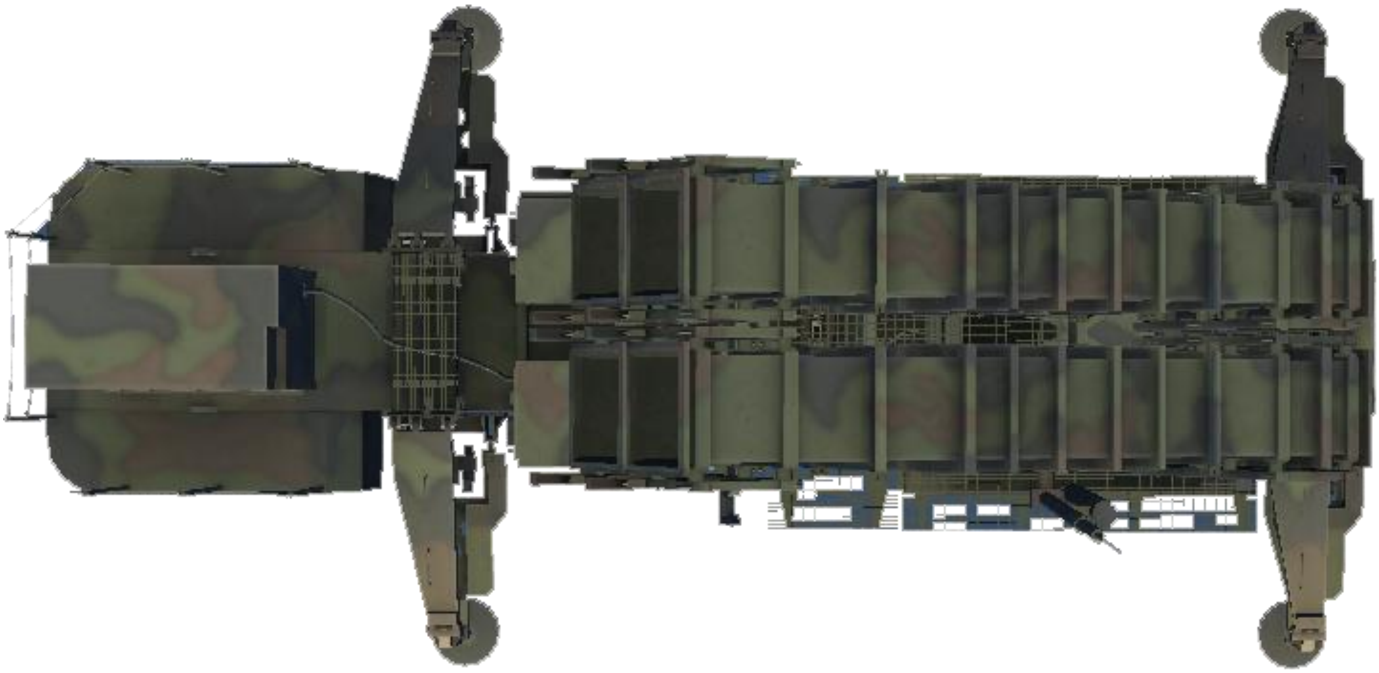


7 SURFACE TO AIR MISSILES (SAMs)

7.1 Introduction

A surface-to-air missile (SAM) is a missile designed to be launched from the ground to destroy aircraft or other missiles in flight.

This chapter provides additional data on specific missile types used by the air defence systems described in chapters 3 to 6. Information provided in this chapter should be used in conjunction with that of the firing system detailed previously.

7.1.1 Summary Table

Type	Max Range (NM)	Max Alt (Ft.)	Max Speed (KTAS)	Guidance Type
FIM-92C	2.0	11000	1100	IR Homing
SA-18	2.5	12000	1150	IR Homing
SA-24	2.5	12000	1150	IR Homing
SA-19	4.0	16000	2000	SACLOS
SA-8	7.5	21000	1060	Radio Command
SA-9	2.5	12000	660	IR Homing
SA-13	2.8	15000	1025	IR Homing
SA-15	6.5	26000	1525	Radio Command
SA-3	11.2	20500	1150	Radio Command
SA-6	19.2	26000	1165	Radio Command / Terminal SARH
SA-11	20.2	>45000	1800	SARH
SA-10	40.0	>45000	2550	TVM
MIM-72G	3.0	9500	1400	IR Homing
MIM-23B	25.6	>45000	1200	SARH
MIM-104	58.0	>45000	2650	TVM
MIM-115	5.1	19500	1060	SACLOS
RIM-66	58	>45000	3400	Radio Command / Terminal SARH

7.2 FIM-92C Stinger

Originators Designation: N/A

7.2.1 Description

The FIM-92 Stinger is a personal portable infrared homing surface-to-air missile (SAM), which can be adapted to fire from ground vehicles or helicopters (as an AAM), developed in the United States and entered into service in 1981. Used by the militaries of the United States and by 29 other countries, it is manufactured by Raytheon Missile Systems, under license by EADS in Germany and by Roketsan in Turkey with 70,000 missiles produced.

The missile is 5.0 ft. (1.52 m) long and 2.8 in (70 mm) in diameter with 10 cm fins. The missile itself weighs 22 lb (10.1 kg), while the missile with launcher weighs approximately 34 lb (15.2 kg). The Stinger is launched by a small ejection motor that pushes it a safe distance from the operator before engaging the main two-stage solid-fuel sustainer, which accelerates it to a maximum speed of Mach 2.54 (750 m/s). The warhead is a 3 kg penetrating hit-to-kill warhead type with an impact fuse and a self-destruct timer.

There are three main variants in use: The Stinger basic, STINGER-Passive Optical Seeker Technique (POST), and STINGER-Reprogrammable Microprocessor (RMP). These correspond to the FIM-92A, FIM-92B, and FIM-92C and later variants respectively.

Guidance Type:	All Aspect IR Homing
Seeker Type:	Argon Cooled Indium Antimonide Imaging Infrared
Warhead Type:	6.6 lbs High Explosive Annular Blast Fragmentation
Fuse Type:	Delayed Impact
Motor Type:	Solid Fuel Boost Rocket
Motor Burn Time:	6 seconds
Max Speed (KTAS):	1100
Max Speed (Mach):	1.7
Time to Max TAS:	4 seconds
Deceleration Rate:	100 KTAS/Sec
Max Effective Range:	2.0 Nautical Miles

Recognition Images

7.3 SA-18 GROUSE

Originators Designation: 9K38 IGLA

7.3.1 Description

The missile weighs 24 pounds / 10.8 KG, with 2.6 pounds / 390 gram being the directed blast fragmentation warhead. A contact / grazing fuse is used.

The GROUSE is equipped with a nitrogen cooled indium antimonide IR seeker with moderate CCM resistance.

Guidance Type:	All Aspect IR Homing
Seeker Type:	Nitrogen Cooled Indium Antimonide
Warhead Type:	2.6 lbs HMX directed blast fragmentation
Fuse Type:	Impact & Magnetic Grazing
Motor Type:	Solid Fuel Boost Rocket
Motor Burn Time:	6.5 seconds
Max Speed (KTAS):	1150
Max Speed (Mach):	1.8
Time to Max TAS:	4 seconds
Deceleration Rate:	100 KTAS/Sec
Max Effective Range:	2.0 Nautical Miles

Recognition Images

7.4 SA-24 GRINCH

Originators Designation: 9K338 IGLA-S

7.4.1 Description

The missile weighs 24 pounds / 10.8 KG, with 2.6 pounds / 390 gram being the directed blast fragmentation warhead. A contact / grazing fuse is used.

The GRINCH is equipped with a nitrogen cooled indium antimonide IR seeker with high CCM resistance.

Guidance Type:	All Aspect IR Homing
Seeker Type:	Nitrogen Cooled Indium Antimonide
Warhead Type:	5.5 lbs HMX directed blast fragmentation
Fuse Type:	Impact & Magnetic Grazing
Motor Type:	Solid Fuel Boost Rocket
Motor Burn Time:	6.5 seconds
Max Speed (KTAS):	1150
Max Speed (Mach):	1.8
Time to Max TAS:	4 seconds
Deceleration Rate:	100 KTAS/Sec
Max Effective Range:	2.0 Nautical Miles

Recognition Images

7.5 SA-19 GRISON

Originators Designation: 9M331

7.5.1 Description

The GRISON is controlled via SACLOS by the launch platform and therefore has no built-in target seeker.

Guidance Type:	SACLOS
Seeker Type:	None
Warhead Type:	Continuous-rod and steel cube fragmentation
Fuse Type:	LASER Proximity
Motor Type:	Solid Fuel Low Smoke Booster and Low Smoke Sustainer Motor
Motor Burn Time:	2 second booster / X second sustainer
Max Speed (KTAS):	2000
Max Speed (Mach):	3.1
Time to Max TAS:	3.5 seconds
Deceleration Rate:	150 KTAS/Sec
Max Effective Range:	4 Nautical Miles

Recognition Images

7.6 SA-8 GECKO

Originators Designation: 9M33

7.6.1 Description

The GECKO is controlled via radio command from the launch platform and therefore has no built-in target seeker.

Guidance Type:	Radio Command
Seeker Type:	None
Warhead Type:	19Kg High Explosive Fragmentation
Fuse Type:	Contact and RF Proximity
Motor Type:	Solid Fuel Booster and Sustainer Rocket Motor
Motor Burn Time:	13.5 Seconds
Max Speed (KTAS):	1060
Max Speed (Mach):	2.1
Time to Max TAS:	4.2 Seconds
Deceleration Rate:	80 KTAS/Sec
Max Effective Range:	7.5 Nautical Miles

Recognition Images

7.7 SA-9 GASKIN

Originators Designation: 9M31

7.7.1 Description

The GASKIN uses a passive IR homing seeker and is therefore a fire and forget system requiring no action by or connection with the launch platform.

Guidance Type:	All Aspect IR Homing
Seeker Type:	AM Modulated Cooled Lead Sulphide
Warhead Type:	2.6 Kg High Explosive Fragmentation
Fuse Type:	Contact and RF Proximity
Motor Type:	Single Stage Solid Rocket
Motor Burn Time:	10 Seconds
Max Speed (KTAS):	660
Max Speed (Mach):	1.3
Time to Max TAS:	4 Seconds
Deceleration Rate:	60 KTAS/Sec
Max Effective Range:	2.5 Nautical Miles

Recognition Images

7.8 SA-13 GOPHER

Originators Designation: 9M37

7.8.1 Description

Guidance Type:	All Aspect IR Homing
Seeker Type:	AM Modulated Cooled Lead Sulphide
Warhead Type:	3 Kg High Explosive Fragmentation
Fuse Type:	Contact & LASER Proximity
Motor Type:	Single Stage Solid Rocket
Motor Burn Time:	8 seconds
Max Speed (KTAS):	1015
Max Speed (Mach):	1.55
Time to Max TAS:	4.5 seconds
Deceleration Rate:	130 KTAS/Sec
Max Effective Range:	2.8 Nautical Miles

Recognition Images

7.9 SA-15 GAUNTLET
Originators Designation: 9M330

7.9.1 Description

Guidance Type:	Radio Command
Seeker Type:	None
Warhead Type:	15 Kg High Explosive Fragmentation
Fuse Type:	RF Proximity
Motor Type:	Single Stage Solid Rocket
Motor Burn Time:	9 seconds
Max Speed (KTAS):	1525
Max Speed (Mach):	2.4
Time to Max TAS:	4 Seconds
Deceleration Rate:	100 KTAS/Sec
Max Effective Range:	6.5 Nautical Miles

Recognition Images

7.10 SA-3 GOA
Originators Designation: 5V27

7.10.1 Description

Guidance Type:	Radio Command
Seeker Type:	None
Warhead Type:	60 Kg High Explosive Fragmentation
Fuse Type:	RF Proximity
Motor Type:	Single Stage Solid Rocket
Motor Burn Time:	24 seconds
Max Speed (KTAS):	1150
Max Speed (Mach):	1.85
Time to Max TAS:	5 seconds
Deceleration Rate:	60 KTAS/Sec (Med Alt)
Max Effective Range:	11.2 Nautical Miles

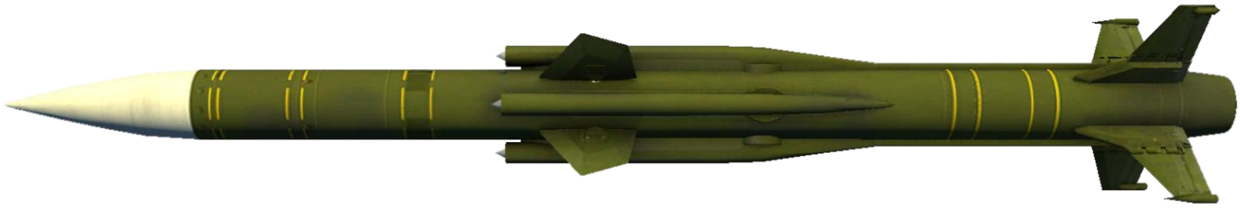
Recognition Images

7.11 SA-6 GAINFUL
Originators Designation: 3M9M

7.11.1 Description

Guidance Type:	Radio Command with Terminal SARH
Seeker Type:	Semi Active RADAR Homing
Warhead Type:	59 Kg High Explosive Fragmentation
Fuse Type:	Contact and RF Proximity
Motor Type:	Dual Stage Solid Rocket Boost and Ramjet Sustain
Motor Burn Time:	27 seconds
Max Speed (KTAS):	1165
Max Speed (Mach):	2.0
Time to Max TAS:	6 seconds
Deceleration Rate:	41 KTAS/Sec (Med Alt)
Max Effective Range:	19.2 Nautical Miles

Recognition Images



7.12 SA-11 GADFLY
Originators Designation: 9M38M1

7.12.1 Description

Guidance Type:	Radio Command/SARH
Seeker Type:	Semi-Active RADAR Homing
Warhead Type:	70 Kg High Explosive Fragmentation
Fuse Type:	RF Proximity
Motor Type:	Single Stage Solid Rocket
Motor Burn Time:	17 seconds
Max Speed (KTAS):	1800
Max Speed (Mach):	2.9
Time to Max TAS:	5.5 seconds
Deceleration Rate:	90 KTAS/Sec (Med Alt)
Max Effective Range:	20 Nautical Miles

Recognition Images

7.13 SA-10A GRUMBLE A

Originators Designation: 5V55

7.13.1 Description

Guidance Type:	Track Via Missile
Seeker Type:	Passive RADAR Receiver
Warhead Type:	100 Kg High Explosive Fragmentation
Fuse Type:	RF Proximity
Motor Type:	Single Stage Solid Rocket
Motor Burn Time:	26 seconds
Max Speed (KTAS):	2600
Max Speed (Mach):	4.6
Time to Max TAS:	26 seconds
Deceleration Rate:	100 KTAS/Sec (Med Alt)
Max Effective Range:	40 Nautical Miles

Recognition Images

7.14 SA-10E GRUMBLE E / SA-20B GARGOYLE B
Originators Designation: 48H6E2

7.14.1 Description

Guidance Type:	Track Via Missile
Seeker Type:	Passive RADAR Receiver
Warhead Type:	150 Kg High Explosive Fragmentation
Fuse Type:	N/K
Motor Type:	Single Stage Solid Rocket
Motor Burn Time:	N/K
Max Speed (KTAS):	N/K
Max Speed (Mach):	N/K
Time to Max TAS:	N/K
Deceleration Rate:	N/K
Max Effective Range:	N/K

Recognition Images

NOTE

This missile is present in DCS files, but is not currently used

7.15 MIM-72G

Originators Designation: MIM-72G

7.15.1 Description

Guidance Type:	IR Homing
Seeker Type:	Passive IR Homing
Warhead Type:	12.2 Kg Continuous Rod
Fuse Type:	Contact and LASER Proximity
Motor Type:	Single Stage Solid Rocket
Motor Burn Time:	4.5 seconds
Max Speed (KTAS):	1400
Max Speed (Mach):	1.9
Time to Max TAS:	4.5 seconds
Deceleration Rate:	117 KTAS/Sec
Max Effective Range:	3.0

Recognition Images

7.16 MIM-23B

Originators Designation: MIM-23B

7.16.1 Description

Guidance Type:	SARH
Seeker Type:	SARH
Warhead Type:	54 Kg High Explosive Fragmentation
Fuse Type:	Contact and RF Proximity
Motor Type:	Single Stage Solid Rocket
Motor Burn Time:	27 seconds
Max Speed (KTAS):	1200
Max Speed (Mach):	2.0
Time to Max TAS:	6 seconds
Deceleration Rate:	55 KTAS/Sec (Med Alt)
Max Effective Range:	25.6

Recognition Images

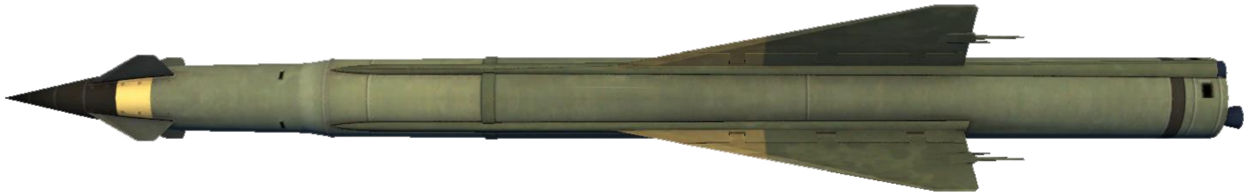
7.17 MIM-115

Originators Designation: MIM-115

7.17.1 Description

Guidance Type:	SACLOS
Seeker Type:	None
Warhead Type:	6.5 Kg High Explosive Fragmentation
Fuse Type:	Contact and RF Proximity
Motor Type:	Dual Stage Solid Rocket Boost/Sustain
Motor Burn Time:	15 seconds
Max Speed (TAS):	1060
Max Speed (Mach):	1.6
Time to Max TAS:	4 seconds
Deceleration Rate:	100 KTAS/Sec (Med Alt)
Max Effective Range:	5.1 Nautical Miles

Recognition Images



7.18 MIM-104

Originators Designation: MIM-104

7.18.1 Description

Guidance Type:	Track via Missile
Seeker Type:	Passive RADAR Receiver
Warhead Type:	90 Kg High Explosive Fragmentation
Fuse Type:	RF Proximity
Motor Type:	Single Stage Solid Rocket
Motor Burn Time:	18 seconds
Max Speed (TAS):	2650
Max Speed (Mach):	4.5
Time to Max TAS:	15 seconds
Deceleration Rate:	112 KTAS/Sec (Med Alt)
Max Effective Range:	58 Nautical Miles

Recognition Images

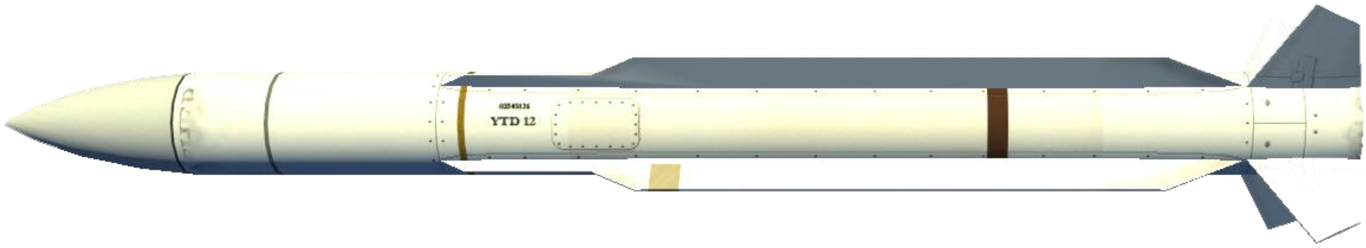
7.19 RIM-66

Originators Designation: RIM-66

7.19.1 Description

Guidance Type:	Radio Command with Terminal Monopulse SARH
Seeker Type:	SARH
Warhead Type:	High Explosive Blast Fragmentation
Fuse Type:	Contact and RF Proximity
Motor Type:	Dual Stage Boost and Sustain Solid Rocket
Motor Burn Time:	15 seconds
Max Speed (TAS):	3400
Max Speed (Mach):	5.5
Time to Max TAS:	15 seconds
Deceleration Rate:	105 KTAS/Sec (Med Alt)
Max Effective Range:	45 Nautical Miles

Recognition Images



8 EARLY WARNING AND ACQUISITION RADARs

8.1 Introduction

An early warning (search) RADAR is any RADAR system used primarily for the long-range detection of its targets, i.e., allowing defences to be alerted as early as possible before the intruder reaches its target. Thereby giving the appropriate air defence systems the maximum time in which to prepare an attack on the threat in question. EWRs are typically lower in resolution than target tracking RADAR, which means that while they can detect aircraft from long range they have a less ability to derive precise altitude/bearing (especially at longer ranges) and also separate multiple aircraft flying in close formation.

Target Acquisition RADARs are generally smaller than EWRs and are linked with SAM system command and control and target tracking RADARs in order to detect and classify potential targets prior to passing them to the system's TTR for engagement of the target.

Systems covered on the following pages are a mix of standalone long range EWRs and EWRs designed to support SAM systems detailed previously.

8.2 BOX SPRING

Originators Designation: 1L13

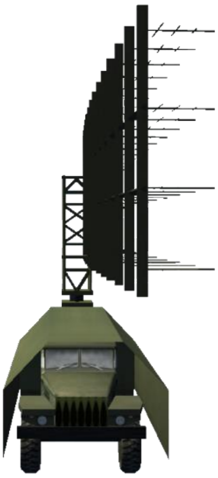
8.2.1 Description

The Box Spring is a 2-dimensional VHF early warning and surveillance RADAR which entered service in 1982.

The system is able to provide bearing and range of airborne targets out to ranges in the region of 150 nautical miles at altitudes up to 100,000 feet.

As a 2-dimensional system it is unable to provide altitude and requires a supporting height finding system in order to provide a 3-dimensional EWR capability.

Front



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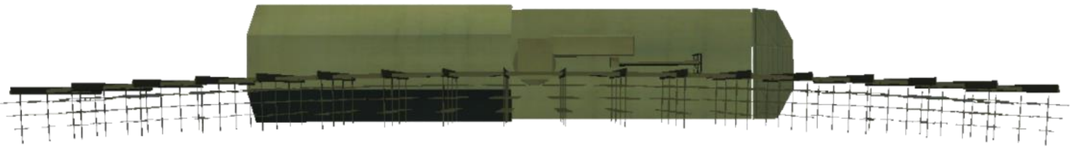


8.3 TALL RACK

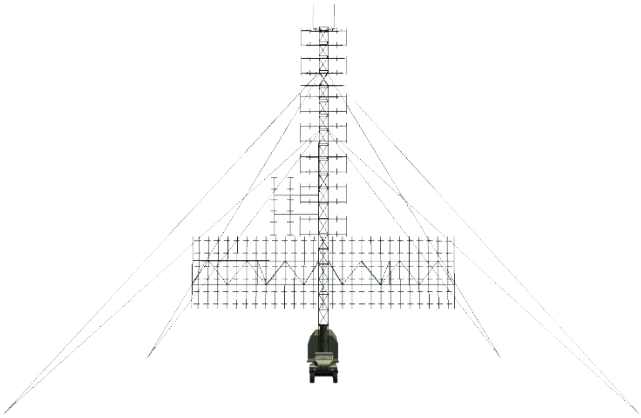
Originators Designation: 55G6

8.3.1 Description

The Tall Rack is a 3-dimensional VHF early warning and surveillance RADAR which entered service in 1982.

The system is able to provide bearing, range, and altitude of airborne targets out to ranges in the region of 200 nautical miles at altitudes up to 100,000 feet.

Front



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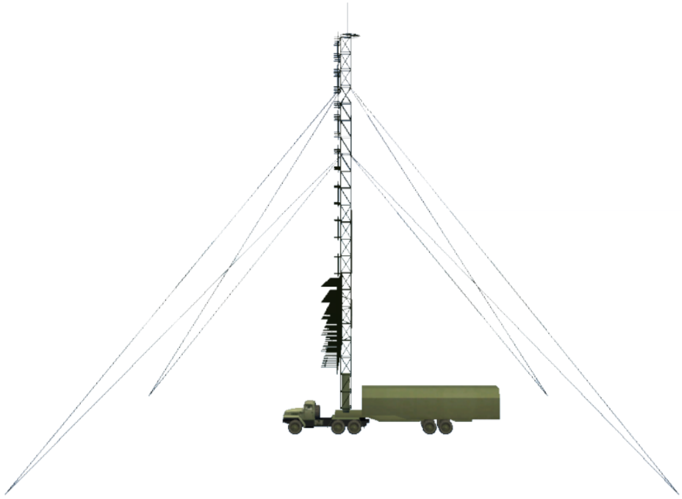

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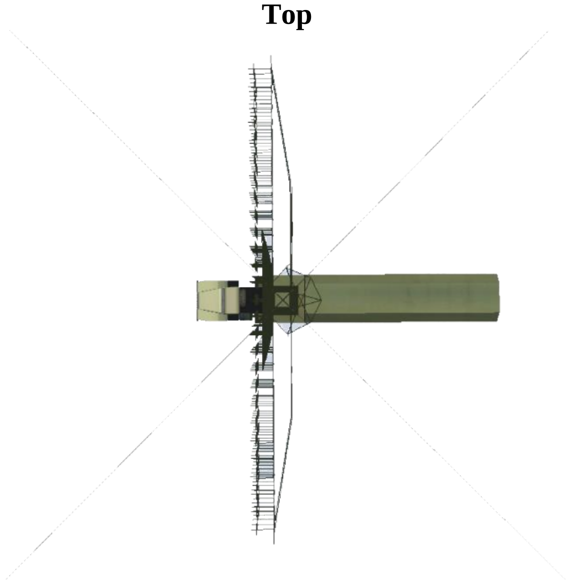


8.4 FLAT FACE B

Originators Designation: P-19

8.4.1 Description

The FLAT FACE is a 2-dimensional UHF target acquisition/surveillance RADAR which entered service in 1974. It is a high mobility RADAR and with the antenna mounted on the single truck. The FLAT FACE uses two open frame elliptical parabolic antenna accomplishing both transmission and reception, each antenna being fed by a single antenna feed in a similar fashion to the older P-15. The radar can rapidly shift its frequency to one of four pre-set frequencies to avoid active interference, with passive interference being removed by a coherent Doppler filter. Azimuth was determined by mechanical scanning with an associated accompanying PRV-11 (NATO reporting name "Side Net") used to determine elevation.

The armed forces of the Czech Republic described the P-19 as having "outstanding mechanical parameters, simple maintenance, overall reliability and multifunctionality". This evaluation was mirrored by a French evaluation of a radar captured in Chad in 1987 during the Chadian–Libyan conflict, describing the P-19 as sturdy, with good low altitude detection and high resistance to countermeasures.

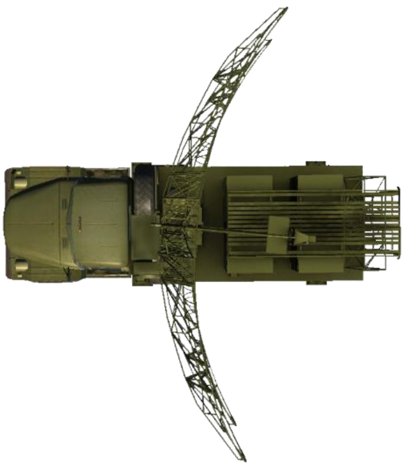
The FLAT FACE B is most often seen in DCS as part of an SA-3 battery.

The system is able to provide bearing and range of airborne targets out to ranges in the region of 85 nautical miles.

Front

Side

Top



8.5 SNOW DRIFT

Originators Designation: 9S18M1 Kupol-M1

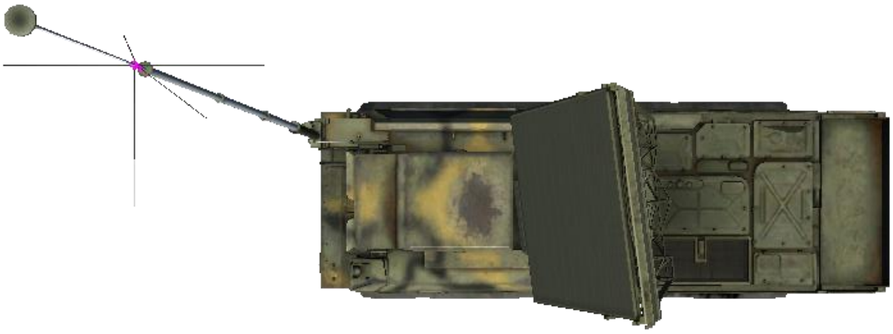
8.5.1 Description

The SNOW DRIFT provides target acquisition for the SA-11 GADFLY system. While the SA-11 TELARs are capable of engaging targets without the support of the SNOW DRIFT, their reaction time and effective range is greatly increased when one is embedded in the firing battery.

Front

Side

Top

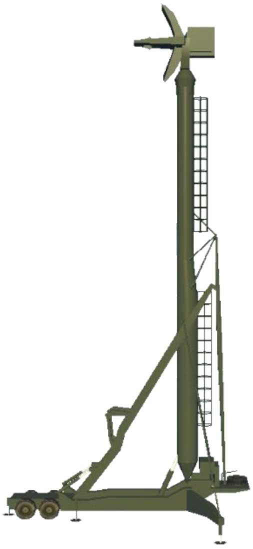


8.6 CLAM SHELL
Originators Designation: 5N66M

8.6.1 Description
The CLAM SHELL is the low altitude target acquisition and search RADAR system for the SA-10 GRUMBLE. It is usually employed alongside the BIG BIRD to provide over the horizon detection of low altitude aircraft. It has a significantly shorter range than the BIG BIRD.

Front

Side



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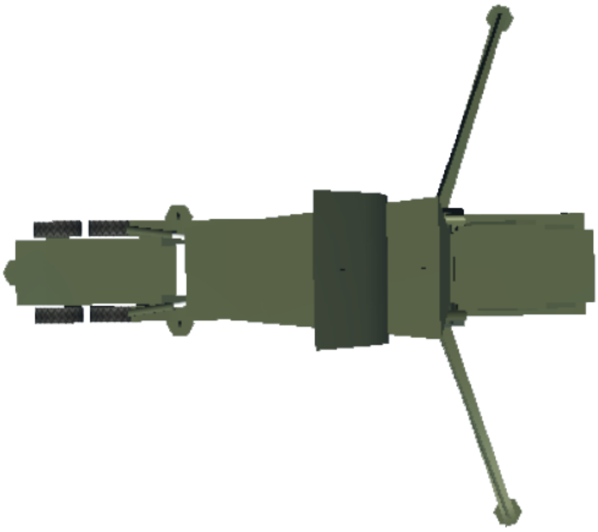


8.7 BIG BIRD

Originators Designation: 64H6E

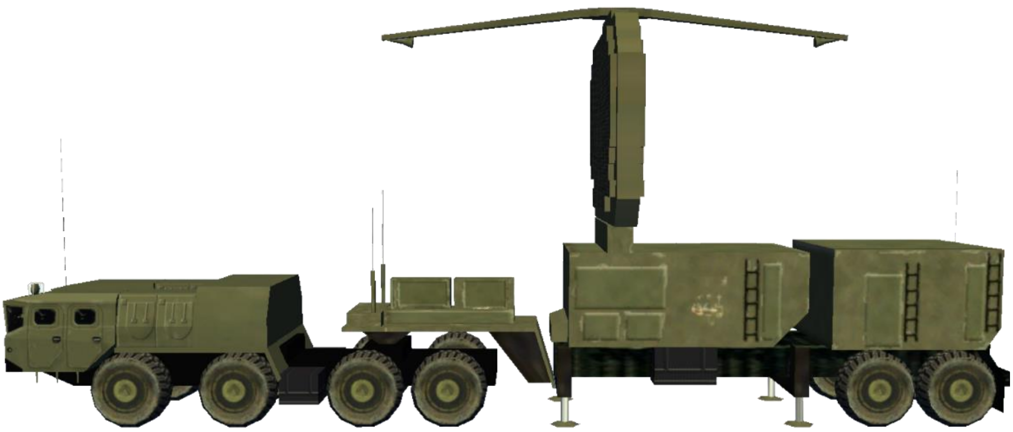
8.7.1 Description

The BIG BIRD is employed as a long-range search and acquisition RADAR for the SA-10A GRUMBLE (S-300PS) system in DCS, however in reality it is used as part of the SA-20 GARGOYLE (S-300PMU-1).

This adds to the ambiguity of the various systems within DCS and is one of many such instances where the various designations and/or associations are apparently mixed up and/or unclear.

Front

Side



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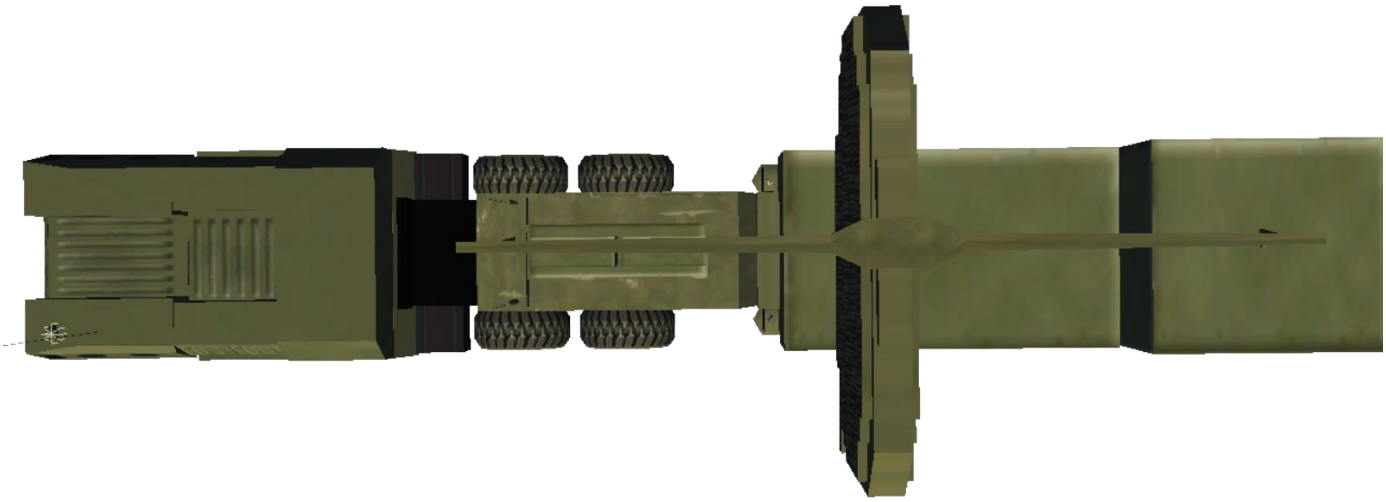


8.8 DOG EAR

Originators Designation: 9S80M1 Sborka

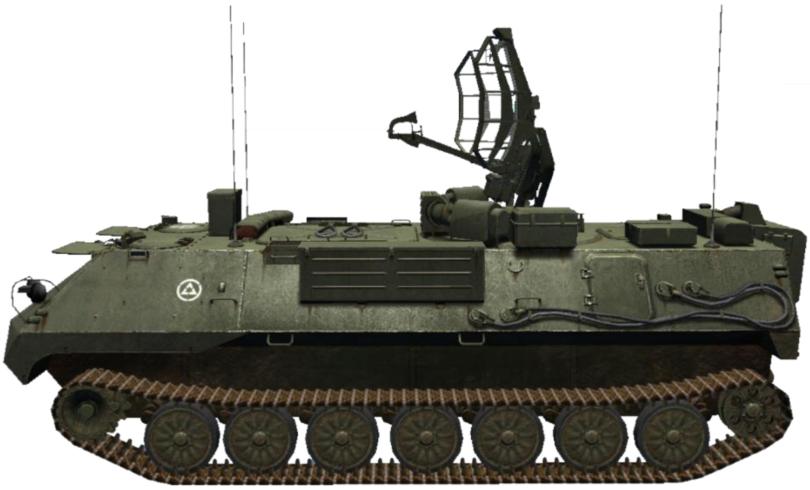
8.8.1 Description

The DOG EAR G Band surveillance RADAR usually employed to support tactical air defence units, such as SA-13 GOPHER batteries.

The system is able to provide bearing and range of airborne targets at ranges in the region of 20 nautical miles.

Front

Side



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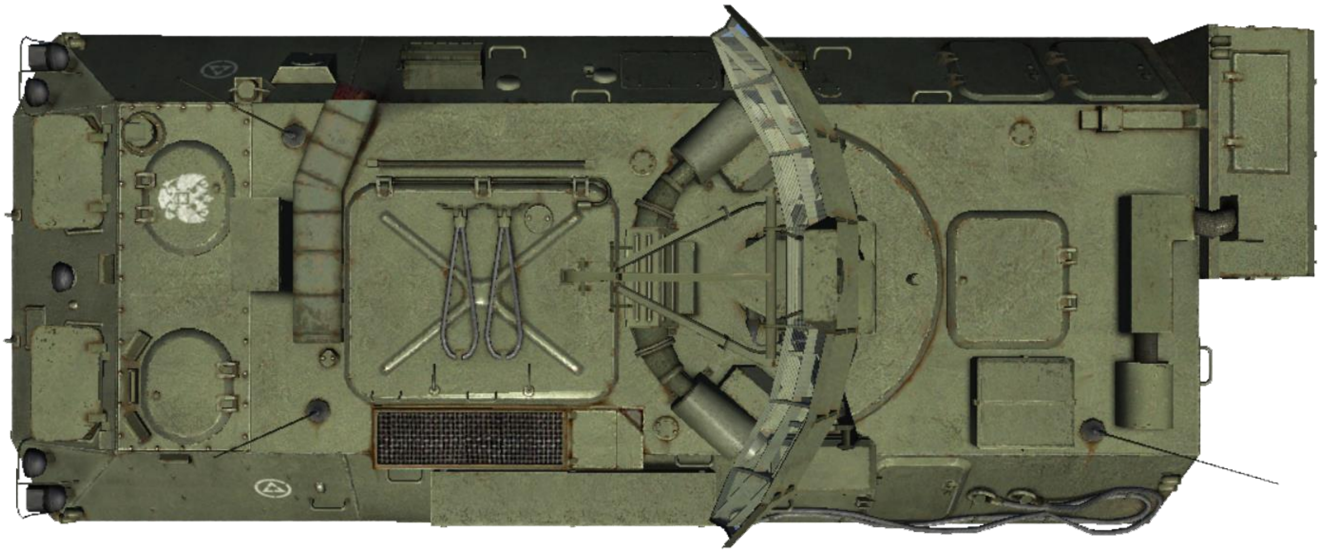


9 TARGET TRACKING RADARs

9.1 Introduction

Target Tracking RADARs (TTRs) are responsible for performing the high-resolution tracking of targets in order to guide a weapon to intercept and destroy the intended target. TTR system also generally provide the missile guidance signals, either continuous wave illumination for semi-active missile guidance or the radio command signal for COLOS systems.

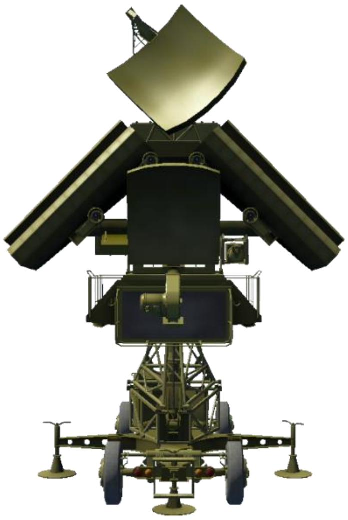
9.2 LOW BLOW

Originators Designation: SNR-125

9.2.1 Description

The LOW BLOW is a 250 kW I/D-band tracking, fire control and guidance radar which provides the missile guidance for the SA-3 GOA system.

Front



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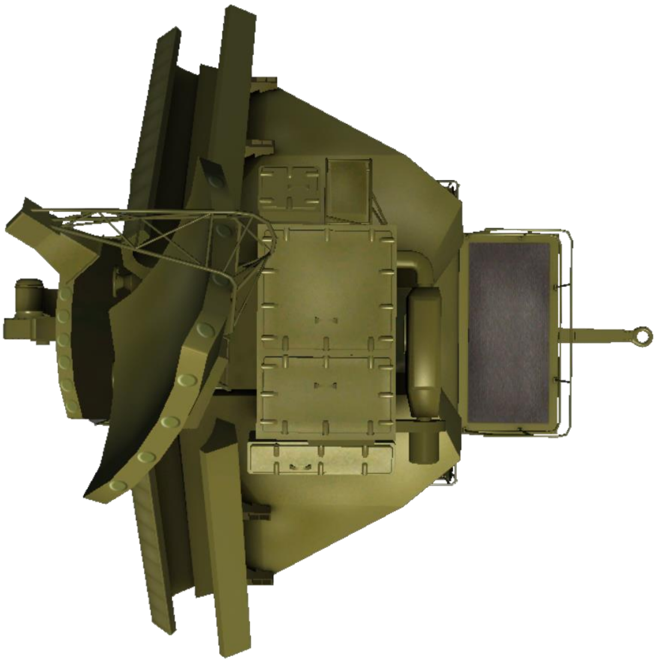
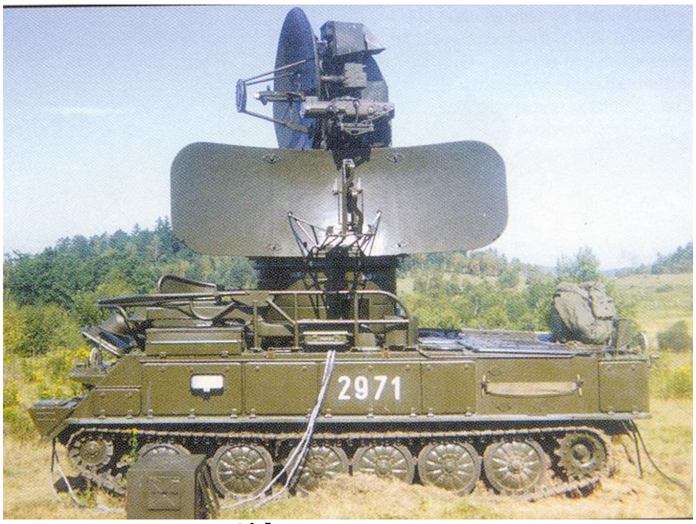


9.3 STRAIGHT FLUSH

Originators Designation: 1S91

9.3.1 Description

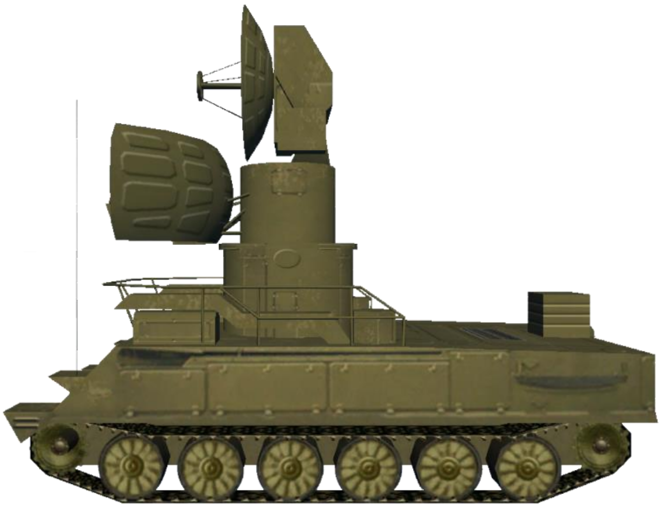
The STRAIGHT FLUISH is the target acquisition and tracking RADAR for the SA-6 GAINFUL system. The vehicle includes two RADAR a target acquisition and distribution radar and a continuous wave illuminator, in addition to an IFF interrogator and an optical tracker for backup/use in heavy ECM environments.



While 1S31 antenna was installed on the upper section of the superstructure and the 1S11 on the lower, they could turn around independently. To make the height of the vehicle lower the central cylinder on which the antennas are mounted is able to move downwards inside the vehicles chassis for movement.

Front

Side



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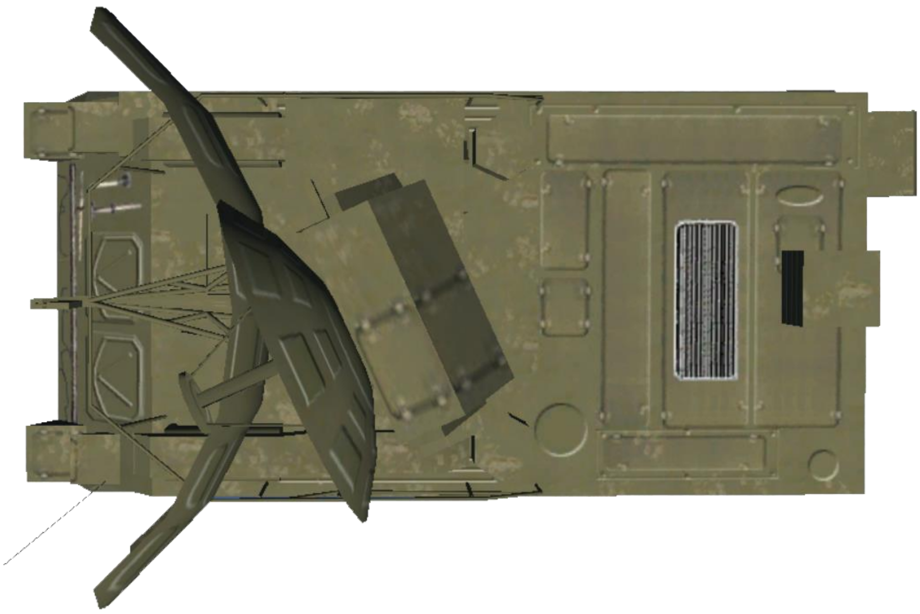


9.4 FLAP LID B

Originators Designation: 30N6E

9.4.1 Description

The FLAP LID B is the target tracking RADAR for the SA-10D GRUMBLE system.

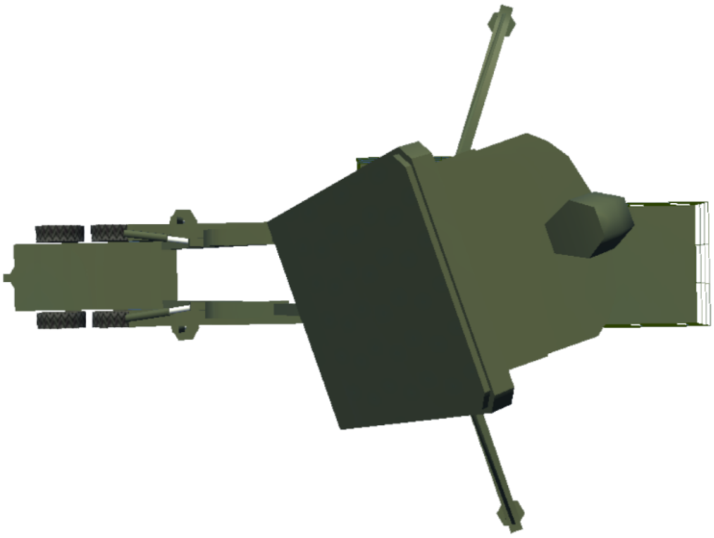
The FLAP LID B is a mast mounted active electronically scanned array system (AESA), with the elevation provided by the mast affording it excellent low altitude/over the horizon engagement capabilities.

The FLAP LID B is able to track and engage up to 6 targets simultaneously, supporting up to 12 missiles in-flight at once.

Front

Side

Top



9.5 AN/MPQ-46 HPIR
Originators Designation: N/A

9.5.1 Description

The AN/MPQ-46 High Power Illuminator Radar is the target tracking RADAR for the MIM-23 HAWK system. The AN/MPQ-46 was in service from 1971 until 1979 when it was replaced by the upgraded AN/MPQ-57, which was in turn superseded by the AN/MPQ-61.

The AN/MPQ-46 is easily recognisable due to its dual antenna configuration, with one being used to transmit the RF pulses and the other receive the skin returns from the target. The AN/MPQ-46 operates in the J band (10-20Ghz).

Each HAWK battery is usually equipped with 2 AN/MPQ-46 HPIRs in order to enable it to support two missiles and engage up to two targets simultaneously.

Front

Side

Top

9.6 AN/MPQ-53

Originators Designation: N/A

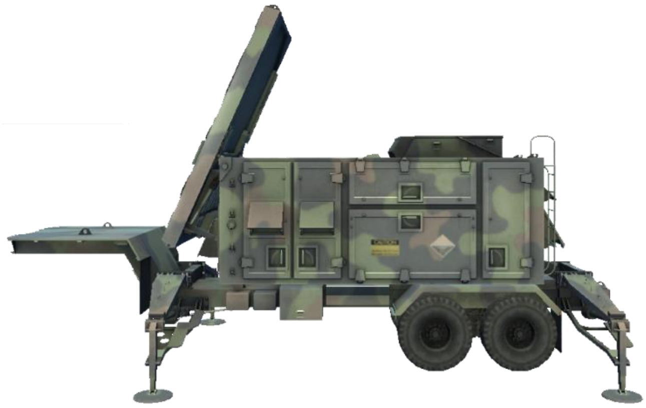
9.6.1 Description

The AN/MPQ-53 is the target acquisition and tracking RADAR for the MIM-104 Patriot system. The AN/MPQ-53 RADAR is a passive electronically scanned array (PESA) radar mounted to a trailer for transport, which also carries the electronics and power generation systems.

Multiple AN/MPQ-53 TTR can be operated within a single Patriot battery to increase coverage and support multiple engagements.

Front

Side



Top

10 FIGHTER AIRCRAFT

THIS SECTION REDACTED FROM PUBLIC RELEASE

11 ATTACK AIRCRAFT

THIS SECTION REDACTED
FROM PUBLIC RELEASE

12 AIR TO AIR MISSILES (AAMs)

**THIS SECTION REDACTED
FROM PUBLIC RELEASE**

13 SHIPS

THIS SECTION REDACTED FROM PUBLIC RELEASE

14 NATO REPORTING NAME INDEX

14.1 Introduction

NATO reporting names are code names for the military equipment of Russia, China, and, the former Eastern Bloc (Soviet Union and other nations of the Warsaw Pact). They provide unambiguous and easily understood English words in a uniform manner in place of the original designations, which either may have been unknown to the Western world at the time or easily confused codes and words with may have no meaning in the English language.

The United States Department of Defence expands on the NATO reporting names in some cases. NATO refers to surface-to-air missile systems mounted on ships or submarines with the same names as the corresponding land-based systems, but the US DoD assigns a different series of numbers with a different suffix (i.e., SA-N- vs. SA-) for these systems. The names are kept the same as a convenience. Where there is no corresponding system, a new name is devised. Some US DoD nomenclature is included in the following pages and is noted as such.

To reduce the risk of confusion, unusual or made-up names are allocated, with the idea being that the names chosen are be unlikely to occur in normal conversation and be easier to memorise. For fixed-wing aircraft, single-syllable words denoted piston-prop and turboprop, while multiple-syllable words denoted jets. Bombers had names starting with the letter B and names like Badger (2 syllables: jet), Bear (single syllable: propeller), and Blackjack were used. “Frogfoot,” the reporting name for the Sukhoi Su-25, references the aircraft’s close air support role. Transports had names starting with C (as in “cargo”), which resulted in names like Condor or Candid.

14.1.1 Missiles

The initial letter of the name indicated the use of that equipment.

A — air-to-air missiles, example AA-2 Atoll.
K — air-to-surface missiles (from the Russian Kh designation), example AS-17 Krypton.
G — surface-to-air missiles, SAM (or Ground-to-air), including ship- and submarine-launched, example SA-2 Guideline.
S — surface-to-surface missiles, including ship- and submarine-launched. (most famously the SS-1 Scud)

14.1.2 Aircraft

The first letter indicates the type of aircraft, like Bear for a bomber aircraft, or Fulcrum for a fighter aircraft.

F — fighter aircraft, also later ground attack aircraft: List of NATO reporting names for fighter aircraft.
B — bomber aircraft: List of NATO reporting names for bomber aircraft.
C — commercial aircraft and airliners, and cargo aircraft: List of NATO reporting names for transport aircraft.
H — helicopters: List of NATO reporting names for helicopters.
M — Miscellaneous; trainers, reconnaissance, seaplanes, tankers, AEW etc.: List of NATO reporting names for miscellaneous aircraft.

For fixed-wing aircraft, one syllable names were used for propeller-powered craft (turboprops included), while two-syllable names indicated jet engines.

14.2 Air to Air Missiles

List of NATO reporting names for AA series air-to-air missiles, with originators designations.

NATO DESIGNATION	NATO REPORTING NAME	ORIGINATORS DESIGNATION
AA-1	ALKALI	K-5/RS-1U
AA-2	ATOLL	K-13/R-3/R-13
AA-3	ANAB	K-8/R-8
AA-4	AWL	K-9/K-155
AA-5	ASH	R-4
AA-6	ACRID	R-40
AA-7	APEX	R-23
AA-8	APHID	R-60
AA-9	AMOS	R-33
AA-10	ALAMO	R-27
AA-11	ARCHER	R-73
AA-12	ADDER	R-77
AA-13	ARROW	R-37

14.3 Air to Surface Missiles

List of NATO reporting names for AS series air-to-surface missiles, with originators designations.

NATO DESIGNATION	NATO REPORTING NAME	ORIGINATORS DESIGNATION
AS-1	KENNEL	KS-1 Kometa
AS-2	KIPPER	K-10S Yen
AS-3	KANGAROO	H-20
AS-4	KITCHEN1	H-22 Burya
AS-5	KELT	H-11/KSR-2
AS-6	KINGFISH	H-66/KSR-5
AS-7	KERRY	H-66/H-23 Grom
AS-8/AT-6	SPIRAL	9M114V Sturm-V
AS-9	KYLE	H-28
AS-10	KAREN	H-25
AS-11	KILTER	H-58 Izdelive
AS-12	KEGLER	H-25MP/H-27PS
AS-13	KINGBOLT	H-59 Ovod
AS-14	KEDGE	H-29
AS-15	KENT	H-55/H65S Izdeliye
AS-16	KICKBACK	H-15
AS-17	KRYPTON	H-59M Ovod-M
AS-18	KAZOO	P-750 Grom
AS-19	KOALA	3M25A Metrorit-A
AS-20	KAYAK	H-35/H-37 Uran
AS-21		KH-90 Gela
AS-22	KINGBOLT	KH-59MK2 Ovod
AS-23		KH-38

14.4 Anti-Tank Missiles

List of NATO reporting names for AT series Anti-Tank missiles, with originators designations.

NATO DESIGNATION	NATO REPORTING NAME	ORIGINATORS DESIGNATION
AT-1	SNAPPER	3M6 Shmel
AT-2	SWATTER	9M17 Fleyta
AT-3	SAGGER	9M14 Malyutka
AT-4	SPIGOT	9K111 Fagot
AT-5	SPANDREL	9M113 Konkurs
AT-6/AS-8	SPIRAL	9M114 Shturm
AT-7	SAXHORN	9M115 Metis
AT-8	SONGSTER	9M112 Kobra
AT-9	SPIRAL-2	9M120 Ataka
AT-10	STABBER	9M117 Bastion
AT-11	SNIPER	9M119 Svir/Refleks
AT-12	SWINGER	9M118 Sheksna
AT-13	SAXHORN-2	9M131 Metis-M
AT-14	SPRIGGAN	9M133 Kornet
AT-15	SPRINGER	9M123 Khrizantema
AT-16	SCALLION	9A1472 Vikhr/Vikhr-M

14.5 Surface to Air Missiles

List of NATO reporting names for SA series Surface to Air missiles, with originators designations.

NATO DESIGNATION	NATO REPORTING NAME	ORIGINATORS DESIGNATION
SA-1	GUILD	S-25 Berkut
SA-2	GUIDELINE	S-75 Dvina/Volkhov/Desna
SA-3	GOA	S-125 Nyeva
SA-4	GANEF	9M8 Krug
SA-5	GAMMON	S-200 Volga
SA-6	GAINFUL	3M9 Kub/Kvadrat
SA-7	GRAIL	9K32 Strela-2
SA-8	GECKO	9K33 Osa
SA-9	GASKIN	9K31 Strela-1
SA-10	GRUMBLE	S-300P/PS/PT
SA-11	GADFLY	9K37 Buk
SA-12	GLADIATOR/GIANT	S-300V
SA-13	GOPHER	9K35 Strela-10
SA-14	GREMLIN	9K36 Strela-3
SA-15	GAUNTLET	9K330/9K331/9K332 Tor
SA-16	GIMLET	9K310 Igla-1
SA-17	GRIZZLY	9K37 Buk-M1-2
SA-18	GROUSE	9K38 Igla
SA-19	GRISON	2K22 Tunguska
SA-20	GARGOYLE	S-300PM/PMU Favorit
SA-21	GROWLER	S-400 Triumf
SA-22	GREYHOUND	Pantsir-S1
SA-23	GLADIATOR/GIANT	S-300VM
SA-24	GRINCH	9K338 Igla-S

U.S. DoD designations for SA-N series naval surface-to-air missiles, with originators designations. Note that these are not NATO designations. NATO uses the SA-# series designations for naval SAMS, however the US DoD refer to them by the designations below.

US DoD DESIGNATION	NATO DESIGNATION	NATO REPORTING NAME	ORIGINATORS DESIGNATION
SA-N-1	SA-3	GOA	S-125 Nyeva
SA-N-2	SA-2	GUIDELINE	S-75 Dvina/Volkhov/Desna
SA-N-3	NONE	GOBLET	4K60/4K65 Shtorm
SA-N-4	SA-8	GECKO	9K33 Osa
SA-N-5	SA-7	GRAIL	9K32 Strela-2
SA-N-6	SA-10	GRUMBLE	S-300P/PS/PT
SA-N-7	SA-11	GADFLY	9K37 Buk
SA-N-8	SA-14	GREMLIN	9K36 Strela-3
SA-N-9	SA-15	GAUNTLET	9K330/9K331/9K332 Tor
SA-N-10	SA-18	GROUSE	9K38 Igla
SA-N-11	SA-19	GRISON	2K22 Tunguska
SA-N-12	SA-17	GRIZZLY	9K37 Buk-M1-2

14.6 Fighter Aircraft

NATO REPORTING NAME	ORIGINATORS DESIGNATION
FACEPLATE	Mikoyan-Gurevich Ye-2A
FAGOT	Mikoyan-Gurevich MiG-15
FAITHLESS	Mikoyan-Gurevich MiG-23PD
FANG	Lavochkin La-11
FANTAIL	Lavochkin La-15
FANTAN	Nanchang Q-5/A-5
FARGO	Mikoyan-Gurevich MiG-9
FARMER	Shenyang J-6 and Mikoyan-Gurevich MiG-19
FEATHER	Yakovlev Yak-15/Yak-17
FENCER	Sukhoi Su-24
FIDDLER	Tupolev Tu-28/Tu-128
FIN	Lavochkin La-7
FINBACK	Shenyang J-8
FIREBAR	Yakovlev Yak-28P
FIREBIRD	Chengdu J-10
FIRKIN	Sukhoi Su-47
FISHBED	Mikoyan-Gurevich MiG-21 and Chengdu J-7
FISHPOT	Sukhoi Su-9 and Su-11
FITTER	Sukhoi Su-7 and Su-17/Su-20/Su-22
FLAGON	Sukhoi Su-15
FLANKER	Sukhoi Su-27/Su-30/Su-33/Su-35/Su-37
FLASHLIGHT	Yakovlev Yak-25
FLATPACK/FOXGLOVE	MiG MFI project 1.44/1.42
FLIPPER	Mikoyan-Gurevich Ye-150
FLOGGER	Mikoyan-Gurevich MiG-23 and MiG-27
FLORA	Yakovlev Yak-23
FLOUNDER	Xian JH-7
FORGER	Yakovlev Yak-38
FOXBAT	Mikoyan-Gurevich MiG-25
FOXHOUND	Mikoyan MiG-31
FRANK	Yakovlev Yak-9
FRED	Bell P-63 Kingcobra
FREEHAND	Yakovlev Yak-36
FREESTYLE	Yakovlev Yak-41/Yak-141
FRESCO	Mikoyan-Gurevich MiG-17 and Shenyang J-5
FRITZ	Lavochkin La-9
FROGFOOT	Sukhoi Su-25
FULCRUM	Mikoyan MiG-29/MiG-33/MiG-35
FULLBACK	Sukhoi Su-32/Su-34

14.7 Bomber Aircraft

NATO REPORTING NAME	ORIGINATORS DESIGNATION
BACKFIN	Tupolev Tu-98
BACKFIRE	Tupolev Tu-22M
BADGER	Tupolev Tu-16
BANK	North American B-25 Mitchell
BARGE	Tupolev Tu-85
BARK	Ilyushin Il-2
BAT	Tupolev Tu-2
BEAGLE	Ilyushin Il-28
BEAR	Tupolev Tu-95
BEAST	Ilyushin Il-10
BISON	Myasishchev M-4
BLACKJACK	Tupolev Tu-160
BLINDER	Tupolev Tu-22
BLOWLAMP	Ilyushin Il-54
BOB	Ilyushin Il-4
BOOT	Tupolev Tu-91
BOSUN	Tupolev Tu-14
BOUNDER	Myasishchev M-50
BOX	Douglas A-20 Havoc
BRASSARD	Yakovlev Yak-28
BRAWNY	Ilyushin Il-40
BREWER	Yakovlev Yak-28B
BUCK	Petlyakov Pe-2
BULL	Tupolev Tu-4
BUTCHER	Tupolev Tu-82

14.8 Transport Aircraft

NATO REPORTING NAME	ORIGINATORS DESIGNATION
CAB	Lisunov Li-2
CAMBER	Ilyushin Il-86
CAMEL	Tupolev Tu-104
CAMP	Antonov An-8
CANDID	Ilyushin Il-76
CARELESS	Tupolev Tu-154
CART	Tupolev Tu-70
CASH	Antonov An-28
CAT	Antonov An-10
CHAN	Harbin Y-11
CHARGER	Tupolev Tu-144
CLAM	Ilyushin Il-18 (1947)
CLANK	Antonov An-30
CLASSIC	Ilyushin Il-62
CLEAT	Tupolev Tu-114
CLINE	Antonov An-32
CLOBBER	Yakovlev Yak-42
CLOD	Antonov An-14
COACH	Ilyushin Il-12
COALER	Antonov An-72/An-74
COCK	Antonov An-22
CODLING	Yakovlev Yak-40
COKE	Antonov An-24
COLT	Antonov An-2
CONDOR	Antonov An-124
COOKER	Tupolev Tu-110
COOKPOT	Tupolev Tu-124
COOT	Ilyushin Il-18/Il-22
CORK	Yakovlev Yak-16
COSSACK	Antonov An-225
CRATE	Ilyushin Il-14

CREEK	Yakovlev Yak-12
CRIB	Yakovlev Yak-8
CROW	Yakovlev Yak-12
CRUSTY	Tupolev Tu-134
CUB	Antonov An-12
CUFF	Beriev Be-30/Be-32
CURL	Antonov An-26

14.9 Helicopters

NATO REPORTING NAME	ORIGINATORS DESIGNATION
HAITUN	Harbin Z-9
HALO	Mil Mi-26
HARE	Mil Mi-1
HARKE	Mil Mi-10
HARP	Kamov Ka-20
HAT	Kamov Ka-10
HAVOC	Mil Mi-28
HAZE	Mil Mi-14
HELIX	Kamov Ka-27/29/32
HEN	Kamov Ka-15
HERMIT	Mil Mi-34
HIND	Mil Mi-24
HIP	Mil Mi-8/9/17
HOG	Kamov Ka-18
HOKUM	Kamov Ka-50/52
HOMER	Mil V-12
HOODLUM	Kamov Ka-26/126
HOOK	Mil Mi-6
HOOP	Kamov Ka-22
HOPLITE	Mil Mi-2
HORMONE	Kamov Ka-25
HORSE	Yakovlev Yak-24
HOUND	Mil Mi-4

14.10 Miscellaneous Aircraft

NATO REPORTING NAME	ORIGINATORS DESIGNATION
MADCAP	Antonov An-74
MADGE	Beriev Be-6
MAESTRO	Yakovlev Yak-25
MAGNET	Yakovlev Yak-17
MAGNUM	Yakovlev Yak-30
MAIDEN	Sukhoi Su-9U
MAIL	Beriev Be-12
MAINSTAY	Beriev A-50
MALLOW	Beriev Be-10
MANDRAKE	Yakovlev Yak-25RV
MANGROVE	Yakovlev Yak-28U
MANTIS	Yakovlev Yak-32
MARE	Yakovlev Yak-14
MARK	Yakovlev Yak-7V
MASCOT	Ilyushin Il-28U
MAX	Yakovlev Yak-18
MAYA	Aero L-29
MERMAID	Beriev Be-40
MIDAS	Ilyushin Il-78
MIDGET	Mikoyan-Gurevich MiG-15UTI
MINK	Yakovlev UT-2
MIST	Tsybin Ts-25
MITTEN	Yakovlev Yak-130
MOLE	Beriev Be-8
MONGOL	Mikoyan-Gurevich MiG-21 two-seat trainer version
MOOSE	Yakovlev Yak-11
MOP	PBY Catalina
MOSS	Tupolev Tu-126
MOTE	Beriev MBR-2
MOUJIK	Sukhoi Su-7U
MUG	Beriev Be-4
MULE	Po-2 (U-2)
MYSTIC	Myasishchev M-17/M-55

15 GLOSSARY

AAA	Anti-Aircraft Artillery
AAM	Air to Air Missile
ACLOS	Automatic Command to Line of Sight
ADS	Air Defence System
AESA	Active Electronically Scanned Array
AIRCM	Active Infra-Red Countermeasures
AR	Acquisition RADAR
ARH	Active RADAR Homing
CLOS	Command to Line of Sight
CM	Countermeasures
COLOS	Command Off Line of Sight
DA	Defensive Aids
DIRCM	Directional Infra-Red Countermeasures
ECM	Electronic Countermeasures
EWR	Early Warning RADAR
IFF	Identification Friend or Foe
IR	Infra-Red
IRCM	Infra-Red Countermeasures
LASER	Light Amplification by Stimulated Emission of Radiation
LORAD	Long Range Air Defence
LOS	Line of Sight
LOSR	Line of Sight Rate
LRS	Long Range Search
LWS	LASER Warning System
MANPADS	Man Portable Air Defence System(s)
MAWS	Missile Approach Warning System
MERAD	Medium Range Air Defence
MEZ	Missile Engagement Zone
MWS	Missile Warning System
NM	Nautical Mile
PESA	Passive Electronically Scanned Array
RADAR	Radio Detection and Ranging
RWR	RADAR Warning Receiver
RWS	Range While Search
RWS-SAM	Range While Search Situational Awareness Mode
RWT	Range While Track
SACLOS	Semi-Automatic Command to Line of Sight
SAM	Surface to Air Missile
SARH	Semi-Active RADAR Homing
SHORAD	Short Range Air Defence
SPAAA	Self-Propelled Anti-Aircraft Artillery
SPAAG	Self-Propelled Anti-Aircraft Gun
SR	Search RADAR
STR	Search and Tracking RADAR
STT	Single Target Track
TEL	Transporter Erector Launcher
TELAR	Transporter Erector Launcher and RADAR
TTR	Target Tracking RADAR
TWS	Track While Scan
WEZ	Weapon Engagement Zone