

REVIEW REPORT ON MISSILE DEFENSE SYSTEMS

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ABSTRACT

In this paper, the main description is about missile Defense system. The Missile Defense Systems are a type of missile defense intended to shield a country against incoming missiles, such as conventional or nuclear missiles. Our main emphasis is on Prithvi series Defense systems and S-400 Air defense systems.

Keywords

Interceptor missiles, Prithvi Air defense (PAD), Advanced Air Defense (AAD), S-400 air Defense system.

1. INTRODUCTION

Any mechanism which can detect and then destroy a missile before it can cause any harm is called missile defense system (MDS). They include ground-and air-based weapon systems, associated sensor systems, command and control arrangements. This system is very important for national security of each country to secure them from threat of nuclear missile attacks.



Russian S-400 Triumf Air Defense System

S-400 Triumf air defense system is designed to intercept all types of aerial targets, including ballistic and cruise missiles.



India's indigenously developed Prithvi (MDS) S-400 triumph air defense system.

2. CLASSIFICATIONS OF MISSILE DEFENSE SYSTEM

- 1) **Strategic missile defense**- Which can Targets long-range ICBMs, which travel at about 7 km/s (15,700 mph).
- 2) **Theater missile defense**- Which can Targets medium-range missiles, which travel at about 3 km/s (6,700 mph) or less.
- 3) **Tactical missile defense**- Which can Targets short-range tactical ballistic missiles, which usually travel at less than 1.5 km/s (3,400 mph).

3. TRAJECTORY PHASE OF MISSILE DEFENSE SYSTEM

Ballistic missiles can be intercepted in three regions of their trajectory: boost phase, midcourse phase or terminal phase.

A. Boost phase

Intercepting the missile while its rocket motors are firing, usually over the launch territory

Advantages

1. Bright, hot rocket exhaust makes detection and targeting easier.
2. Decoys cannot be used during boost phase.
3. At this stage, the missile is full of flammable propellant, which makes it very vulnerable to explosive warheads.

Disadvantages

1. Difficult to geographically position interceptors to intercept missiles in boost phase (not always possible without flying over hostile territory).
2. Short time for intercept (typically about 180 seconds).

B. Mid-course phase

Intercepting the missile in space after the rocket burns out.

Advantages

1. Extended decision/intercept time (the coast period through space before reentering the atmosphere can be several minutes, up to 20 minutes for an ICBM).
2. Very large geographic defensive coverage; potentially continental.

Disadvantages

1. Requires large/heavy anti-ballistic missiles and sophisticated powerful radar which must often be augmented by space-based sensors.
2. Must handle potential space-based decoys.

C. Terminal phase

Intercepting the missile after it reenters the atmosphere

Advantages

1. Smaller/lighter anti-ballistic missile is sufficient.
2. Balloon decoys do not work during reentry.
3. Smaller, less sophisticated radar required.

Disadvantages

1. Very short intercept time, possibly less than 30 seconds.
2. Less defended geographic coverage.
3. Possible blanketing of target area with hazardous materials in the case of detonation of nuclear warhead(s).

4. PRITHVI SERIES.

Prithvi Air Defense (PAD) / Pradyumna Ballistic Missile Interceptor:-The Prithvi Air Defense (PAD) is an anti-ballistic missile developed to intercept incoming ballistic missiles outside the atmosphere (exo-atmospheric). Based on the Prithvi missile, PAD is a two-stage missile with a maximum interception altitude of 80 km (50 mi). The first stage is a Solid fuelled motor while the second stage is Liquid fuelled. It has maneuver thrusters which can generate a lateral acceleration of more than 5 gs at 50 km altitude. Guidance is provided by an inertial navigation system with mid-course updates from LRTR and active radar homing in the terminal phase. PAD has capability to engage the 300 to 2,000 km (190 to 1,240 mi) class of ballistic missiles at a speed of Mach 5.

LRTR is the target acquisition and fire control radar for the PAD missile. It is an active phased array radar having capability to track 200 targets at a range of 600 km (370 mi). The PAD missile has also been called Pradyumna.

5. Advanced Air Defence (AAD)/Ashwin Ballistic Missile Interceptor

Advanced Air Defense (AAD) is an anti-ballistic missile designed to intercept incoming ballistic missiles in the endo-atmosphere at an altitude of 30 km . AAD is a single-stage, solid-fuelled missile. Guidance is similar to that of PAD: it has an inertial navigation system, midcourse updates from ground based radar and active radar homing in the terminal phase. It is 7.5 m, weighs around 1.2 t (1.2 long tons; 1.3 short tons) and a diameter of less than 0.5 m.

Prithvi Air Defense (PAD)

S-400 MISSILE DEFENSE SYSTEM

The S-400 is a Russian made air defense missile system is designed to counter mass raids of air attack weapons, including modern and prospective aircraft, low-flying targets, strategic cruise missiles, aeroballistics, tactical and theatre ballistic missiles within a vast variety of their operational altitudes and speeds, under severe ECM conditions.

Specifications	
Operational range	400 km (40N6 missile)
	250 km (48N6 missile)
	120 km (9M96E2 missile)
	40 km (9M96E missile)

Advanced Air Defense (AAD)

Specifications	
Detonation mechanism	Proximity
Engine	Two Stage
Propellant	Liquid fuel propelled first stage with two propellants and oxidisers, solid fuel propelled second stage with gas thruster.
Operational range	2,000 km (1,200 mi)
Flight altitude	80 km (50 mi) ^[12]
Speed	Mach 5+
Guidance system	Inertial Navigation System Ground-based mid-course correction Active radar homing (Terminal phase)
Launch platform	Tatra TEL 8 x 8

Specifications	
Weight	1,200 kg (2,600 lb)
Length	7.5 m (25 ft)
Diameter	<0.5 m (1.6 ft)
Detonation mechanism	Kinetic Kill (Hit-to-Kill)
Engine	Single Stage ^[18]
Propellant	Solid fuel
Flight ceiling	30 km (19 mi) SAM operational range = 150 km (93 mi) - 200 km (120 mi)
Speed	Mach 4.5
Guidance system	Inertial Navigation System Mid-course update Active radar homing (Terminal phase)
Launch platform	Tatra TEL 8 x 8 manoeuvrability g-limits=between +25 to +30g ^[19]

6. REFERENCES

- [1] Air Defense systems expert catalogue Russian defense enterprises
- [2] [https://en.wikipedia.org/wiki/S-400_\(missile\)](https://en.wikipedia.org/wiki/S-400_(missile))
- [3] https://en.wikipedia.org/wiki/Indian_Ballistic_Missile_Defence_Programme#Prithvi_Air_Defence_28PAD.29_2_F_Pradyumna_Ballistic_Missile_Interceptor
- [4] https://en.wikipedia.org/wiki/Missile_defense