



Rocket Analytics



SEAD Reference Guide
V 1.2

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1 - Overview

This reference guide will provide basic information on the various types of SAMs in DCS. Basics such as system design, concept of operation, and field deployment will be covered.

System performance information will be derived from DCS when available, and open source resources when necessary. Concept of operations as described may not perfectly reflect DCS implementation, such as usage of certain radars within the battery. Some information is derived from in-game testing and may vary from encounter to encounter.

Concept of operation and field deployment will represent a standard “doctrine” and may vary from the real world.

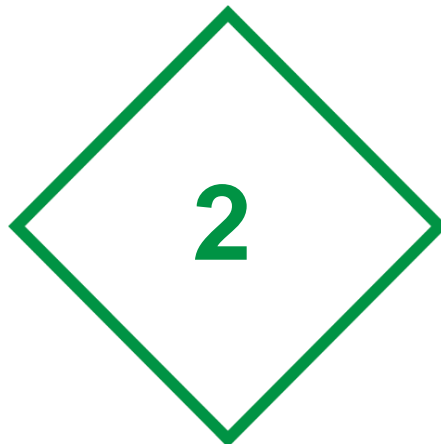
This guide only addresses air defense systems which utilize some form of radar as part of their operation. Since most SEAD operations employ anti-radiation missiles, using the RWR as the primary sensor for identifying and cueing to targets, this guides primary objective is to identify critical air defense battery components for targeting via radar emissions. RWR symbology shown is for Western aircraft.

1 – Quick Target Guide

This quick target guide provides visual references for the crucial equipment required to conduct engagements. For some systems this consists of a central target engagement radar; while others require destruction of each launcher due to autonomous target tracking capabilities.

1 – Quick Target Guide: SA-2

FAN SONG - TTR



1 – Quick Target Guide: SA-3

LOW BLOW - TTR



1 – Quick Target Guide: SA-5

SQUARE PAIR- TIR



RWR Symbol

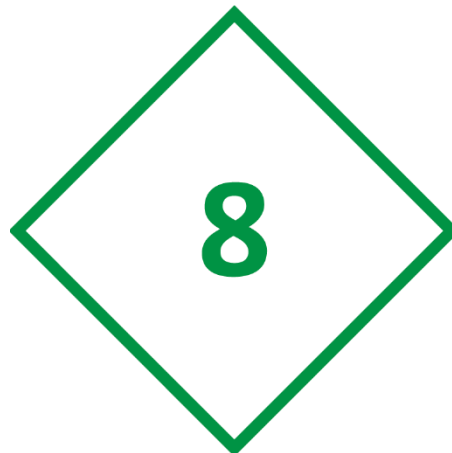
1 – Quick Target Guide: SA-6

STRAIGH FLUSH - TIR



1 – Quick Target Guide: SA-8

LAND ROLL - TTR



1 – Quick Target Guide: SA-10f

FLAP LID - TER



1 – Quick Target Guide: SA-11

FIRE DOME - TIR



1 – Quick Target Guide: SA-13

SNAP SHOT - ROR



1 – Quick Target Guide: SA-15

SCRUM HALF - TTR



1 – Quick Target Guide: SA-19

HOT SHOT - TTR



1 – Quick Target Guide: HAWK

AN/MPQ-46 - TIR



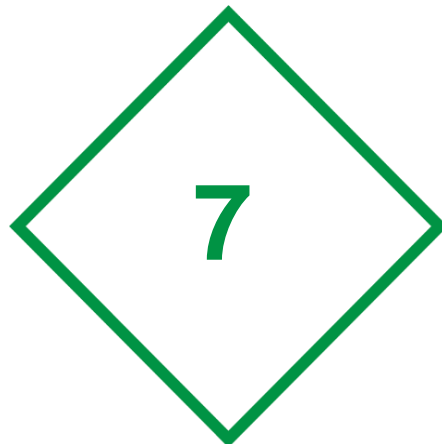
1 – Quick Target Guide: Patriot

AN/MPQ-46 - TER



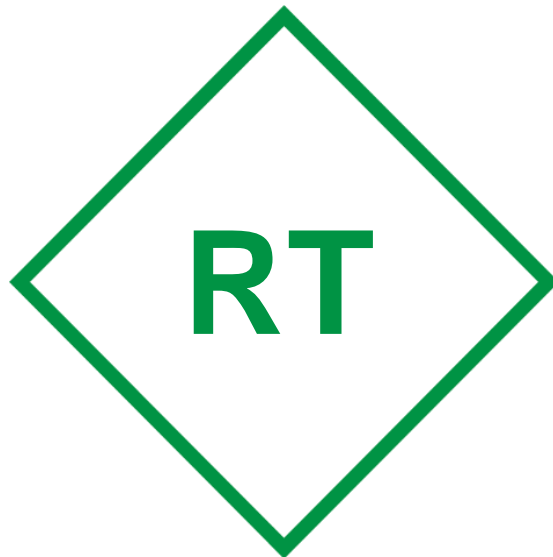
1 – Quick Target Guide: HQ-7

HQ-7- TTR



1 – Quick Target Guide: Rapier

Blindfire- TTR & Optical Tracker



1 – Quick Target Guide: NASAMS

MPQ64F1 - TAR



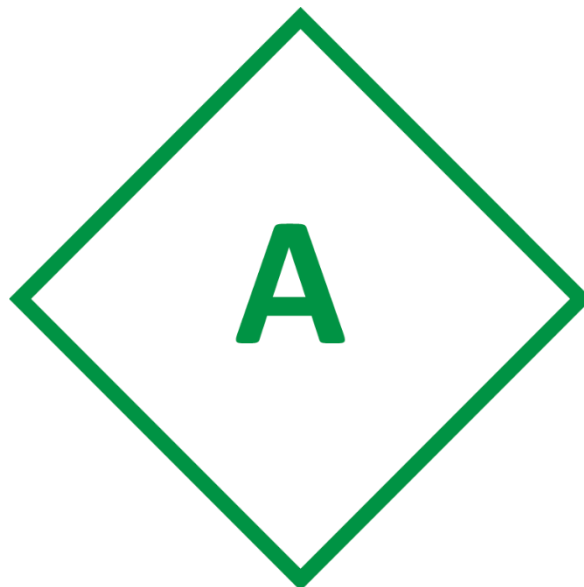
1 – Quick Target Guide: Roland

Roland- TAR & TTR



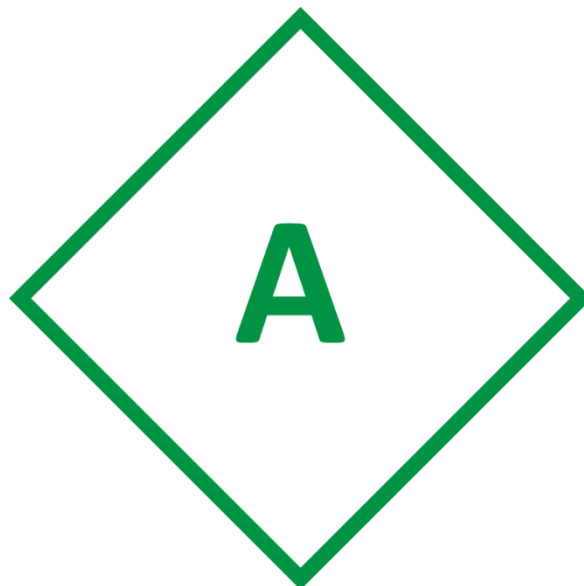
1 – Quick Target Guide: ZSU-23

GUN DISH -TTR



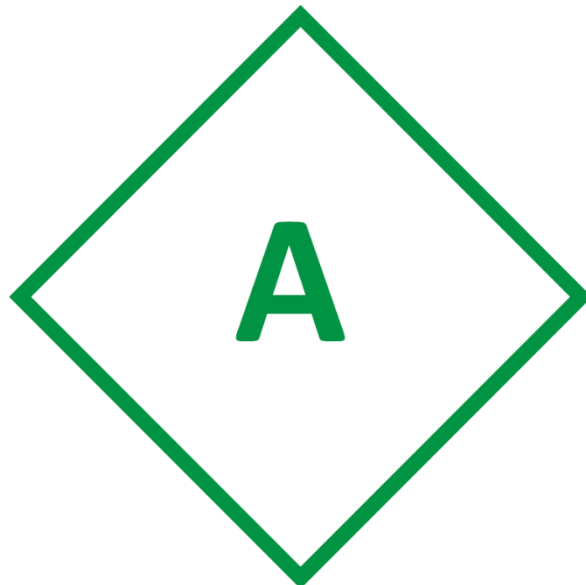
1 – Quick Target Guide: M-163

AN/VPS-2 - ROR



1 – Quick Target Guide: Gepard

Gepard – TAR & TTR



3 – Russian Origin Air Defense: SA-2

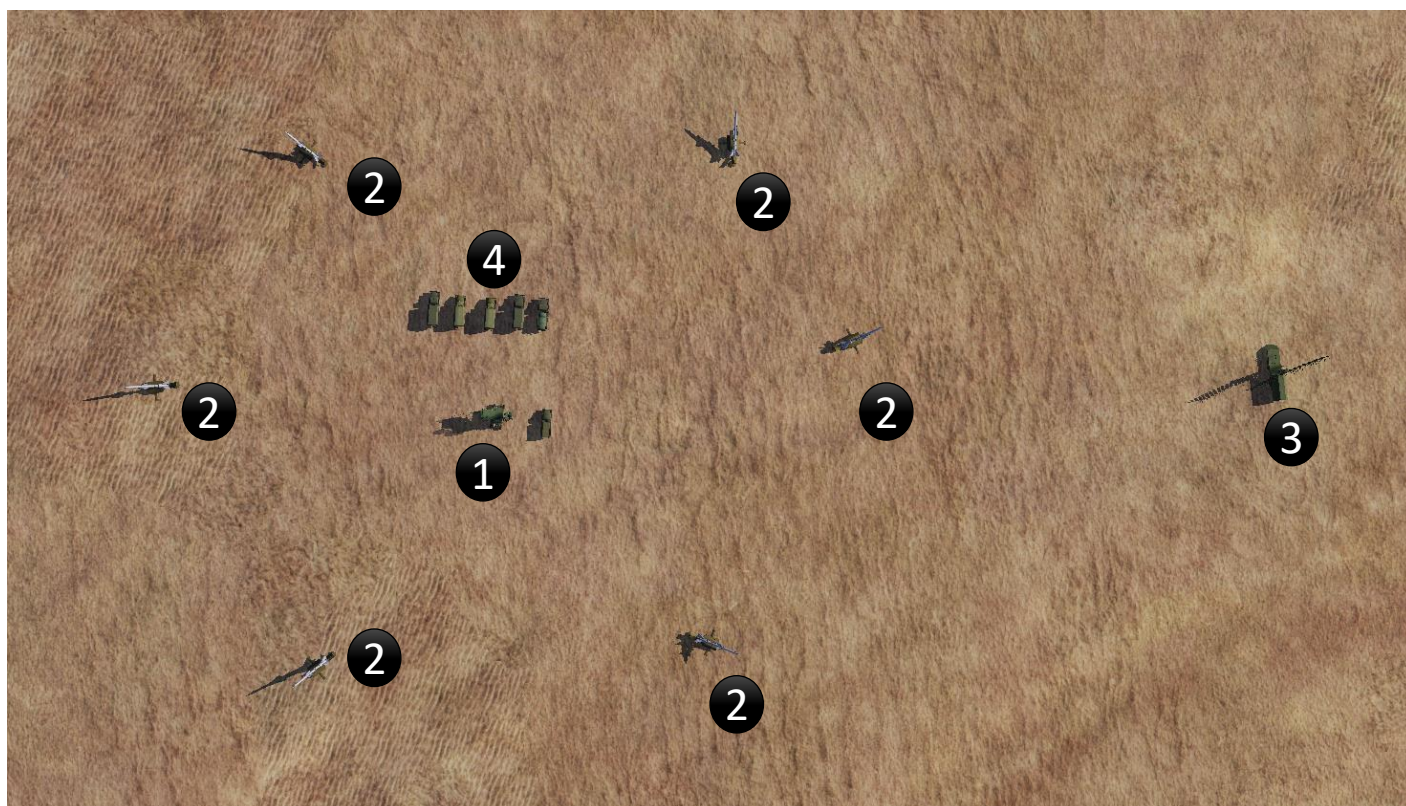


The SA-2 is a medium-range RF SAM designed to defend fixed locations against high-altitude bomber attack. The system is deployed in semi-fixed locations in what is known as a “flower” pattern, with six launchers dispersed around the central FAN SONG target track radar (TTR).

The SA-2 is effective against medium- to high-altitude targets but has limited maneuverability. The SA-2 has no capability to engage HARMs or cruise missile class targets.

Critical Information	
Max Engagement Range	23 nm
Min Engagement Range	3.75 nm
Guidance Type	RF Command Guidance
Missiles per Battery	6
Reaction Time	15 sec

3 – Russian Origin Air Defense: SA-2



1 – FAN SONG TTR x 1

2 – SA-2 Launcher x 6

3 – 1L13 Early Warning Radar (EWR) x 1

4 – Command vans and support vehicles

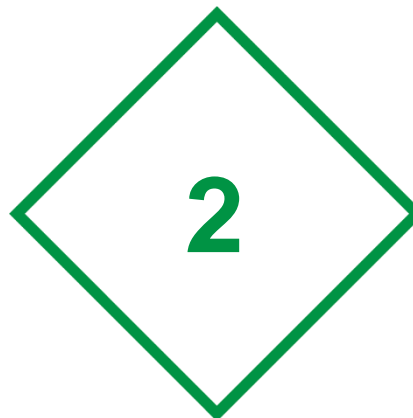
Minimal Equipment Required for Operation

1x FAN SONG TTR

1x SA-2 Launcher

3 – Russian Origin Air Defense: SA-2

FAN SONG - TTR



RWR Symbol

Standard doctrine has a single FAN SONG TTR deployed with each SA-2 battery. The FAN SONG is capable of single target track and one missile engagements, meaning only a single target can be tracked and engaged at a time with a single missile.

The FAN SONG has a max detection range of 54 nm, but this will vary on target radar cross section (RCS). The FAN SONG has a limited autonomous scan ability, so each SA-2 battery is usually equipped with an 1L13 EWR, displayed as “S” RWR. The EWR does not take part in the engagement, and is used solely to support the FAN SONG.

3 – Russian Origin Air Defense: SA-2

Concept of Operation

1. Target Acquisition:

The 1L13 EWR will scan for targets within range of the SA-2. Once a target has been acquired and is within range, the FAN SONG will slew to the target and begin locking-on to it.

2. Target Tracking:

The FAN SONG will begin to lock-on to a single target once it enters the systems range. It will take several seconds for the system to lock-on to the target. Once the target is locked a SA-2 missile launcher will be slewed towards the target.

3. Target Engagement:

With the locked target in range a single SA-2 missile will be launched at the target. The FAN SONG will track the target and the missile for the duration of the fly out, sending guidance commands up to the missile via a separate RF channel. Once the missile reaches the target, it will detonate on command or via proximity fuze.

3 – Russian Origin Air Defense: SA-3



The SA-3 is a medium-range RF SAM designed to defend fixed locations against medium-level attack aircraft with some capability against low altitude targets. The SA-3 is deployed in semi-fixed locations, with four launchers dispersed around the central LOW BLOW target track radar.

The SA-3 is effective against medium- to high-altitude targets with some capability against low level targets. The SA-3 has no capability to engage HARMs or cruise missile class targets.

Critical Information	
Max Engagement Range	13.5 nm
Min Engagement Range	1.4 nm
Guidance Type	RF Command Guidance
Missiles per Battery	16
Reaction Time	15 sec

3 – Russian Origin Air Defense: SA-3



1 – LOW BLOW TTR x 1

2 – SA-3 Launcher x 4

3 – P-19 EWR x 1

4 – Command vans and support vehicles

Minimal Equipment Required for Operation

1x LOW BLOW TTR

1x SA-3 Launcher

3 – Russian Origin Air Defense: SA-3

LOW BLOW - TTR



RWR Symbol



Standard doctrine has a single LOW BLOW TTR deployed with each SA-3 battery. The LOW BLOW TTR is capable of single target track and one missile engagements.

The LOW BLOW TTR has a max detection range of 54 nm, but this will vary on target RCS. The LOW BLOW TTR has a limited autonomous scan ability, so each SA-3 battery is usually equipped with an P-19 EWR, displayed as “S” or “FF” on RWR. The EWR does not take part in the engagement, and is used solely to support the LOW BLOW TTR.

3 – Russian Origin Air Defense: SA-3

Concept of Operation

1. Target Acquisition:

The S-19 EWR will scan for targets within range of the SA-3. Once a target has been acquired and is within range, the LOW BLOW TTR will slew to the target and begin locking-on to it.

2. Target Tracking:

The LOW BLOW TTR will begin to lock-on to a single target once it enters the systems range. It will take several seconds for the system to lock-on to the target. Once the target is locked the SA-3 missile launcher will be slewed towards the target.

3. Target Engagement:

With the locked target in range a single SA-3 missile will be launched at the target. The LOW BLOW TTR will track the target and the missile for the duration of the fly out, sending guidance commands up to the missile via a separate RF channel. Once the missile reaches the target, it will detonate on command or via proximity fuze.

3 – Russian Origin Air Defense: SA-5



The SA-5 is a long-range RF SAM designed to defend against medium- to high-altitude aircraft and cruise missiles. The system is designed as a fixed defense that can be deployed to defend priority locations as well as area defense. A standard SA-5 battery consists of one TIN SHIELD TAR, one SQUARE PAIR TIR, and up to twelve launchers.

The SA-5 is effective against medium- to high-altitude targets and has good maneuverability. The SA-5 has some capabilities to engage cruise missiles, but no capability against HARMs class targets.

Critical Information	
Max Engagement Range	138 nm
Min Engagement Range	3.75 nm
Guidance Type	Semi-active RF Homing
Missiles per Battery	6
Reaction Time	60 sec

3 – Russian Origin Air Defense: SA-5



1 – SQUARE PAIR TIR x 1

2 – TIN SHIELD TAR x 1

3 – SA-5 Launcher x 12

Minimal Equipment Required for Operation

1x SQUARE PAIR TIR

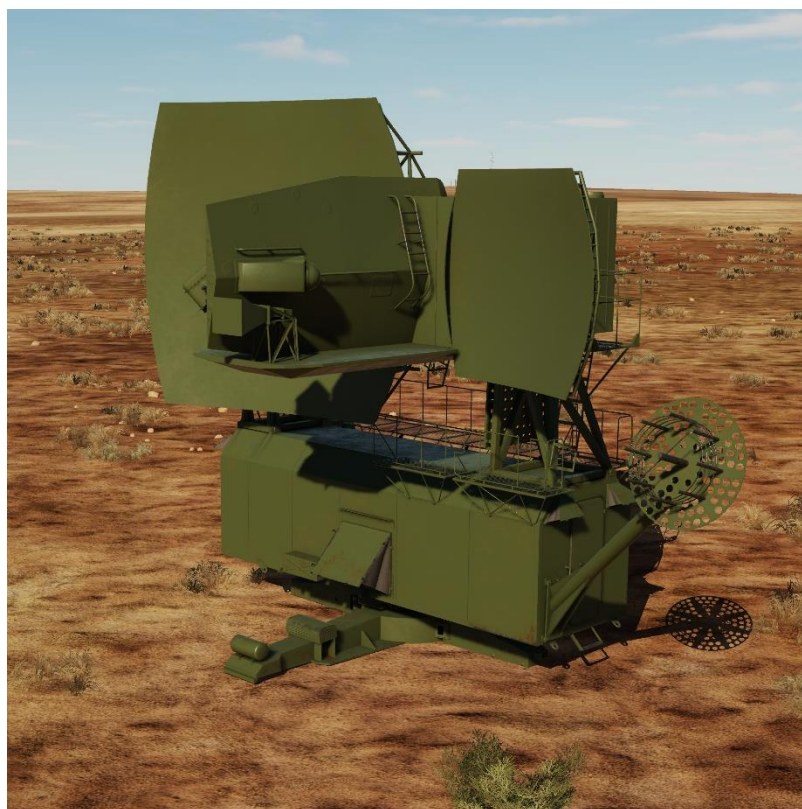
1x SA-5 Launcher

3 – Russian Origin Air Defense: SA-5

SQUARE PAIR- TIR



RWR Symbol



Standard doctrine has a single SQUARE PAIR TIR deployed with each SA-3 battery. The SQUARE PAIR is capable of single target track and one missile engagements.

The SQUARE PAIR has a max detection range of 216 nm, but this will vary on target RCS. The SQUARE PAIR has a limited autonomous scan ability, so each SA-5 battery is usually equipped with an TIN SHIELD EWR, displayed as “TS” on TAR. The TAR does not take part in the engagement, and is used solely to support the SQUARE PAIR.

3 – Russian Origin Air Defense: SA-5

Concept of Operation

1. Target Acquisition:

The TIN SHIELD TAR will scan for targets within range of the SA-5. Once a target has been acquired and is within range, the SQUARE PAIR TIR will slew to the target and begin locking-on to it.

2. Target Tracking:

The SQUARE PAIR TIR will begin to lock-on to a single target once it enters the systems range. It will take several seconds for the system to lock-on to the target. Once the target is locked the SA-5 missile launcher will be slewed towards the target.

3. Target Engagement:

With the locked target in range a single SA-5 missile will be launched at the target. The SQUARE PAIR TIR will track the target for the duration of the flight, and provide illumination of the target for the missile to lock onto the reflected RF energy coming from the target. Once the missile reaches the target, it will detonate on command or via proximity fuze.

3 – Russian Origin Air Defense: SA-6

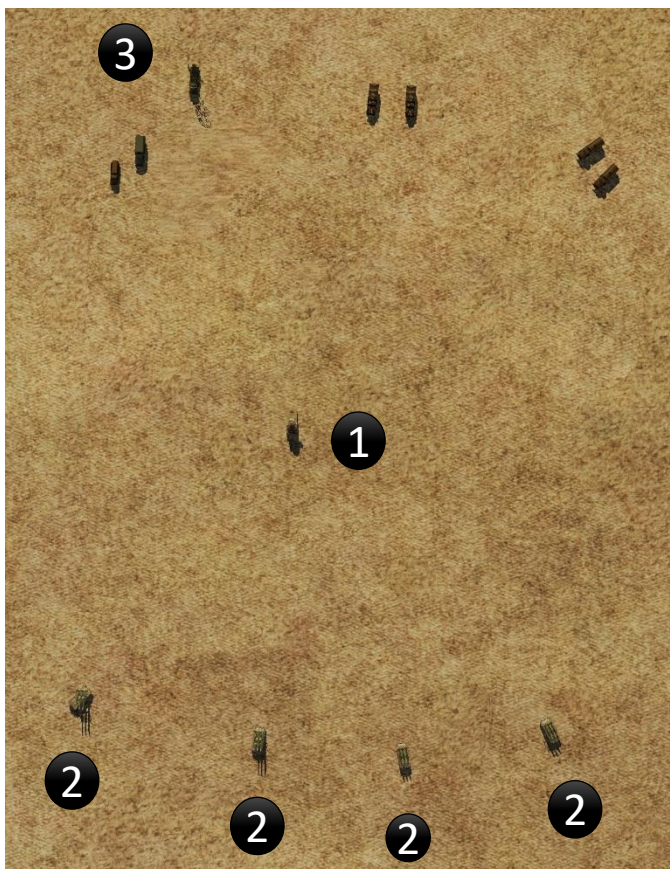


The SA-6 is a medium-range RF SAM designed to defend against low- and medium-altitude attack aircraft. The system is designed as a mobile defense that can be quickly deployed to defend priority locations. Four transporter-erector-launchers (TELs) are dispersed around a central STRAIGHT FLUSH radar.

The SA-6 is effective against low- to medium-altitude targets and has decent maneuverability. The SA-6 has no capability to engage HARMs or cruise missile class targets.

Critical Information	
Max Engagement Range	13 nm
Min Engagement Range	3.75 nm
Guidance Type	Semi-active RF Homing
Missiles per Battery	12
Reaction Time	30 sec

3 – Russian Origin Air Defense: SA-6



1 – STRAIGHT FLUSH x 1

2 – SA-6 Launcher x 4

3 – P-19 EWR x 1

Minimal Equipment Required for Operation

1x STRAIGHT FLUSH TER

1x SA-6 Launcher

3 – Russian Origin Air Defense: SA-6

STRAIGHT FLUSH - TAR and TIR



RWR Symbol



Standard doctrine has a single STRAIGHT FLUSH radar vehicle deployed with each SA-6 battery. The STRAIGHT FLUSH incorporates a spinning target acquisition radar (TAR) and a single TIR. The STRAIGHT FLUSH is capable of single target track and one missile engagements.

The STRAIGHT FLUSH has a max detection range of 38 nm, but this will vary on target RCS. The STRAIGHT FLUSH has a robust autonomous scan ability through its integrated TAR, but is usually supplemented with an P-19 EWR, displayed as “S” or “FF” on RWR. The EWR does not take part in the engagement, and is used solely to support the STRAIGHT FLUSH.

3 – Russian Origin Air Defense: SA-6

Concept of Operation

1. Target Acquisition:

The P-19 will scan for targets within range of the SA-6. Once a target has been acquired with the P-19 its information will be passed to the STRAIGHT FLUSH. The STRAIGHT FLUSH will acquire the target with its onboard TAR.

2. Target Tracking:

Once a target is in range the STRAIGHT FLUSH TIR will begin to lock-on to a single target. It will take several seconds for the system to lock-on to the target. Once the target locked a TEL will be slewed towards the target.

3. Target Engagement:

With the tracked target in range a single SA-6 missile will be launched at the target. The STRAIGHT FLUSH will track the target and illuminate it with a continuous wave (CW) illuminator radar signal. This CW signal is detected by a semi-active radar seeker on the missile, and used to guide the missile to the target. The missile's warhead is active by a proximity fuze.

3 – Russian Origin Air Defense: SA-8

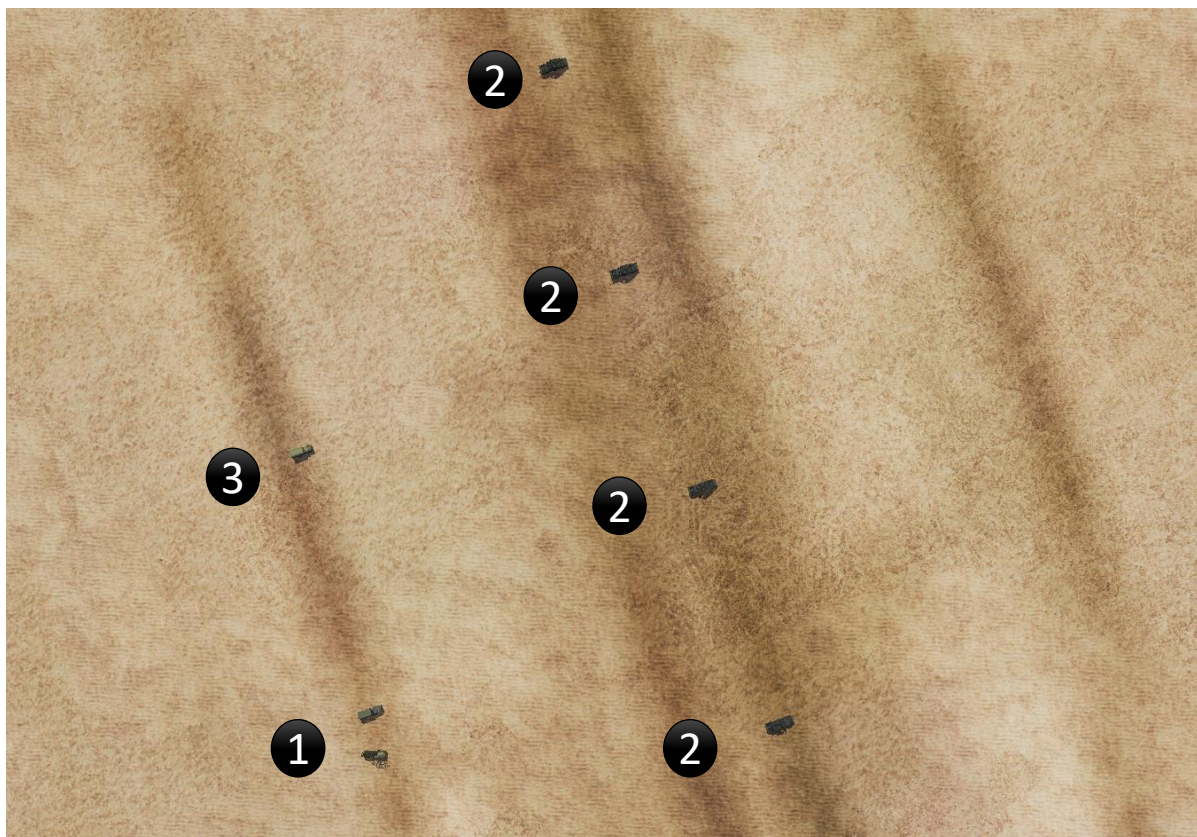


The SA-8 is a mobile short-range RF SAM designed to defend against low- and medium-altitude attack aircraft and helicopters. A SA-8 battery of four TLARs is loosely deployed with each unit operating autonomously, supported by a battery command vehicle and P-19 EWR.

The SA-8 is effective against low- to medium-altitude targets and has good maneuverability. The SA-8 has no capability to engage HARMs but has a capability to engage cruise missile class targets.

Critical Information	
Max Engagement Range	5.5 nm
Min Engagement Range	<1nm
Guidance Type	Command Line of Sight
Missiles per Battery	24
Reaction Time	25 sec

3 – Russian Origin Air Defense: SA-8



Not A Deployment Layout

1 – P-19 EWR x 1

2 – SA-8 TLAR x 4

3 – Battery command vehicle x 1

Minimal Equipment Required for Operation

1x SA-8 TLAR

3 – Russian Origin Air Defense: SA-8

LAND ROLL - TTR



RWR Symbol



Each TLAR is equipped with a its own radars for engagement; incorporates a spinning TAR, single TTR, two missile track radars, and missile capture and uplink antennas. The LAND ROLL is capable of single target track and two missile engagements.

The TAR has a max detection range of 16 nm, but this will vary on target RCS. The LAND ROLL has a robust autonomous scan ability through its integrated TAR, but is usually supplemented with an P-19 EWR, displayed as “S” or “FF” on RWR. The EWR does not take part in the engagement, and is used solely to support the LAND ROLL.

3 – Russian Origin Air Defense: SA-8

Concept of Operation

1. Target Acquisition:

The P-19 will scan for targets within range of the SA-8. Once a target has been acquired with the P-19 its information will be passed to the TLAR, which will acquire it with its onboard TAR.

2. Target Tracking:

Once a target is in range the LAND ROLL TTR will begin to lock-on to a single target. It will take several seconds for the system to lock-on to the target, after which up to two SA-8 missiles can be launched.

3. Target Engagement:

Post launch, each missile will be acquired by one of the missile track radars on either side of the TTR. The system will calculate the necessary guidance commands required to intercept the target. These commands are then sent to the missiles via a missile uplink signal. The warhead can be activated via a commanded detonation, or a radio proximity fuze.

3 – Russian Origin Air Defense: SA-10f

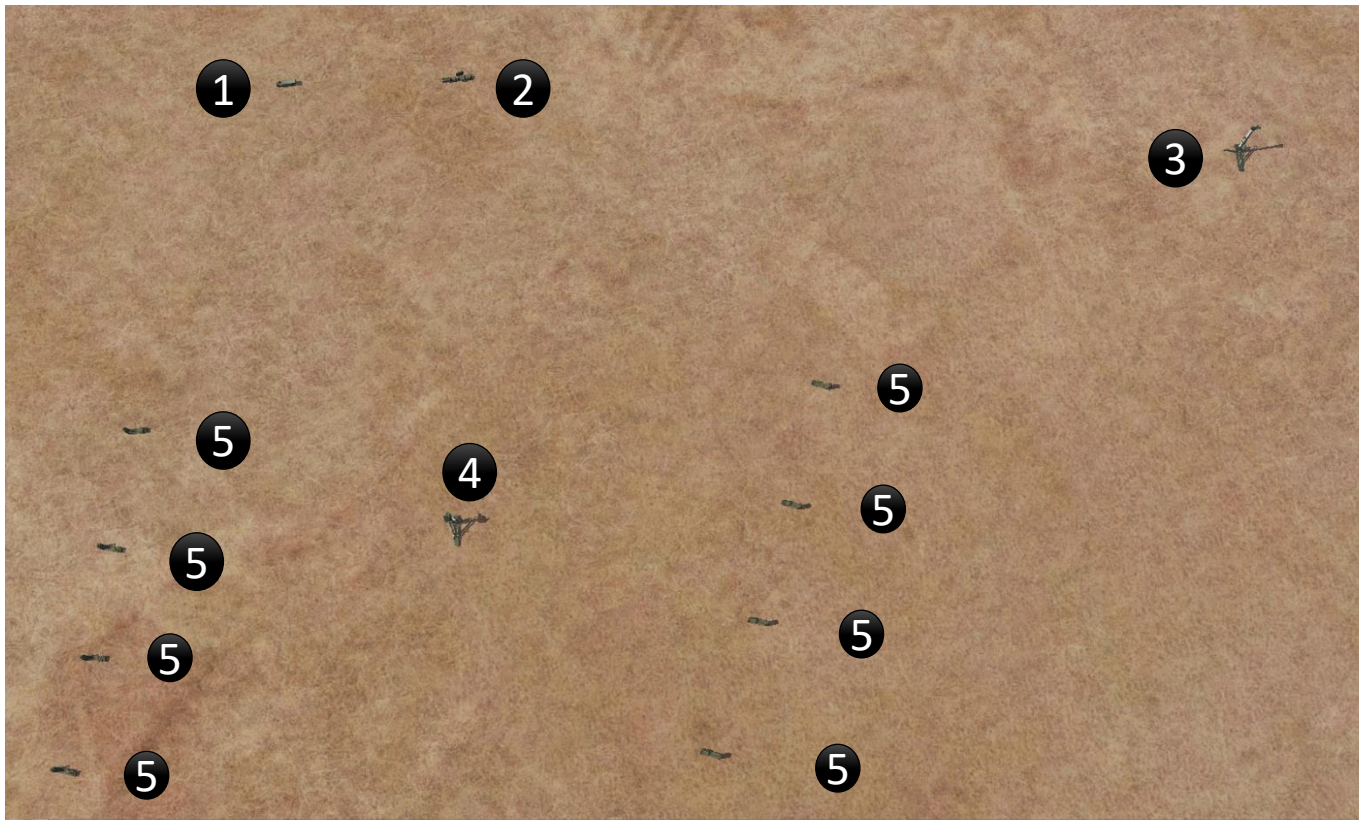


The SA-10f is a long-range RF SAM designed to defend against medium- to high-altitude aircraft and cruise missiles. The system is designed as a semi-mobile defense that can be deployed to defend priority locations as well as area defense. A standard SA-10f battery consists of one battery command vehicle, one CLAM SHELL low-altitude TAR, one FLAP LID target engagement radar, and up to eight TELs. A BIG BIRD EWR usually supports multiple SA-10f batteries.

The SA-10f is effective against medium- to high-altitude targets and has good maneuverability. The SA-10f has a capability to engage HARMs and cruise missile class targets.

Critical Information	
Max Engagement Range	65 nm
Min Engagement Range	3.75 nm
Guidance Type	Semi-active RF Homing
Missiles per Battery	32
Reaction Time	20 sec

3 – Russian Origin Air Defense: SA-10f



1 – Battery Command Vehicle x 1

2 – BIG BIRD EWR x 1

3 – CLAM SHELL TAR x 1

4 - FLAP LID TER x1

5 – SA-10f TELs x8

Minimal Equipment Required for Operation

1x FLAP LID TER

1x Battery Command Vehicle

1x SA-10f TEL

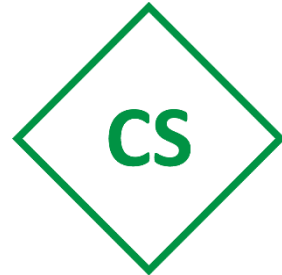
3 – Russian Origin Air Defense: SA-10f

FLAP LID - TER



RWR Symbol

CLAM SHELL - TAR



RWR Symbol

Standard doctrine has a single CLAM SHELL TAR and a single FLAP LID TER deployed with each SA-10f battery. A single BIG BIRD EWR, displayed as “BB” on RWR, can be deployed to support multiple SA-10f batteries. The FLAP LID TER can support up to 5 simultaneous engagements, with up to 2 missiles per target.

The FLAP LID has a max detection range of 86 nm, but this will vary on target RCS. The CLAM SHELL has a limited autonomous scan ability tailored to detect low level targets. An EWR is required to effectively detect medium- to high-altitude targets. The FLAP LID is the only radar that conducts actual engagements.

3 – Russian Origin Air Defense: SA-10f

Concept of Operation

1. Target Acquisition:

The CLAM SHELL, supported by a BIG BIRD, will scan for targets within range of the SA-10f. Once a target has been acquired target information will be passed to the FLAP LID TER.

2. Target Tracking:

The FLAP LID will attempt to lock-on to the target based on tracking information from the EWR. It will take several seconds for the system to lock-on to the target. Once it is in range, up to 2 missiles are assigned to up to five targets.

3. Target Engagement:

With the locked target in range, the assigned missiles will be launched at the target. Typically aircraft will be engaged with 1 missile, while incoming missiles will be engaged with 2 missiles. The FLAP LID will track the target and the missile, providing course correction commands until the missile can acquire the reflected RF energy off the target with its' onboard seeker. The missiles warhead is activated by command or a proximity fuze.

3 – Russian Origin Air Defense: SA-11



The SA-11 is a medium-range RF SAM designed to defend against low- to high-altitude attack aircraft. The system is designed as a mobile defense that can be quickly deployed to defend priority locations. Up to six transporter-erector-launchers-and-radars (TELARs) are dispersed around the battery command vehicle, supported by the SNOW DRIFT TAR.

The SA-11 is effective against low- to high-altitude targets and has good maneuverability. The SA-11 has a capability to engage HARMs and cruise missile class targets.

Critical Information	
Max Engagement Range	19 nm
Min Engagement Range	2 nm
Guidance Type	Semi-active RF Homing
Missiles per Battery	16-24
Reaction Time	30 sec

3 – Russian Origin Air Defense: SA-11



Not A Deployment Layout

1 – Battery Command Vehicle x 1

2 – SA-11 TELAR x 4-6

3 – SNOW DRIFT TAR x 1

Minimal Equipment Required for Operation

1x SA-11 TELAR

3 – Russian Origin Air Defense: SA-11

FIRE DOME - TIR



RWR Symbol



Each TELAR is equipped with a FIRE DOME TIR. The FIRE DOME TIR tracks targets and provides the illumination signal for the missile to track the target. The FIRE DOME is capable of single target track with single missile engagement.

The FIRE DOME has a max detection range of 38 nm, but this will vary on target RCS. The FIRE DOME has a limited autonomous scan ability directly in front of the radar, but is usually supplemented with an SNOW DRIFT TAR radar. The SNOW DRIFT does not take part in the engagement.

3 – Russian Origin Air Defense: SA-11

Concept of Operation

1. Target Acquisition:

The SNOW DRIFT will scan for targets within range of the SA-11. Once a target has been acquired with the SNOW DRIFT its information will be passed to a TELAR.

2. Target Tracking:

Once a target is in range the FIRE DOME TIR will begin to lock-on to a single target. It will take several seconds for the system to lock-on to the target. Once the target is locked-on the SA-11 TELAR will be slewed towards the target.

3. Target Engagement:

With the locked target in range a single SA-11 missile will be launched at the target. The FIRE DOME TIR will track the target and illuminate it with a radar signal. This radar signal is detected by a semi-active radar seeker on the missile, and used to guide the missile to the target. The missiles warhead is active by a proximity fuze.

3 – Russian Origin Air Defense: SA-13

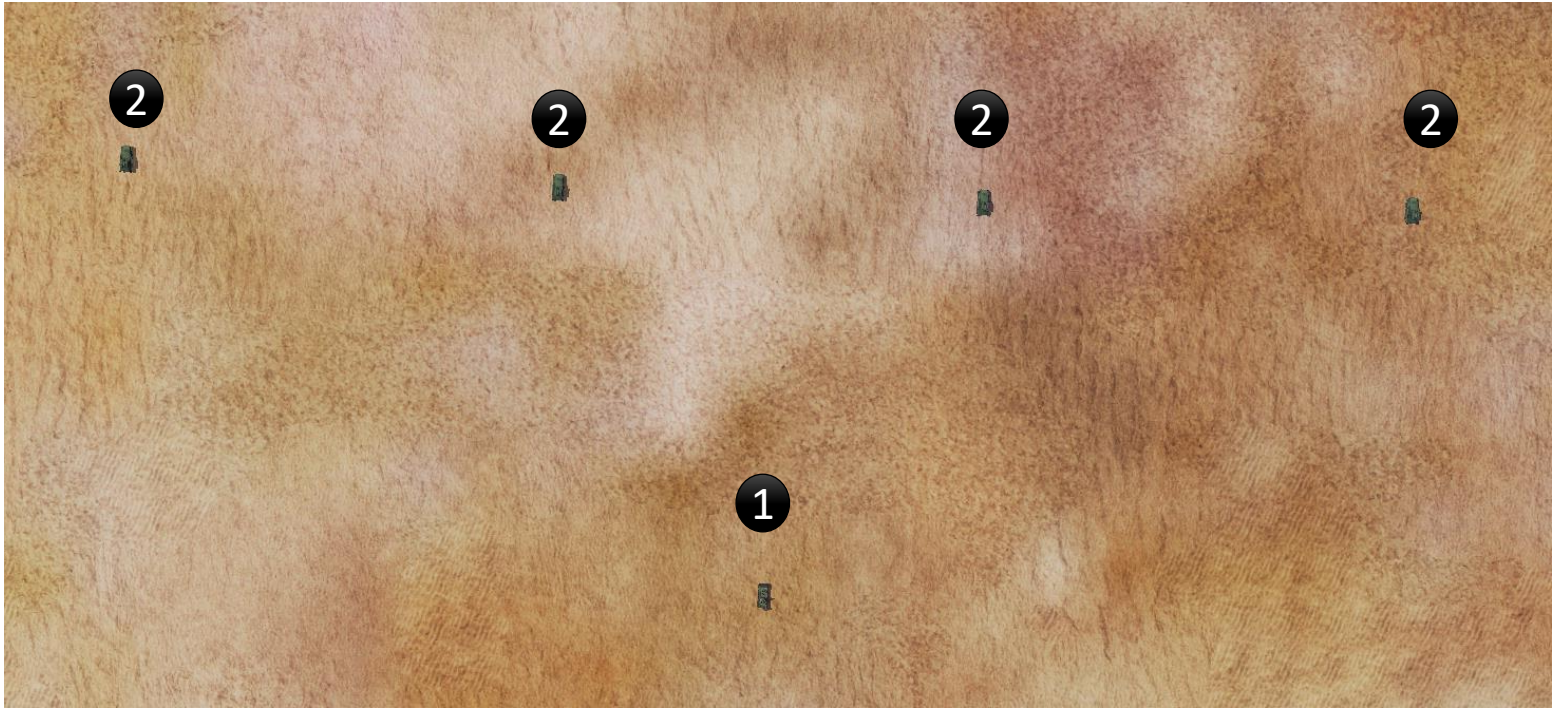


The SA-13 is a mobile short-range IR SAM designed to defend against low-altitude attack aircraft and helicopters. A SA-13 battery of four to six TELARs is loosely deployed with each unit operating autonomously, supported by a battery command vehicle equipped with a DOG EAR EW.

The SA-13 is effective against low-altitude targets and has good maneuverability. The SA-19 has no capability to engage HARMs but has a capability to engage cruise missile class targets.

Critical Information	
Max Engagement Range	3 nm
Min Engagement Range	<.5nm
Guidance Type	Infrared Guidance
Missiles per Battery	16-24
Reaction Time	5 sec

3 – Russian Origin Air Defense: SA-13



Not A Deployment Layout

1 – Battery command vehicle x 1

2 – SA-13 TELARs x 4-6

Minimal Equipment Required for Operation

1x SA-13 TELAR

3 – Russian Origin Air Defense: SA-13

SNAP SHOT - ROR



RWR Symbol



The system conducts autonomous target acquisition with its onboard optical sight. The TEL also incorporates the range only SNAP SHOT radar.

The TELAR has a maximum optical detection range of 4.2 nm. Each SA-13 battery is usually supplemented with a command vehicle equipped with a DOG EAR EWR. The EWR does not take part in the engagement, and is used solely to support the passing of targets to TELs.

3 – Russian Origin Air Defense: SA-13

Concept of Operation

1. Target Acquisition:

The DOG EAR will scan for targets within range of the SA-13. Once a target has been acquired with the DOG EAR its information will be passed to the TELAR.

2. Target Tracking:

Once a target is in range the TELAR will track a single target with its optical sight. Missiles are bore sighted to the optical sight, and will begin attempting to lock-on to the target immediately. It will take several seconds for the missile to lock-on to the target, after which a missile can be launched. Once the target is acquired the SNAP SHOT radar will verify the targets range just prior to launch. Multiple missiles can be fired at a single target.

3. Target Engagement:

Post launch, the missile will track the target with its onboard seeker head. The seeker head tracks onto the thermal output from the aircraft engine. The missile warhead can be activated via contact or proximity fuze.

3 – Russian Origin Air Defense: SA-15

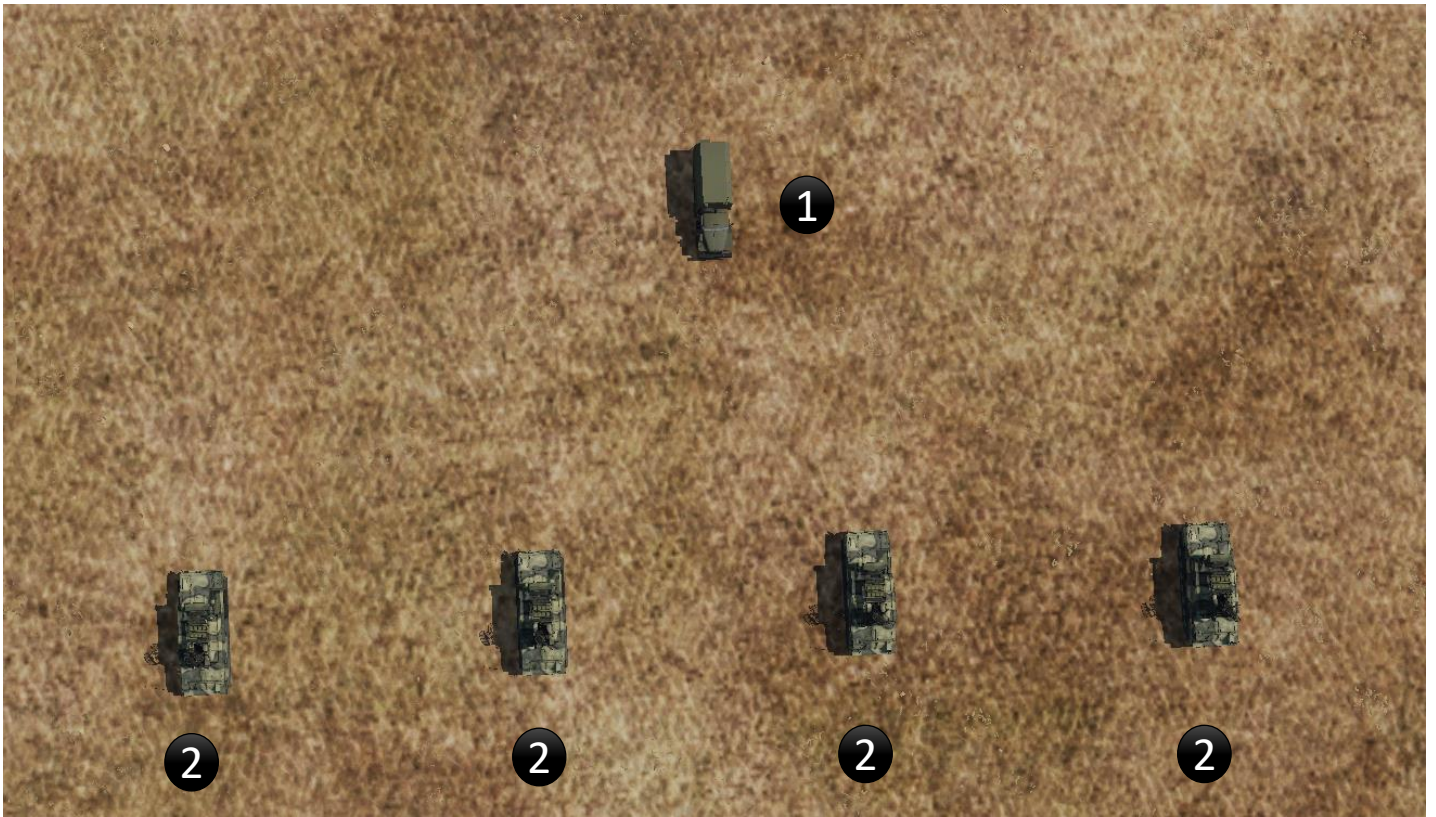


The SA-15 is a mobile short-range RF SAM designed to defend against low- and medium-altitude attack aircraft, helicopters, and cruise missiles. A SA-15 battery of four TLARs is loosely deployed with each unit operating autonomously, supported by a battery command vehicle.

The SA-15 is effective against low- to medium-altitude targets and has very good maneuverability. The SA-15 has a capability to engage against HARMs and cruise missile class targets.

Critical Information	
Max Engagement Range	6.5 nm
Min Engagement Range	<1nm
Guidance Type	Command Line of Sight
Missiles per Battery	32
Reaction Time	10 sec

3 – Russian Origin Air Defense: SA-15



Not A Deployment Layout

1 – Battery Command Vehicle x 1

2 – SA-15 TLAR x 4

Minimal Equipment Required for Operation

1x SA-15 TLAR

3 – Russian Origin Air Defense: SA-15

SCRUM HALF - TTR



RWR Symbol



Each TLAR is equipped with a its own radars for engagement; incorporating a spinning TAR, SCRUM HALF TTR and missile capture and uplink antenna. The SCRUM HALF is capable of single target track with two missile per engagement.

The TAR has a max detection range of 13 nm, but this will vary on target RCS. The SA-15 has a robust autonomous scan ability through its integrated TAR.

3 – Russian Origin Air Defense: SA-15

Concept of Operation

1. Target Acquisition:

The SA-15 will scan for targets within range of the TLAR. The TAR is capable of detecting aircraft, helicopters, and cruise missiles at significant ranges

2. Target Tracking:

Once a target is in range the SCRUM HALF TTR will begin locking-on to a single target. It will take several seconds for the system to lock-on to the target, after which up to two missiles can be launched.

3. Target Engagement:

Post launch, each missile will be acquired by the missile capture antenna on either side of the TTR. The TTR will calculate the necessary guidance commands required to intercept the target. These commands are then sent to the missiles via a missile uplink signal. The warhead can be activated via a commanded detonation, or a radio proximity fuze.

3 – Russian Origin Air Defense: SA-19



The SA-19 is a mobile short-range RF SAM designed to defend against low- and medium-altitude attack aircraft, helicopters, and cruise missiles. A SA-19 battery of four TELARs is loosely deployed with each unit operating autonomously, supported by a battery command vehicle.

The SA-19 is effective against low- to medium-altitude targets and has very good maneuverability. The SA-19 has capability to engage HARMs and cruise missile class targets.

Critical Information	
Max Engagement Range	4 nm
Min Engagement Range	< .5nm
Guidance Type	Command Line of Sight
Missiles per Battery	32
Reaction Time	7 sec

3 – Russian Origin Air Defense: SA-19



Not A Deployment Layout

1 – Battery Command Vehicle x 1

2 – SA-19 TELAR x 4

Minimal Equipment Required for Operation

1x SA-19 TELAR

3 – Russian Origin Air Defense: SA-19

HOT SHOT - TTR



RWR Symbol



Each TELAR is equipped with a its own radars for engagement; incorporates a spinning TAR and HOT SHOT TTR. The HOT SHOT is capable of single target track with one missile per engagement. The missile of the SA-19 has a unique boosted dart design that results in very low smoke signature.

The TAR has a max detection range of 10 nm, but this will vary on target RCS. The SA-19 has a robust autonomous scan ability through its integrated TAR.

3 – Russian Origin Air Defense: SA-19

Concept of Operation

1. Target Acquisition:

The SA-19 will scan for targets within range of the TELAR with its onboard TAR. Once a target has been acquired with the system will attempt to lock onto the target with the HOT SHOT TTR or passive EO/IR sensors.

2. Target Tracking:

Once a target is in range the HOT SHOT TTR will begin locking-on to a single target. It will take several seconds for the system to lock-on to the target, after which one missile can be launched. Alternatively, the system can also conduct passive engagements using only the EO/IR sensor package.

3. Target Engagement:

Post launch, each missile will be acquired and the system will calculate the necessary guidance commands required to intercept the target. This can be done with the radar, or passively with the EO/IR sensor suite. These commands are then sent to the missile via a missile uplink signal. The warhead can be activated via a contact or proximity fuze.

3 – Russian Origin Air Defense: ZSU-23



The ZSU-23 is a Self-Propelled Anti-Aircraft Gun (SPAAG) designed to defend troops against low-altitude aircraft. A ZSU-23 battery of four SPAAGs is loosely deployed with each unit operating autonomously, supported by a battery command vehicle.

The ZSU-23 is effective against slow moving, low-altitude targets and can engage ground targets as well. The ZSU-23 has no capability to engage HARMs but has a capability to engage cruise missile class targets.

Critical Information	
Max Engagement Range	1.3 nm
Min Engagement Range	N/A
Max Rate of Fire	4000 RPM
Rounds Per Vehicle	2000
Reaction Time	12 sec

3 – Russian Origin Air Defense: ZSU-23



1 – Battery Command Vehicle x 1

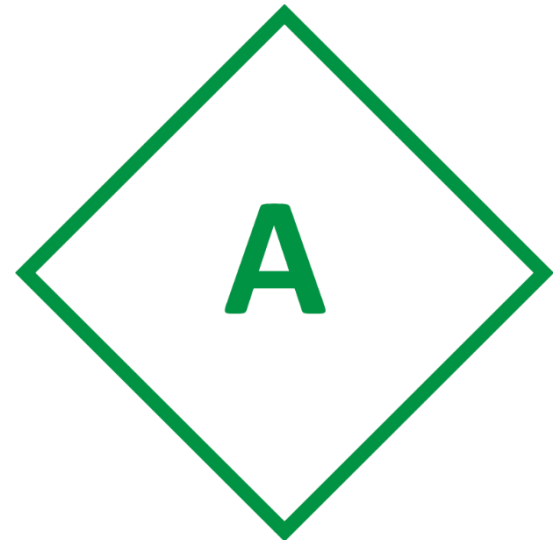
2 – SPAAG x 4

Minimal Equipment Required for Operation

1x SPAAG

3 – Russian Origin Air Defense: ZSU-23

GUN DISH - TTR



RWR Symbol

Each ZSU-23 SPAAG is equipped with a GUN DISH TTR, which can also be used for limited scanning of targets. The GUN DISH is capable of single target track, which is then used to compute target lead angles.

The GUN DISH has a max detection range of 2.5 nm, but this will vary on target RCS. The GUN DISH has a limited autonomous scan ability, so each ZSU-23 battery is usually paired with an battery command vehicle to receive targets feeds from other radars.

3 – Russian Origin Air Defense: ZSU-23

Concept of Operation

1. Target Acquisition:

The ZSU-23 will scan for targets with the GUN DISH or optical sights. The GUN DISH has a narrow beam width, making wide area scanning difficult.

2. Target Tracking:

The GUN DISH will begin to locking-on to a single target once it enters the systems range. It will take several seconds for the system to lock-on to the target. Once the target is locked the system will automatically compute lead angles for the guns.

3. Target Engagement:

The ZSU-23 will engage by firing its four gun in a controlled burst onto a calculated point of impact, computed from position and velocity information of the target. This position is reliant on the aircraft to not maneuver after the rounds have been fired.

4 – US Origin Air Defense: HAWK

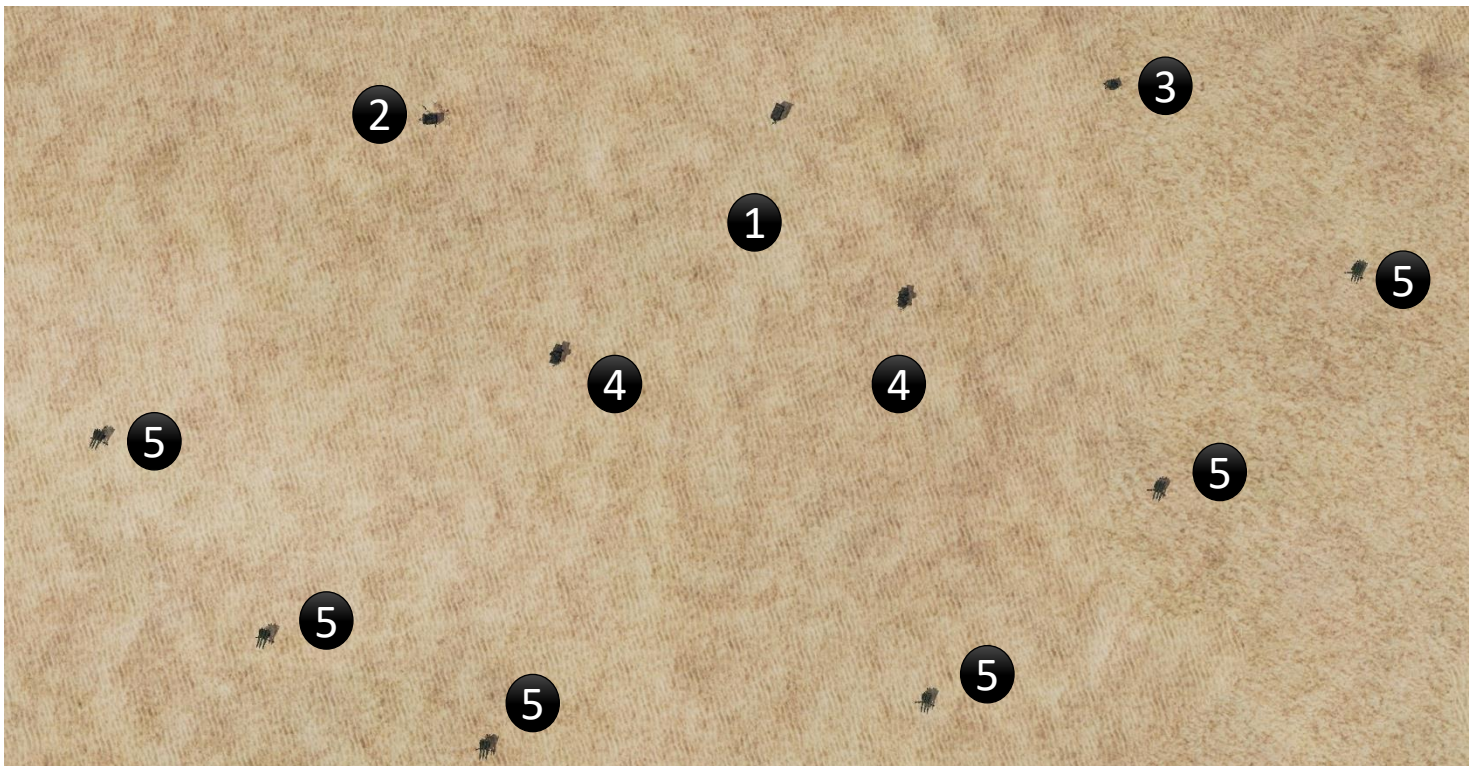


The HAWK (Homing All the Way Killer) is a medium-range RF SAM designed to defend against medium- and high-altitude attack aircraft. A standard HAWK battery is made of a battery command vehicle, four radars, and six launchers. A HAWK battery is capable of single target track with a four missile engagement.

The HAWK is effective against medium- to high-altitude targets and has good maneuverability. The HAWK has no capability to engage HARMs but has a capability to engage cruise missile class targets.

Critical Information	
Max Engagement Range	24 nm
Min Engagement Range	2 nm
Guidance Type	Semi-active RF Homing
Missiles per Battery	18
Reaction Time	35 sec

4 – US Origin Air Defense: HAWK



1 – Battery Command Vehicle x 1

2 – AN/MPQ-50 TAR x 1

3 – AN/MPQ-55 TAR x 1

4 – AN/MPQ-46 TIR x 2

5 – Launcher x 6

Minimal Equipment Required for Operation

1x Battery Command Vehicle

1x AN/MPQ-46 TER

1x Launcher

4 – US Origin Air Defense: HAWK

AN/MPQ-46 - TIR



RWR Symbol



The AN/MPQ-46 TIR consists of separate transmit and receive arrays. The AN/MPQ-46 tracks the target, illuminates the target for the missile, as well as tracking the missile for mid-course guidance. The TIR is capable of single target track with two missile engagements.

The TIR has a max detection range of 48 nm, but this will vary on target RCS. The TIR has a limited autonomous scan ability so each HAWK battery is usually equipped with TARs, labeled as HA in RWR. The TARs do not take part in the engagement, and are used solely to support the TIR.

4 – US Origin Air Defense: HAWK

Concept of Operation

1. Target Acquisition:

Both TARs will scan for targets within range of the TER. Once a target has been acquired the target information will be used to cue the AN/MPQ-46 TIR.

2. Target Tracking:

Once a target is in range both AN/MPQ-46 TIRs will typically begin to lock-on to a single target, instead of each locking-on to separate targets. It will take several seconds for the system to lock-on to the target, after which two HAWK missiles can be launched per TIR.

3. Target Engagement:

Post launch, each missile will acquire the target from signals reflected by the target from the AN/MPQ-46 TIRs. The target track is compared with missile reference signals transmitted to the missile by the AN/MPQ-46 TIR. At endgame, the warhead can be activated via a contact or proximity fuze.

4 – US Origin Air Defense: Patriot



The Patriot is a long-range RF SAM designed to defend against medium- and high-altitude attack aircraft and cruise missiles. A standard Patriot battery is made of numerous command vehicles, one radar, and up to eight launchers.

The Patriot is effective against medium- to high-altitude targets and has good maneuverability. The Patriot has a capability to engage HARMs and cruise missile class targets.

Critical Information	
Max Engagement Range	54 nm
Min Engagement Range	2 nm
Guidance Type	Semi-active RF Homing
Missiles per Battery	32
Reaction Time	15 sec

4 – US Origin Air Defense: Patriot



- 1 – AN/MSQ-104 Engagement Control Station (ECS) x 1
- 2 – Information and Coordination Central Vehicle x 1
- 3 – AN/MPQ-53 TER x 1
- 4 – Launcher x 8

Minimal Equipment Required for Operation

- 1x AN/MSQ-104 ECS
- 1x AN/MPQ-53 TER
- 1x Launcher

4 – US Origin Air Defense: Patriot

AN/MPQ-53 - TER



RWR Symbol



The AN/MPQ-53 TER is a phased array antenna that performs target acquisition and target engagement in one unit. The array is stationary while transmitting, and is only able to scan a 103 deg sector directly in front of it. The AN/MPQ-46 tracks the target, illuminates the target for the missile, as well as tracking the missile.

The AN/MPQ-53 has a max detection range of 86 nm, but this will vary on target RCS. The TER is operated from the ECS, which is also required in order to operate the radar.

4 – US Origin Air Defense: Patriot

Concept of Operation

1. Target Acquisition:

The AN/MPQ-53 will scan for targets within its scan zone. Once a target has been acquired the system will lock-on to the target. Up to five targets can be tracked at once.

2. Target Tracking:

The AN/MPQ-53 will attempt to lock-on to the target immediately after acquisition. It will take several seconds for the system to lock-on to the target. Once it is in range, up to 2 missiles are assigned to each target.

3. Target Engagement:

With the tracked target in range, the assigned missiles will be launched at the target. Typically aircraft will be engaged with 1 missile, while attacking missiles will be engaged with 2 missiles. The AN/MPQ-53 will track the target and the missile, providing course correction commands to the missile via RF commands. The missile's seeker will acquire the reflected RF signal from the target, and compare this information with radar tracking data. The missile's warhead is activated by command or a proximity fuze.

4 – US Origin Air Defense: M-163

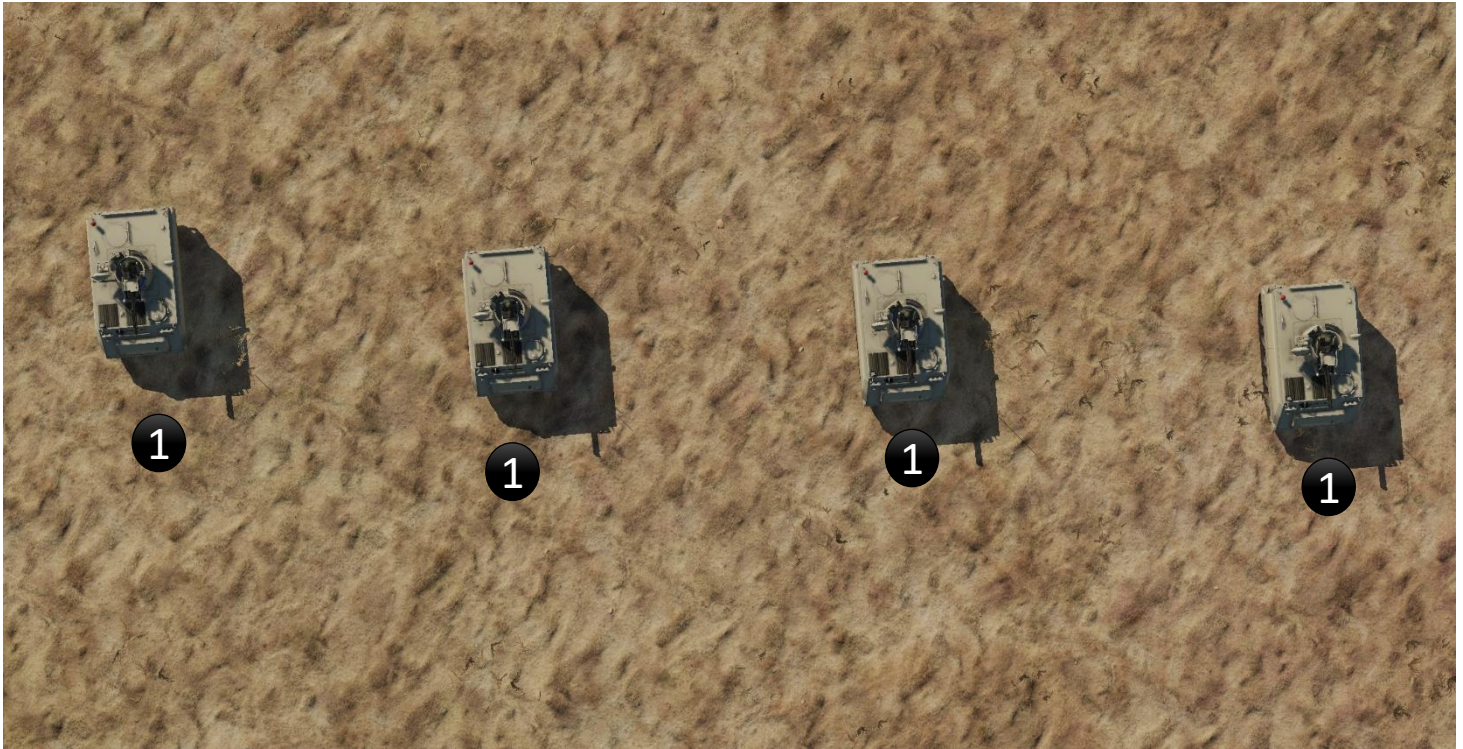


The M-163 is a SPAAG designed to defend troops against low-altitude aircraft. A M-163 battery is loosely deployed with each unit operating autonomously.

The M-163 is effective against slow moving, low-altitude targets and can engage ground targets as well. The M-163 has no capability to engage HARMs but has a capability against cruise missile class targets.

Critical Information	
Max Engagement Range	1 nm
Min Engagement Range	N/A
Max Rate of Fire	3000 RPM
Rounds Per Vehicle	2280
Reaction Time	12 sec

4 – US Origin Air Defense: M-163



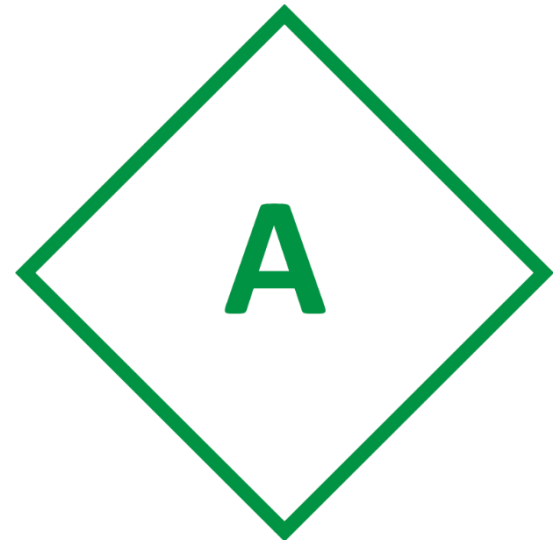
1 – SPAAG x 4

Minimal Equipment Required for Operation

1x SPAAG

4 – US Origin Air Defense: M-163 M613

AN/VPS-2 - ROR



RWR Symbol

Each M-163 SPAAG is equipped with a AN/VPS-2 ROR, which is only used just prior to engagement to confirm target range. Primary target tracking and angle calculation is done through the optical sight.

The AN/VPS-2 has a max detection range of 2.7 nm, but this will vary on target RCS. The AN/VPS-2 has no autonomous scan ability, requiring the gunner to visually scan for target.

4 – US Origin Air Defense: M-163

Concept of Operation

1. Target Acquisition:

The M-163 gunner will visually scan for a target. Once the target is acquired, he will slew the turret towards the target.

2. Target Tracking:

The M-163 gunner will begin to manually track the target through his optical system, which also computes lead angles for the gun. The gunner will range the target with the AN/VPS-2, confirming the target as in range.

3. Target Engagement:

The M-163 will engage by firing its cannon in a controlled burst onto a calculated point of impact, computed from position and velocity information of the target. This position is reliant on the aircraft to not maneuver after the rounds have been fired.

5 – ROW Origin Air Defense: HQ-7



The HQ-7 is a short-range RF SAM designed to defend against low- and medium-altitude attack aircraft and cruise missiles. The system is designed as a mobile defense that can be quickly deployed to defend priority locations or front line locations. A standard HQ-7 battery is made of a radar equipped battery command vehicle and three TELARs

The HQ-7 is effective against low- to medium-altitude targets and has good maneuverability. The HQ-7 has no capability to engage HARMs but has a capability to engage cruise missile class targets.

Critical Information	
Max Engagement Range	6.5 nm
Min Engagement Range	<1 nm
Guidance Type	Command Line of Sight
Missiles per Battery	12
Reaction Time	8 sec

5 – ROW Origin Air Defense: HQ-7



Not A Deployment Layout

1 – Battery Command Vehicle x 1

2 – TELAR x 3

Minimal Equipment Required for Operation

1x TELAR

5 – ROW Origin Air Defense: HQ-7

HQ-7 TELAR - TTR



RWR Symbol

Each HQ-7 TELAR is equipped with a TTR used for target and missile tracking. The HQ-7 TTR is capable of single target track and one missile engagements.

The HQ-7 TTR has a max detection range of 10.75 nm, but this will vary on target RCS. The HQ-7 TELAR has a limited ability to acquire targets autonomously, but is usually supported by the battery command vehicle TAR, displayed as “HQ” or “UK” on RWR. The TAR does not take part in the engagement, and is used solely to support the HQ-7 TELAR.

5 – ROW Origin Air Defense: HQ-7

Concept of Operation

1. Target Acquisition:

The HQ-7 TAR will scan for targets within its scan zone. This radar currently displays in RWR displays as “HQ” or “UK”, for unknown. Once a target has been acquired the system will put the target in track. Target tracks are then passed to the TELARs.

2. Target Tracking:

The HQ-7 TELAR TTR will acquire the target. It will take several seconds for the system to lock-on to the target. Once it is in range, up to one missile is launched at each target.

3. Target Engagement:

Post launch the missile will be acquired by the onboard EO/IR sensor, then by the TTR. The system will calculate the necessary guidance commands required to intercept the target. These commands are then sent to the missiles via a missile uplink signal. The warhead is activated via a proximity fuze.

5 – ROW Origin Air Defense: Rapier



The Rapier is a short-range RF SAM designed to defend against low-altitude attack aircraft. The system is designed as a mobile defense that can be fielded to defend priority locations. A standard Rapier battery is made of a Blindfire radar, optical tracker, and launcher. The Rapier is effective against low-altitude targets and has good maneuverability. The Rapier has a no capability to engage HARMs but does have a capability to engage cruise missile class targets.

Critical Information	
Max Engagement Range	3.6 nm
Min Engagement Range	<.5 nm
Guidance Type	Command Line of Sight
Missiles per Battery	4
Reaction Time	14 sec

5 – ROW Origin Air Defense: Rapier



1 – Blindfire Radar x 1

2 – Optical Tracker x 1

3 – Launcher x 1

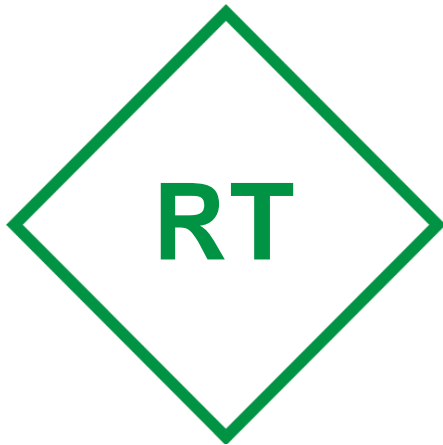
Minimal Equipment Required for Operation

1x Blindfire Radar OR Optical Tracker

1x Launcher

5 – ROW Origin Air Defense: Rapier

Blindfire - TTR



RWR Symbol



Each Rapier battery is equipped with a Blindfire TTR for target and missile tracking. The Blindfire TTR is capable of single target track and one missile engagements. The Rapier can also conduct engagements passively with the optical tracker.

The Blindfire TTR has a max detection range of 16 nm, but this will vary on target RCS. The Rapier system also uses a general search radar mounted to the launcher, which can be seen in RWR just prior to and during an engagement.

5 – ROW Origin Air Defense: Rapier

Concept of Operation

1. Target Acquisition:

The Rapier operator will scan for targets within its scan zone. Once a target has been acquired the Blindfire and optical trackers will be slewed to the target.

2. Target Tracking:

The Blindfire TTR will lock-on to the target. It will take several seconds for the system to lock-on to the target. Once it is in range, the Rapier launcher will be slewed to the target and up to one missile is launched at each target.

3. Target Engagement:

Post launch the missile will be acquired by the Blindfire TTR and optical tracker. The system will calculate the necessary guidance commands required to intercept the target. These commands are then sent to the missiles via a transmitter mounted to the launcher. The warhead is activated via a proximity fuze.

5 – ROW Origin Air Defense: NASAMS

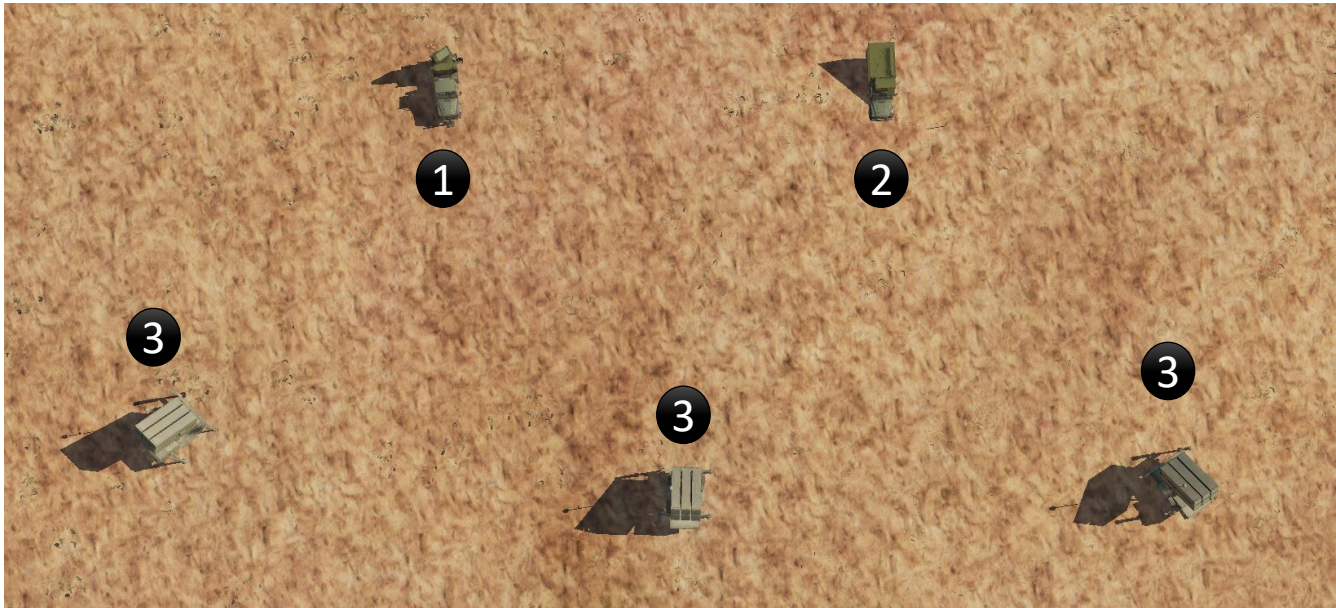


The NASAMS is a short-range RF SAM designed to defend against low- and medium-altitude attack aircraft and helicopters. The system is designed as a mobile defense that can be fielded to defend priority locations. A standard NASAMS battery is made of a MPQ64F1 radar, battery command vehicle, and launchers.

The NASAMS is effective against low-altitude targets and has very good maneuverability. The NASAMS has a capability to engage against HARMs and cruise missile class targets.

Critical Information	
Max Engagement Range	8 nm
Min Engagement Range	<.5 nm
Guidance Type	Active RF
Missiles per Battery	18
Reaction Time	15 sec

5 – ROW Origin Air Defense: NASAMS



Not A Deployment Layout

- 1 – MPQ64F1 Radar x 1
- 2 – Battery Command Vehicle x 1
- 3 – Launcher x 3

Minimal Equipment Required for Operation

- 1x MPQ64F1 Radar
- 1x Battery Command Vehicle
- 1x Launcher

5 – ROW Origin Air Defense: NASAMS

MPQ64F1 - TAR



RWR Symbol



Each NASAMS battery is equipped with a MPQ64F1 TAR for target acquisition and missile cueing. The MPQ64F1 TAR is capable of multi-target track and can provide target data to each launcher for simultaneous engagements.

The MPQ64F1 TAR has a max detection range of 27 nm, but this will vary on target RCS. The MPQ64F1 TAR will not provide indications to the aircraft of engagement and is only used to provide target position to slew launchers

5 – ROW Origin Air Defense: NASAMS

Concept of Operation

1. Target Acquisition:

The Sentinel TAR automatically scans for targets within its scan zone. Once a target has been acquired one of the launchers will be slewed towards the target.

2. Target Engagement:

Once the target is within range of the AIM-120 missile in use the system will fire a missile. The active radar seeker of the missile activates upon launch and tracks the target on its own for the duration of the flight. The warhead is activated via a proximity fuze.

5 – ROW Origin Air Defense: Roland

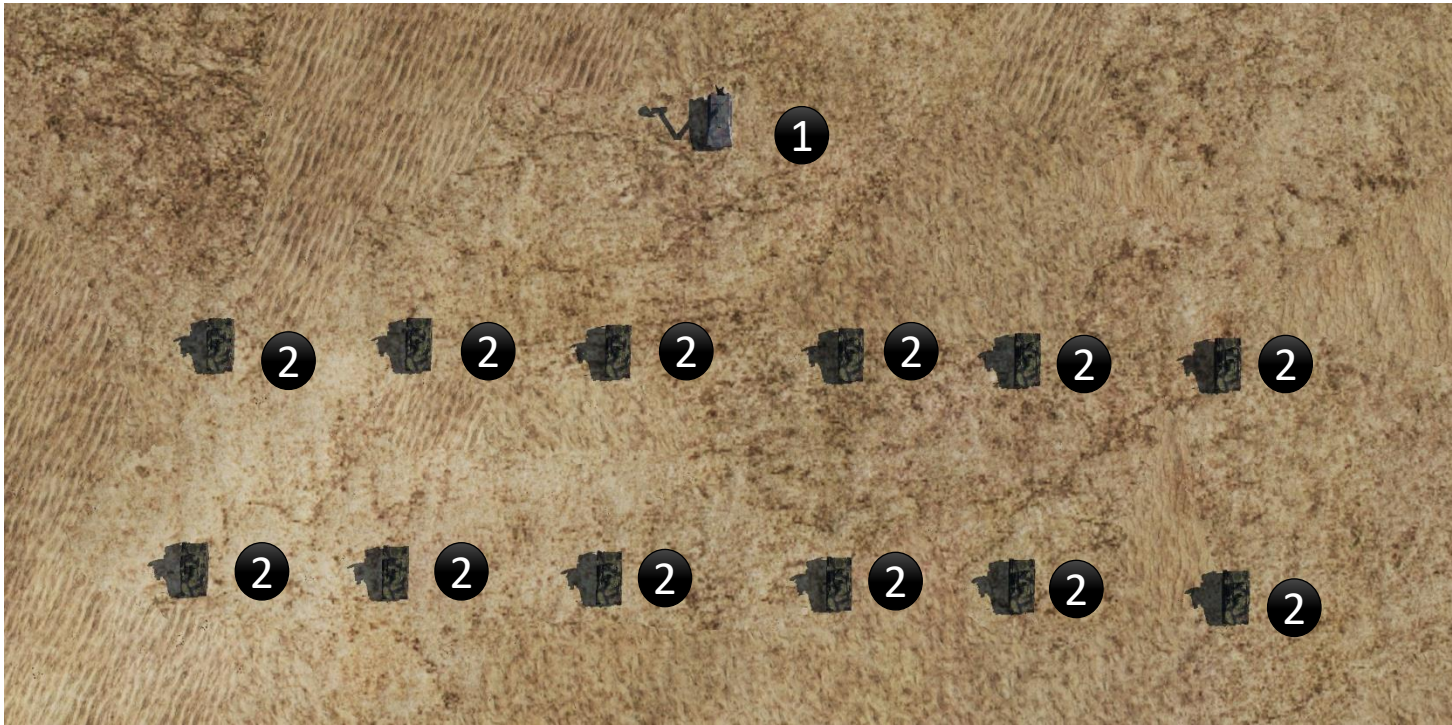


The Roland is a mobile short-range RF SAM designed to defend against low- and medium-altitude attack aircraft and cruise missiles. A Roland battery of eight to twelve TELARs is loosely deployed with each unit operating autonomously, supported by a battery command vehicle equipped with a TAR.

The Roland is effective against low- to medium-altitude targets and has good maneuverability. The Roland has no capability to engage HARMs but has a capability to engage cruise missile class targets.

Critical Information	
Max Engagement Range	4 nm
Min Engagement Range	<1 nm
Guidance Type	Command Line of Sight
Missiles per Battery	16-24
Reaction Time	12 sec

5 – ROW Origin Air Defense: Roland



Not A Deployment Layout

1 – Battery Command Vehicle x 1

2 – TELAR x 8-12

Minimal Equipment Required for Operation

1x TELAR

5 – ROW Origin Air Defense: Roland

Roland TLAR - TAR & TTR



RWR Symbol



Each TELAR is equipped with a its own radars for engagement; incorporates a spinning TAR and single TTR. The Roland TTR is capable of single target track and one missile engagements.

The TAR has a max detection range of 6.5 nm, but this will vary on target RCS. The Roland TELAR has a robust autonomous scan ability through its integrated TAR, but is usually supplemented with an Roland EWR. The EWR does not take part in the engagement, and is used solely to support the Roland TLAR in acquiring the target.

5 – ROW Origin Air Defense: Roland

Concept of Operation

1. Target Acquisition:

The Roland TAR will scan for targets within its scan zone. This radar displays in RWR as “S”. Once a target has been acquired the system will pass the target to the TELAR. Each TELAR will then attempt to acquire the target with its onboard TAR.

2. Target Tracking:

The Roland TELAR TTR will lock-on to the target once it is in range. It will take several seconds for the system to lock-on to the target. Once it is in range, up to one missile is launched at each target.

3. Target Engagement:

Post launch the missile will be steered to the target by the TTR. The system will calculate the necessary guidance commands required to intercept the target. These commands are then sent to the missiles via a missile uplink signal. The warhead is activated via a proximity fuze.

5 – ROW Origin Air Defense: Gepard



The Gepard is a SPAAG)designed to defend troops against low-altitude aircraft. A Gepard battery is loosely deployed with each unit operating autonomously.

The Gepard is effective against slow moving, low-altitude targets and can engage ground targets as well. The Gepard has no capability to engage HARMs or cruise missile class targets.

Critical Information	
Max Engagement Range	2 nm
Min Engagement Range	N/A
Max Rate of Fire	2200 RPM
Rounds Per Vehicle	620
Reaction Time	6 sec

5 – ROW Origin Air Defense: Gepard



Not A Deployment Layout

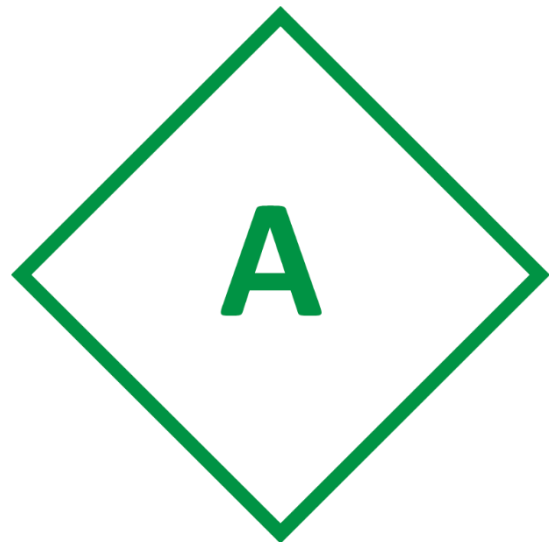
1 – SPAAG x 4

Minimal Equipment Required for Operation

1x SPAAG

5 – ROW Origin Air Defense: Gepard

Gepard – TAR & TTR



RWR Symbol

Each Gepard SPAAG is equipped with a TAR and TTR. Primary target tracking and angle calculation is done through the optical sight. The TTR is capable of single target track.

The Gepard TAR has a max detection range of 8 nm, but this will vary on target RCS. The Gepard has good autonomous scan ability and does not operate with a battery command vehicle.

5 – ROW Origin Air Defense: Gepard

Concept of Operation

1. Target Acquisition:

The Gepard SPAAG scans for targets with the onboard TAR. Once the target is acquired, the turret will slew to the target and attempt to lock-on with the TTR.

2. Target Tracking:

The Gepard TTR will lock-on to a single target once it enters the systems range. It will take several seconds for the system to lock-on to the target. Once the target is lock-on to the system will automatically compute lead angles for the guns

3. Target Engagement:

The Gepard SPAAG will engage by firing its cannon in a controlled burst onto a calculated point of impact, computed from position and velocity information of the target. This position is reliant on the aircraft to not maneuver after the rounds have been fired.