
TacRef
Falcon 4.0
Munitions

TACTICAL REFERENCE

MUNITIONS HANDBOOK

Rev. 2.0

TABEL OF CONTENTS

INTRODUCTION

You are currently reading the Munitions volume of the Falcon 4.0 Tactical Reference Manual from the F4TacRef Group. Along with the other two volumes, Aircraft and Vehicles, this will provide documentation for all the entities available in the Falcon universe. Our appreciation goes to those community developers that have made the Falcon universe such a rich and diverse experience.

The data in this handbook are based upon the SuperPAK 4, Free Falcon 2 and Falcon AF Tactical Reference Databases. Compared to the Tactical References included in those patches you will find details on over 130 new additional weapons and stores. An updated online Tactical Reference with this information will be available in the future. This Volume is divided into two major chapters, the "***US/Allied Munitions Chapter***" and the "***Russian Munitions Chapter***". American, French, British, German, Israeli and Italian munitions can be found in the US/Allied Munitions. The Russian chapter includes Chinese munitions.

The information in this manual was derived from several internet Web sites. The major ones are listed in the "Sources and Resources" section. None of the Web sites are classified, and all should be generally available. Every effort has been made to obtain permission from the copyright owners for inclusion of their work in this Manual.

It should be noted that all the entries are based on the real life performance of the weapons. It is hoped that given the attention to detail and realism by the community modders that performance in Falcon should be similar to those found here. Also searching for weapon performance data often reveals quite different values, we have attempted to choose the best and most reasonable values where discrepancies occurred, but if you have additional information or spot an error in an entry, please report it to the F4TacRef group.

We hope you like it.

Best Regards

The F4TacRef Group

SOURCES AND RESOURCES

These internet pages are the major sources for the new information in this manual:

http://www.303rdbga.com/
http://www.anft.net/
http://www.aeronautics.ru/
http://www.clubhyper.com/
http://www.designation-systems.net/
http://www.europa1939.com/
http://www.f-16.net/
http://www.flug-revue.rotor.com/
http://www.fighter-jets.de/
http://www.futura-dtp.dk/
http://www.global-defence.com/
http://www.globalsecurity.org/
http://www.hazegray.org/
http://www.military-info.de/
http://www.military.cz/
http://www.vectorsite.net/
http://www.fas.org/
http://skyraider.org/
http://www.phoenixosfs.org/
http://www.x-plane.org/
http://www.kinder-hd-uni.de/
http://www.hausarbeiten.de/
http://dc2.uni-bielefeld.de/
http://de.wikipedia.org/
http://www.mbda.net/

US/ALLIED MUNITIONS CHAPTER

FREE FALL BOMBS

B-53

General Info:
Origin = USA
Type = Strategic high yield nuclear bomb
Manufacture = Los Alamos National Laboratory
IOC = 1962
Guidance = Ballistic

Performance:
Range = Gravity bomb
CEP = Estimated 330ft - 660ft

Dimensions:
Length = 147.6in
Diameter = 50.4in
Tail Span = 70.8in
Weight = 8,850lbs

Warhead:
Yield = 9Mt

Description:

The B53 was designed to be carried internally by the B-52. It was to be replaced by the B83 but retirement was delayed until 1987, probably due to a wish to retain a high yield weapon capable of destroying very hard underground targets.
340 of these early nuclear weapons were produced and they does not feature the safety and security features of the B61 and B83 bombs. The fusing must be accomplished on the ground by the maintenance personnel

B-61

General Info:
Origin = USA
Type = Tactical variable yield nuclear bomb
Manufacture = Los Alamos National Laboratory
IOC = 1967
Guidance = Ballistic

Performance:
Range = Gravity bomb
CEP = Under 650ft, as low as 65ft for Mod-10

Dimensions:
Length = 141.6in
Diameter = 13.4in
Tail Span = 22.8in
Weight = 705lbs

Warhead:
Yield = Mod-3 3, 1.5, 60, 170 Kt
Mod-4 3, 1.5, 10, 45 Kt
Mod-10 4, 5, 10, 80 Kt

Description:

The B61 is primarily a tactical weapon with a in-flight selectable yield. The three variants that exist are the Mod-3, Mod-4 and Mod-10. The last one is a converted W85 Pershing II warhead. All three variants has four yield settings from .3-170Kt. The weapons can be delivered free-fall or parachute retarded.
Over 3,000 B61s were manufactured.

B-83

General Info:
Origin = USA
Type = Strategic nuclear bomb
Manufacture = Lawrence Livermore National Laboratory
IOC = 1984
Guidance = Ballistic

Performance:
Range = Gravity bomb
CEP = Estimated 330ft - 660ft

Dimensions:
Length = 144in
Diameter = 18.1in
Tail Span = 35.4in
Weight = 2,400lbs

Warhead:
Yield = Low to 1.2Mt

Description:

This is the most recent U.S. nuclear bomb design and probably the last. It is a megaton class weapon capable of laydown surface delivery against hardened targets. It is the first megaton class weapon with such capability.
To be able to survive a high-speed, low-level drop its nose cone is capable of withstanding impact with concrete or steele. The detonation may be delayed up to 120 seconds to allow the aircraft to escape the blast.
Originally intended for delivery by the B-1B Lancer the B83 can survive delivery at speeds up to Mach 2 at an altitude of 150ft. Now it will likely be carried by the B-2 Spirit.

BLU-1/B


INCENDIARY BOMB BLU-1/B

General Info:
Origin = USA
Type = Fire bomb
Guidance = Ballistic

Performance:
Range = Gravity bomb

Dimensions:
Length = 130in
Diameter = 18.5in
Weight (Empty) = 80lbs
Weight (Loaded) = 694lbs

Warhead:
110gal jellied gasoline
Fuse = Contact

BLU-10/A

General Info:
Origin = USA
Manufacture = Kendall Model Company
Type = Fire bomb
Guidance = Ballistic

Performance:
Range = Gravity bomb

Dimensions:
Length = 89in
Diameter = 12.5in
Weight (Empty) = 39lbs
Weight (Loaded) = 236lbs

Warhead:
35gal jellied gasoline
Fuse = Contact

Description:

Fire bombs are aluminium tanks filled with an incendiary mixtures or jellied gasoline. A fuse and igniter is installed on each end of the bomb to ignite the filler when the bomb bursts upon impact.

BLU-27/B

General Info:
Origin = USA
Manufacture = Legend Productions
Type = Fire bomb
Guidance = Ballistic

Performance:
Range = Gravity bomb

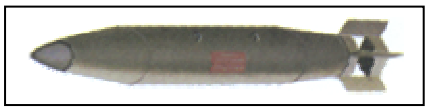
Dimensions:
Length = 138in
Diameter = 19in
Fin Span = 24in
Weight = 885lbs

Warhead:
Weight = 870lbs
Fuse = Contact
Lethal Radius = 100ft
MSD, protected = 365ft
MSD, exposed = 365ft

Description:

The BLU-27 Fire Bomb is a napalm-filled tank designed to break on impact and spread burning fuel on the surrounding area. The bomb is intended for use against dug-in troops, parked aircraft, supply installations, wooden structures, combustible materials and land convoys.

BLU-32/B



General Info:
Origin = USA
Manufacture = Kendall Model Company
Type = Fire bomb
Guidance = Ballistic

Performance:
Range = Gravity bomb
Weight = 529lbs (595lbs for BLU-32A/B)

Warhead:
67gal Napalm-B
Fuse = Contact

Description:

These 500 lb class stores happen to be finned which allowed for a more accurate and predictable trajectory. If the fins were removed, the canisters would tumble unpredictably after release which created a wider dispersion pattern for the napalm. Napalm was used as an incendiary type weapon.

BLU-82/B

General Info:
Type = Very large HE Blast
Origin = U.S.A.
IOC = 1970
Guidance = Ballistic, Parachute stabilized
Platforms = MC-130

Performance:
Range = Gravity bomb

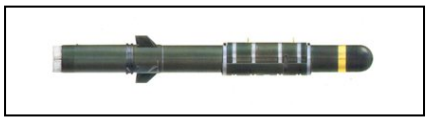
Dimensions:
Length = 142in
Diameter = 54in
Weight = 15,000lbs

Warhead:
12,600lbs GSX
Fuse = M904 nose, M905 tail

Description:

The Daisy Cutter was first used by the Air Force in the final year of U.S. involvement in the Vietnam War for clearing thick jungle areas to create instant landing zones for Army helicopters. Air Force documents call the BLU-82B weapon system "Commando Vault."
It is a general-purpose "dumb bomb" loaded aboard newer versions of the C-130 Hercules, a four-engine workhorse used by the Air Force for more than 30 years.
Because the bomb lacks a tail fin assembly, the same parachute that pulls the weapon from the back of the C-130 keeps its nose down as it falls.
The warhead contains 12,600 pounds of explosives and is detonated just above the ground by a 38-inch fuse probe extending from the bomb's nose.
It produces enough power to level trees and buildings.
Eleven BLU-82s were dropped during Operation Desert Storm, all from special operations C-130s known as Combat Talons.
The initial drops were intended to test the bomb's ability to clear mines; however, no reliable assessment was completed because the war didn't last long enough.
The crew of a MC-130E Combat Talon special operations airplane dropped a BLU-82 bomb near an Iraqi position.
The bomb detonated in an explosion that momentarily lit up the entire front.
A leaflet drop warned Iraqi soldiers more such bombs would be dropped on their positions; the threat was believed to be responsible for mass defections, including almost all of one Iraqi battalion's staff.

BLU-107B Durandal



General Info:
Type = Penetration, Anti-runway bomb
Origin = France
Manufacture = MATRA
Guidance = Ballistic, Parachute stabilized

Performance:
Range = Gravity bomb with engine
Velocity = 850ft/sec
Engine Burn = 1sec
Ceiling = 250ft

Dimensions:
Length = 99in
Diameter = 9in
Fin Span = 16in
Weight = 450lbs

Warhead:
Weight = 330lbs
Fuse = Delayed
Concrete = 4ft

Description:

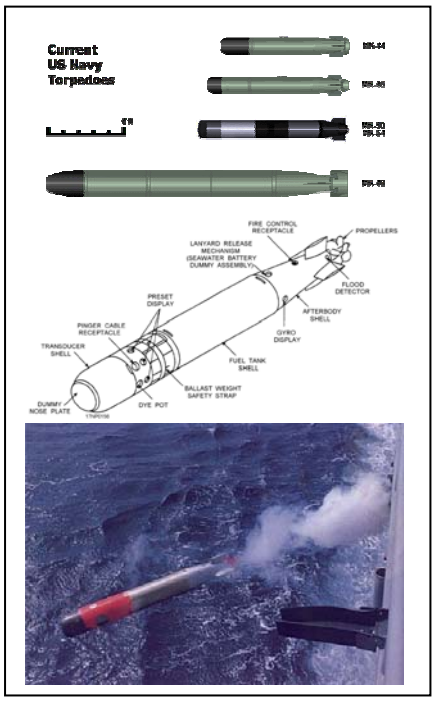
The BLU-107 Durandal is a specialized runway demolition bomb. A general purpose bomb like the Mk-84 will leave a nice crater in the middle of a runway, but this crater is easily filled in with a bulldozer and patched. In contrast, the Durandal will penetrate underneath the runway surface before it explodes, thus buckling the concrete slabs around the blast area. Not only does the Durandal blast affect a larger area, the damage takes longer to repair since the buckled concrete must be excavated before the hole can be patched.

Engagement Sequence
The BLU-107 is dropped like any other high-drag munition. After release, the Durandal deploys a drag chute to arrest its forward motion. Once the bomb slows and swings down to a vertical attitude, a sensor jettisons the chute and fires a rocket motor. The rocket drives the weapon through the runway surface into the ground. A delayed fuze detonates the warhead. The bomb is designed for a 250-foot level delivery at speeds up to 620 KCAS.

Tactics
Most aircraft don't need an entire runway for takeoff. To put a runway completely out of action, several Durandals must be dropped along the length of the runway. This can be done by rippling singles or pairs of bombs on a fast, low pass. Of course, runways tend to be heavily protected by anti-aircraft weapons, so surprise is highly desirable. (In the Gulf War, British Tornados tasked with this mission suffered the highest loss rate per sortie.)

Even after the best attack, a runway can usually be repaired in 4-6 hours, so air bases must be continually retargeted during a campaign to keep them out of operation.

MK-46



General Info:
Type = Air and ship-launched lightweight torpedo
Origin = U.S.A.
Manufacture = Alliant Techsystems
Guidance = Active or passive/active acoustic homing
Power Plant = Two-speed, reciprocating external combustion; Mono-propellant (Otto fuel II) fuelled

Performance:
Range = 8,000 yards
Weapon acquisition range = 1600 yards
Min/Max ASROC launching ranges = 1500 to 12000 yards
Speed = 45 knots
Operating Depth = Greater than 1,200 ft (365 meters)
Run characteristics = 6-8 minutes clockwise

Dimensions:
Length = 102.36in
Diameter = 12.75in
Weight = 517lbs

Warhead:
98 lbs. of PBXN-103 high explosive (bulk charge)

Description:

Torpedoes are self-propelled guided projectiles that operate underwater and are designed to detonate on contact or in proximity to a target. They may be launched from submarines, surface ships, helicopters and fixed-wing aircraft. They are also used as parts of other weapons; the Mark 46 torpedo becomes the warhead section of the ASROC (Anti-Submarine ROCket) and the Captor mine uses a submerged sensor platform that releases a torpedo when a hostile contact is detected. The three major torpedoes in the Navy inventory are the Mark 48 heavyweight torpedo, the Mark 46 lightweight and the Mark 50 advanced lightweight.

The MK-46 torpedo is designed to attack high performance submarines, and is presently identified as the NATO standard. The MK-46 torpedo is designed to be launched from surface combatant torpedo tubes, ASROC missiles and fixed and rotary wing aircraft. In 1989, a major upgrade program began to enhance the performance of the MK-46 Mod 5 in shallow water. Weapons incorporating these improvements are identified as Mod 5A and Mod 5A(S). The MK-46 Mod 5 torpedo is the backbone of the Navy's lightweight ASW torpedo inventory and is expected to remain in service until the year 2015. The MK 46 originated with the RETORC I (Research Torpedo Configuration I) program conducted by the US Naval Undersea Center (NUC) at Pasadena, CA.

MK-77

General Info:
Type = Napalm
Origin = U.S.A.
Guidance = Ballistic

Performance:
Range = Gravity bomb
Lethal Radius = 100ft
MSD, protected = 365ft
MSD, exposed = 365ft

Dimensions:
Length = 11.5ft
Diameter = 19in
Fin Span = 24in

Warhead:
Mk 77 Mod 0 - 340 kg total weight with 416 litres of petroleum oil.
Mk 77 Mod 1 - 227 kg total weight with 284 litres of petroleum oil.
Mk 77 Mod 2
Mk 77 Mod 3
Mk 77 Mod 4 - Approx 230 kg total weight with 284 litres of fuel (Used during the 1991 Gulf War)
Mk 77 Mod 5 - Approx 230 kg total weight with 284 litres of JP4/JP5 fuel and thickener (Used during the 2003 invasion of Iraq)

Description:

A fire bomb is a thin skinned container of fuel gel designed for use against dug-in troops, supply installations, wooden structures, and land convoys. The MK 77 500-pound fire bomb is the only fire bomb now in service. Fire bombs rupture on impact and spread burning fuel gel on surrounding objects. MK 13 Mod 0 igniters are used to ignite the fuel gel mixture upon impact. The MK-77 is a napalm canister munition. The MK77 familiy is an evolution of the incendiary bombs M-47 and M-74, used during the conflict in Korea and the war in Vietnam. Napalm is an incendiary mixture of benzene, gasoline and polystyrene. The Marine Corps dropped all of the approximately 500 MK-77s used in the Gulf War. They were delivered primarily by the AV-8 Harriers from relatively low altitudes. MK-77s were used to ignite the Iraqis oil-filled fire trenches, which were part of barriers constructed in southern Kuwait. The containers of napalm bomber are very light and fabricated of aluminum, with a capacity for about 75 gallons of combustible gel. They lack stabilizing fins, and consequently acquire a tumbling motion on being dropped that contributes to the scattering of the combustible gel over a wide area.
While the MK-77 is the only incendiary munition currently in active inventory, a variety of other incendiary devices were produced, including the M-47 Napalm bomb, the M-74 incendiary bomb, and white phosphorous and munitions manufacturing. Production of these devices continued during the Korean conflict, though various demilitarization and decontamination programs were initiated in the late 1950s. Munitions destroyed included M-47 Napalm-filled bombs and incendiary cluster bombs.
Napalm is a mixture of benzene (21%), gasoline (33%), and polystyrene (46%). Benzene is a normal component of gasoline (about 2%).

MK-78, MK-79

General Info:
Type = Napalm
Origin = U.S.A.
Guidance = Ballistic

Warhead:
MK78 = 500lb Napalm
MK79 = 1000lb Napalm

Description:

A fire bomb is a thin skinned container of fuel gel designed for use against dug-in troops, supply installations, wooden structures, and land convoys. The MK 77 500-pound fire bomb is the only fire bomb now in service. Fire bombs rupture on impact and spread burning fuel gel on surrounding objects. MK 13 Mod 0 igniters are used to ignite the fuel gel mixture upon impact. The MK-77 is a napalm canister munition. The MK77 familiy is an evolution of the incendiary bombs M-47 and M-74, used during the conflict in Korea and the war in Vietnam. Napalm is an incendiary mixture of benzene, gasoline and polystyrene. The Marine Corps dropped all of the approximately 500 MK-77s used in the Gulf War. They were delivered primarily by the AV-8 Harriers from relatively low altitudes. MK-77s were used to ignite the Iraqis oil-filled fire trenches, which were part of barriers constructed in southern Kuwait. The containers of napalm bomber are very light and fabricated of aluminum, with a capacity for about 75 gallons of combustible gel. They lack stabilizing fins, and consequently acquire a tumbling motion on being dropped that contributes to the scattering of the combustible gel over a wide area.
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Napalm is a mixture of benzene (21%), gasoline (33%), and polystyrene (46%). Benzene is a normal component of gasoline (about 2%). The gasoline used in napalm is the same leaded or unleaded gas that is used in automobiles. Gasoline is a mixture of hydrocarbons, which burn in an engine. It is a clear liquid, made from crude oil that burns and explodes easily. It naturally contains some benzene (which makes gas smell the way it does). Gasoline is lighter than, and floats on, water, but it will not mix with water. It dissolves grease and oil but will not dissolve polystyrene by itself, more benzene must be added to it. If gasoline is inhaled or swallowed, it can be dangerous or fatal. Breathing it results in an intense burning sensation in the throat and lungs, resulting in bronchitis and, eventually, pneumonia and possibly death. Swallowing gasoline results in inebriation (drunkenness), vomiting, dizziness, fever, drowsiness, confusion, and cyanosis (blue color). Benzene is a light, colorless, aromatic liquid made from a variety of raw materials, mostly crude oil and coal. In many ways it is similar to gasoline, of which it is a part. The major uses of benzene are in making plastics and other chemicals, not fuel, although it could be used as one. If benzene is breathed or swallowed, it causes throat irritation, rest lessens, excitement, depression, and, finally, convulsions, which can lead to death. A long exposure to benzene vapors (months or years) leads to bone marrow depression and in rare cases, leukemia.
Polystyrene is the white, tough plastic that is used to make cups, plates, and other tableware and food containers. In the pure state it is slightly heavier than water. It dissolves easily in acetone and benzene, but not in gasoline. It is not poisonous; if swallowed it passes unchanged through the digestive tract. But it is possible to choke on it. Heated polystyrene softens at about 185 F. At higher temperatures it turns back into styrene, the chemical from which it was made. Styrene has been tested as toxic to rats. In air, polystyrene melts and burns with a yellow, sooty flame. Styrene itself has a sharp, unpleasant smell that is easy to recognize.

MK-81

General Info:
Type = Low Drag General Purpose
Origin = U.S.A.
Manufacture = Nad Crane
IOC = 1950
Guidance = Ballistic

Performance:
Range = Gravity bomb

Dimensions:
Length = 70in
Diameter = 9in
Fin Span = 9in
Weight = 250lbs

Warhead:
Weight = 121lbs HE and carbon steel balls
Fuse = Impact

Description:

The MK 80 series Low Drag General Purpose (LDGP) bombs are used in the majority of bombing operations where maximum blast and explosive effects are desired. LDGP bombs are designed to be aerodynamically streamlined. Their cases are relatively light and approximately 45 percent of their complete weight is explosive. General purpose bombs may use both nose and tail fuzes and conical or retarded tail fins. Snakeye was fielded in 1964 and used extensively since; the retarder tail (Mk 14 fins for Mk 81 250-pound) allowed low-level, high-precision attack while avoiding bomb-fragment damage to delivery aircraft and retaining a low-drag delivery option.

MK-82

General Info:
Type = Low Drag General Purpose
Origin = U.S.A.
Manufacture = Nad Crane
IOC = 1950s
Guidance = Ballistic
Platforms = A-10A, B-1B, B-2, B-52, F-4G, F-15A-E, F-16A-D, F-111D-F, F-117A

Performance:
Range = Gravity bomb
Lethal Radius = 750ft
Min Release Alt = 320ft
Drag = 5
MSD, protected = 750ft
MSD, exposed = 1,650ft

Dimensions:
Length = 66.15in
Diameter = 10.75in
Weight = 500 lbs

Warhead:
Weight = 192lbs Tritonal, Minol II, or H-6
Fuse = Impact
Mk-82: Standard Mk-82
Mk-82SE: Standard Mk-82 with Snakeye fins
Mk-82ex: Standard Mk-82 with fuse extender
Mk-82SEex: Mk-82 Snakeye with fuse extender

Description:

The MK-82 is a free-fall, nonguided general purpose [GP] 500-pound bomb. The bomb is usually equipped with the mechanical M904 (nose) and M905 (tail) fuzes or the radar-proximity FMU-113 air-burst fuze. The MK 80 series Low Drag General Purpose (LDGP) bombs are used in the majority of bombing operations where maximum blast and explosive effects are desired. LDGP bombs are designed to be aerodynamically streamlined. Their cases are relatively light and approximately 45 percent of their complete weight is explosive. General purpose bombs may use both nose and tail fuzes and conical or retarded tail fins.
The MK82 AIR is a 500 pound bomb modified with a BSU-49/B high drag tail assembly. The "ballute" air bag which deploys from the tail provides a high speed, low altitude delivery capability by quickly slowing the bomb and allowing the aircraft to escape the blast pattern. The tail assembly consists of a low-drag canister unit containing a ballute (combination balloon and parachute), and a release lanyard assembly that opens the canister releasing the ballute. The ballute assembly is made from high strength low porosity nylon fabric. When the bomb is released from the aircraft a lanyard unlatches the back cover which opens, releasing part of the nylon bag/retarder. Air turbulence at the rear of the bomb acts on that portion of the retarder, pulling the remainder out of the housing. Ram air inflation is accomplished through four air inlet ports toward the aft end of the ballute. The weapon can be delivered in the low-drag mode (canister remains closed after release) or in the high drag mode. The pilot may select either a high drag or low drag configuration depending on mission requirements.

MK-83

General Info:
Type = Low Drag General Purpose
Origin = U.S.A.
Manufacture = Nad Crane
IOC = 1950s
Guidance = Ballistic
Platforms = F-14, F-18

Performance:
Range = Gravity bomb

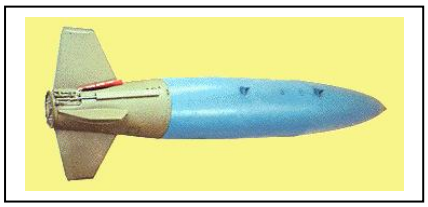
Dimensions:
Length = 119.49in
Diameter = 14.06in
Weight = 1014lbs

Warhead:
Weight = 385lbs Tritonal, Minol II, or H-6
Fuse = Impact

Description:

The MK-83 is a free-fall, nonguided general purpose [GP] 1,000 pound bomb. The bomb can be fitted either with mechanial nose and tail fuzes or with a proximity fuze. During Desert Storm, this bomb was dropped mainly by Marine aircraft conducting close air support/battlefield air interdiction (CAS/BAI) missions. The MK 80 series Low Drag General Purpose (LDGP) bombs are used in the majority of bombing operations where maximum blast and explosive effects are desired. LDGP bombs are designed to be aerodynamically streamlined. Their cases are relatively light and approximately 45 percent of their complete weight is explosive. General purpose bombs may use both nose and tail fuzes and conical or retarded tail fins.
The MK83 AIR is a 1,000 pound bomb modified with a BSU-85/B high drag tail assembly. The "ballute" air bag which deploys from the tail provides a high speed, low altitude delivery capability by quickly slowing the bomb and allowing the aircraft to escape the blast pattern. The tail assembly consists of a low-drag canister unit containing a ballute (combination balloon and parachute), and a release lanyard assembly that opens the canister releasing the ballute. The ballute assembly is made from high strength low porosity nylon fabric. When the bomb is released from the aircraft a lanyard unlatches the back cover which opens, releasing part of the nylon bag/retarder. Air turbulence at the rear of the bomb acts on that portion of the retarder, pulling the remainder out of the housing. Ram air inflation is accomplished through four air inlet ports toward the aft end of the ballute. The weapon can be delivered in the low-drag mode (canister remains closed after release) or in the high drag mode. The pilot may select either a high drag or low drag configuration depending on mission requirements.
The MK-80 series was developed in the 1950s in response to the need for bombs producing less aerodynamic drag. All MK-80 series bombs are similar in construction. MK-80 series bombs are cylindrical in shape and are equipped with conical fins or retarders for external high-speed carriage. They are fitted for both nose and tail fuzes to ensure reliability and produce effects of blast, cratering, or fragmentation.
Some bombs are thermally protected for use on aircraft carriers. The thermally protected MK 80 series bomb was developed to increase the cookoff time and decrease the reaction of bombs when engulfed in a fuel fire. The MK 82 and MK 83 series LDGP bombs underwent a Product Improvement Initiative (PII) which entailed filling the bomb cases with a less sensitive explosive. When so filled the MK 82 and MK 83 bombs are redesignated BLU-111/B and BLU-110/B, respectively.

MK-84



General Info:
Type = Low Drag General Purpose
Origin = U.S.A.
Manufacture = Nad Crane
IOC = 1950s
Guidance = Ballistic
Platforms = A-10A, B-1B, B-52H, F-4G, F-15A-E, F-16A-D, F-111D-F, F-117A

Performance:
Range = Gravity bomb
Drag = 9
Lethal Radius = 3,000ft
Min Release Alt = 1,480ft
MSD, protected = 800ft
MSD, exposed = 3,250ft

Dimensions:
Length = 153in
Diameter = 18in
Fin Span = 25in
Weight = 1,970lbs

Warhead:
Weight = 945lbs Tritonal, Minol II, or H-6
Fuse = Impact

Description:

The MK-84 is a free-fall, nonguided GP 2,000-pound bomb. The MK 80 series Low Drag General Purpose (LDGP) bombs are used in the majority of bombing operations where maximum blast and explosive effects are desired. LDGP bombs are designed to be aerodynamically streamlined. Their cases are relatively light and approximately 45 percent of their complete weight is explosive. General purpose bombs may use both nose and tail fuzes and conical or retarded tail fins. Normal fuzes are the mechanical M904 (nose) and the M905 (tail). Most of the over 12,000 MK-84s expended during Desert Storm were dropped by Air Force F-15Es, F-16s and F-111Fs; less than 1,000 of the total were dropped by Marine Corps tactical aircraft.

The MK84 AIR is a 2,000 pound bomb modified with a BSU-50/B high drag tail assembly. The "ballute" air bag which deploys from the tail provides a high speed, low altitude delivery capability by quickly slowing the bomb and allowing the aircraft to escape the blast pattern. The tail assembly consists of a low-drag canister unit containing a ballute (combination balloon and parachute), and a release lanyard assembly that opens the canister releasing the ballute. The ballute assembly is made from high strength low porosity nylon fabric. When the bomb is released from the aircraft a lanyard unlatches the back cover which opens, releasing part of the nylon bag/retarder. Air turbulence at the rear of the bomb acts on that portion of the retarder, pulling the remainder out of the housing. Ram air inflation is accomplished through four air inlet ports toward the aft end of the ballute. The weapon can be delivered in the low-drag mode (canister remains closed after release) or in the high drag mode. The pilot may select either a high drag or low drag configuration depending on mission requirements.

BSU-49/B
"Ballute" Air Inflatable Retarder Fin for MK 82 bomb

BSU-50/B
"Ballute" Air Inflatable Retarder Fin for MK 84 bomb

BSU-85/B
"Ballute" Air Inflatable Retarder Fin for MK 83 bomb

AN-M30

General Info:
Type = General Purpose
Origin = U.S.A.
IOC = 1940s (WW2)
Target = Railroad equipment, small buildings, ammo dumps, hangars
Guidance = Ballistic

Performance:
Range = Gravity bomb
Min. Safe BA = 1500ft

Dimensions:
Weight = 100lbs

Warhead:
Weight = 45lbs Tritonal
Fuse = 1sec. delayed (Nose AN-M103 or M118 or M119) ¼sec. delayed (Tail AN-M100A2 or M112A1)

AN-M57

General Info:
Type = General Purpose
Origin = U.S.A.
IOC = 1940s (WW2)
Target = Railroad equipment, small buildings, ammo dumps, hangars
Guidance = Ballistic

Performance:
Range = Gravity bomb
Min. Safe BA = 2000ft

Dimensions:
Weight = 250lbs

Warhead:
Weight = 123lbs Tritonal
Fuse = 1sec. delayed (Nose AN-M103 or M118 or M119) ¼sec. delayed (Tail AN-M100A2 or M112A1)

AN-M58A1

General Info:
Type = Semi Armour Piercing
Origin = U.S.A.
IOC = 1940s (WW2)
Target = Armour plate, light armoured vessels, reinforced concrete
Guidance = Ballistic

Performance:
Range = Gravity bomb

Dimensions:
Weight = 500lbs

Warhead:
Weight = 145lbs Tritonal
Fuse = impact (Nose steel plug), (Tail AN-M101A2)

AN-M59

General Info:
Type = Semi Armour Piercing
Origin = U.S.A.
IOC = 1940s
Target = Armour plate, light armoured vessels, reinforced concrete
Guidance = Ballistic

Performance:
Range = Gravity bomb

Dimensions:
Weight = 1000lbs

Warhead:
Weight = 303lbs Tritonal
Fuse = impact (Nose steel plug), (Tail AN-M102A2)

AN-M64

General Info:
Type = General Purpose
Origin = U.S.A.
IOC = 1940s (WW2)
Target = Steel railroad bridges, subways, concrete docks, light cruisers
Guidance = Ballistic

Performance:
Range = Gravity bomb
Min. Safe BA = 2500ft

Dimensions:
Weight = 500lbs

Warhead:
Weight = 262lbs Tritonal
Fuse = 1sec. delayed (Nose AN-M103 or M118 or M119) ¼sec. delayed (Tail AN-M101A2 or M113A1)

Description:

The standard bombs used by the 8th Bomber Command from September 1942 were the five General Purpose types: the M30 100lb, M31 300lb, M43 500lb, M44 1000lb and M34 2000lb. Generally, 500lb, 1000lb, and 2000lb bombs were carried for industrial targets and the others for airfields. The 8th Air Force used 1000lb and 2000lb bombs for attacks on submarine pens, but these had little effect on the vast concrete fortifications that sheltered the U-boats most of the damage was done to the surrounding port area.

The General Purpose (GP) bombs used in the early missions were fitted with quarter second delay tail fuses with an extra tenth of a second fuse in the nose. In a report in December 1942, after the raid on Lille, it was calculated that 30 percent of the bombs dropped had failed to explode because the arming mechanisms had frozen up after being exposed the damp conditions on the airfields overnight. Standard Operating Procedure was soon changed so that fuses were installed just before take off. Eventually, to avoid accidents in landing, fuses were to be inserted only when the bombs were securely fixed into the aircraft.

In 1943, a new set of GP bombs were produced: the M57 250lb, M64 500lb, M65 1000lb and M66 2000lb. These accounted for most of the bombs dropped in the final year of the war. In January 1945, experts recommended 250lb GP bombs to be used against synthetic oil plants, ammunition dumps and oil storage facilities. the 100lb bomb was recommended for attacking railway yards and runways.

AN-M81

General Info:
Type = Fragmentation bomb
Origin = U.S.A.
IOC = 1940s
Guidance = Ballistic

Dimensions:
Weight = 260lbs

Warhead:
Fuse = time blasting fuse,

AN-M103

General Info:
Type = Semi-armour piercing bomb
Origin = U.S.A.
IOC = 1940s
Guidance = Ballistic

Dimensions:
Weight = 2000lbs

Warhead:
Fuse = time blasting fuse,

M117

General Info:
Type = General Purpose bomb
Origin = U.S.A.
Guidance = Ballistic
Platforms = B-52

Performance:
Range = Gravity bomb
Striking Velocity = 1000fps
Min Release Alt = 800ft

Dimensions:
Length = 82in
Diameter = 16in
Weight = 750lbs

Warhead:
Fuse = Impact (Nose M904) (Tail M905)
Optimum Fuse Delay = 0.01sec

Description:

The M117 is a free-fall, unguided, general purpose [GP] 750-pound bomb. Its usual fuzes are the mechanical M904 (nose) and M905 (tail), or the mechanical FMU-54 (tail). The M117 is employed in several configurations.

The basic M117 dates from the Korean War and uses a low-drag tail fin for medium and high-altitude deliveries.

The M117R (Retarded) uses a special fin assembly providing either high-drag or low-drag release options. For low altitude deliveries, the tail assembly opens four large drag plates which rapidly slow the bomb and allow the aircraft to escape its blast.

The M117D (Destructor) is similar to the M117R but uses a magnetic influence fuze which enables the bomb to function as a mine. The M117D is released in a high-drag configuration for ground implant or shallow water mining. It detonates when an object passing near the bomb triggers the fuze.

The M117 series was used extensively during the Vietnam War, and B-52G aircraft dropped thousands of tons of M117 and M117R bombs during Operation Desert Storm. The B-52s dropped virtually all of the M117 bombs during Desert Storm.

M118

General Info:
Type = General Purpose, low-drag bomb
Origin = U.S.A.
Guidance = Ballistic

Performance:
Range = Gravity bomb

Dimensions:
Weight = 3000lbs

JP-233

General Info:
Type = Dispenser
Origin = U.K.
Manufacture = Hunting
Guidance = Ballistic
Platforms = Tornado

Dimensions:
Length = 258in
Diameter = 33in
Weight = 5147lbs

Warhead:
Type = HB.876 Area-denial
Number = 215
Weight = 5.5 kg
or
Type = SG.357 Cratering
Number = 30
Weight = 57lbs

Description:

However, another Hunting Engineering weapon, the "JP-233" bomblet dispenser, was used in the Gulf War in its intended role, airfield attack. The JP-233s were extensively used by RAF Tornado strike aircraft early in the air war to disrupt the operation of Iraqi airfields. The strikes were at low level and were extremely hazardous to the Tornado crews.

Two 6.5 meter (21 foot 6 inch) long JP-233s can be fixed to the bottom of a Tornado. Each of the two dispensers consists of two sections, with the rear section carrying 30 "SG-357" runway cratering submunitions and the front section carrying 215 "HB-876" antipersonnel mines.

CLUSTER BOMB UNITS

CBU-1/A
Anti-Materiel Bomb Cluster (509 BLU-4/B in SUU-7/A)

CBU-2/A
General Purpose Bomb Cluster
(360 BLU-3/B in SUU-7/A (CBU-2/A),
409 BLU-3/B in SUU-7/A (CBU-2B/A))

CBU-14/A
General Purpose Bomb Cluster
(BLU-3/B in SUU-7B/A (CBU-14/A),
BLU-3/B in SUU-14A/A (CBU-14A/A))

CBU-24

General Info:
Origin = USA
Type = Anti-material/Anti-personnel
Guidance method = free fall
Platforms = A7, F4, F11, B52

Dimensions:
Length = 93 inches
Diameter = 16 inches
Weight = 800 lbs.

Warhead:
Submunition = MK339, 650 BLU-26B

Description:

As the US Air Force must focus more on anti-personnel munitions, it needs to consider bringing the CBU-24 back into its inventory. The CBU-24 was one of the first of the antipersonnel area weapons, so far as I know. I believe it was developed after the human-wave attacks in the Korean War. It uses a standard canister - an 845# fat cylinder with a rounded nose and stubby fins that are slightly canted to develop a spin during freefall. The CBU mean cluster bomb unit - the number denotes its contents. The '24' has 665 spherical bomblets each with arced flutes to cause it to spin during freefall. The spin arms the bomblet, and in the '24' ground contact detonates it. The bomblet is about the same size and looks much like a mini-frag minus the spoon and ring.

A variant, the CBU-29, has a mix of instantaneous and delayed detonation bomblets. The delay is random, up to 30 minutes after impact. Its more for area denial. Neither is worth much as an anti-materiel weapon - not enough blast power. The CBU-52 has grapefruit sized bomblets, about 335 of them, and is also an anti-materiel weapon. AFAIK they all leave duds - bad news if you have to go into the area later.

When you employ the CBUs you have to take into account how big a pattern you want - due to the spin of the canister and the flutes on the bomblets they migrate sideways after release. Drop one too high and it functions early and the pattern on the ground has a hole in the donut. Thus an accurate drop could lead to missing the target. Dropped too close the pattern can be over-concentrated. This last isn't of much concern to the dropper.

The CBU has both a safe-arm time and a function time. Safe arm time is normally set to 4 seconds, to let the thing drop away from the plane before the fuze arms. Functioning (opening the canister) is by one of two methods, depending as to whether one has a time fuze or radar fuze. One checks the mission, then refers to precomped data from the weapons manual to pick the function time or altitude. 3000 AGL was a pretty common functioning altitude for troops in the open, SEAD, or general dive bomb delivery. However, we were once fragged for SEAD, covering a helo evac up by Dong Hoi (or Hue - I forget which now). the problem was NVN with 51 cal across a river shooting at the helos.

We had 4 F4s with 6 CBU 24 each. I briefed and led the flight. I briefed a low angle delivery, 20 degree dive at 500K, releasing one CBU per pass, on call from the ground. We dropped at around 2300 feet AGL with a 2 second arm time with the radar fuzes set at 800 AGL. This gave us a concentrated pattern comprising an elongated ellipse on the ground. In effect, rather like an instant strafing pass. (Our F4Ds did not have a gun). Every time we dropped a CBU the MG fire stopped for quite awhile. I suppose they had to get a new crew or maybe even a new MG after each pass. The helo evac was successful with no helo losses. The same result might have been attained by conventional dive bombing with the same radar altitude set, but by coming in low-angle we could pin-point the target without a mark from the GFAC. As it was, the delivery method was very similar to a combat strafing pass only much more effective due to the 665 bomblets released each time.

CBU-49

General Info:
Origin = USA
Type = Fragmentation Cluster Bomb,
Anti-material/Anti-personnel
Guidance method = free fall
Platforms = F4

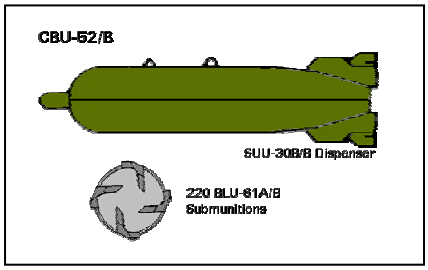
Performance:
Length = 7.5ft
Diameter = 16in
Weight = 840 lbs.

Warhead:
Submunition = 217 BLU-61/B or 670 x BLU-59/B (in SUU-30 dispenser)

Description:

The CBU-24, -49, -52, -58 and -71 all use SUU-30 dispensers, a metal cylinder divided longitudinally. One-half contains a strong back section that provides for forced ejection and sway-bracing. The two halves lock together. Four cast aluminum fins are attached at a 9~degree angle to the aft end of the dispenser and are canted 1.25 degrees to impart spin-stabilized flight. When released from the aircraft, the arming wire/lanyard initiates the fuze arming and delay cycle. At fuze function, the fuze booster ignites and unlocks the forward end of the dispenser. Ram air action on the dispenser forces the two halves apart, instantaneously dispensing the payload and allowing the bomblets to spin-arm and self-dispense. A total of 17,831 were expended during the Gulf War.

CBU-52



General Info:
Origin = USA
Type = Anti-personnel
Guidance method = free fall
Platforms = F16, B52, F18

Performance:
Drag = 20
Min. Release Alt. = 550ft

Dimensions:
Length = 7.5ft
Diameter = 16 inches
Weight = 785lbs

Warhead:
Submunition = 217 BLU-61/B (2.7 lbs.)
Lethal Radius = 425ft
Armor = 0.47in

Description:

The CBU-52 cluster munition dispenses 217 BLU-61 high-explosive bomblets. The BLU-61/B is a spherical, grenade-like anti-personnel fragmentation bomblet about the size of a tennis ball
The BLU-61 is similar in design to the BLU-63 used in the CBU-58, but each unit weighs twice as much. The trade off is that there are fewer submunitions per bomb. The weapon is effective against lightly armored targets such as APCs, ADA and other soft targets. It isn't as effective against enemy personnel as the CBU-58, nor as effective against heavy armor as the Mk-20 Rockeye.
The CBU-24, -49, -52, -58 and -71 all use SUU-30 dispensers, a metal cylinder divided longitudinally. One-half contains a strong back section that provides for forced ejection and sway-bracing. The two halves lock together. Four cast aluminum fins are attached at a 9~degree angle to the aft end of the dispenser and are canted 1.25 degrees to impart spin-stabilized flight. When released from the aircraft, the arming wire/lanyard initiates the fuze arming and delay cycle. At fuze function, the fuze booster ignites and unlocks the forward end of the dispenser. Ram air action on the dispenser forces the two halves apart, instantaneously dispensing the payload and allowing the bomblets to spin-arm and self-dispense. A total of 17,831 were expended during the Gulf War.

CBU-55/B FAE

General Info:
Origin = USA
Type = fuel/air explosive
Guidance method = free fall
Platforms = F16, B52, F18, A-6

Performance:
Drag = 20
Min. Release Alt. = 450ft

Dimensions:
Length = 85.6in
Diameter = 14in
Weight = 512lbs

Warhead:
460 lb FAE (Fuel/Air Explosive)
Cluster Bomb (3 BLU-73/B in SUU-49/B)

Description:

The the 550-pound CBU-55/72 cluster bomb contains three submunitions known as fuel/air explosive (FAE). The submunitions weigh approximately 100 pounds and contain 75 pounds of ethylene oxide with air-burst fuzing set for 30 feet. An aerosol cloud approximately 60 feet in diameter and 8 feet thick is created and ignited by an embedded detonator to produce an explosion. This cluster munition is effective against minefields, armored vehicles, aircraft parked in the open, and bunkers.
During Desert Storm the Marine Corps dropped all 254 CBU-72s, primarily from A-6Es, against mine fields and personnel in trenches. Some secondary explosions were noted when it was used as a mine clearer; however, FAE was primarily useful as a psychological weapon. Second-generation FAE weapons were developed from the FAE I type devices (CBU-55/72) used in Vietnam.
The original CBU-55 was employed from helicopters and low-performance aircraft such as the AH-1 and OV-10D.
The CBU-55A is an imporved version featuring an external hardback allowing it to be carried by higher-performance aircraft.
The CBU-72 is a CBU-55A equiped with the same Mk-339 fuze used by the Mk-7 dispensor

CBU-58

General Info:
Origin = USA
Type = High-Explosive
Guidance method = free fall
Platforms = F16, B52, F18

Performance:
Drag = 20
Min. Release Alt. = 450ft

Dimensions:
Length = 90in
Diameter = 16in
Weight = 800lbs

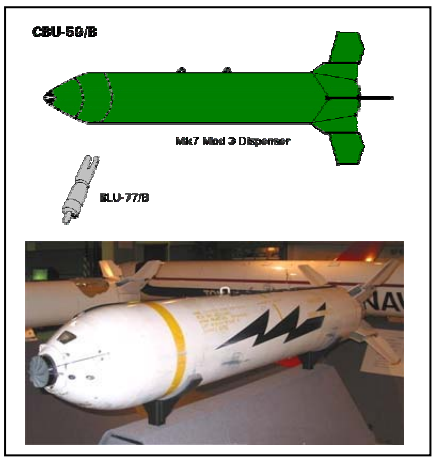
Warhead:
Submunition = 650 BLU-63 (0.9 lbs.)
Fuse = M339, FMU-56, FMU-11, FMU-26, M907
Lethal Radius = 450ft
Armour = 0.31in

Description:

The CBU-58 is loaded with 650 bomblets. These bomblets contain 5-gram titanium pellets, making them incendiary and useful against flammable targets. The CBU-58 cluster munition disperses 650 BLU-63 anti-personnel bomblets. The weapon consists of a SUU-30 dispenser carrying BLU-63 self-dispersing sub-munitions. The BLU-63 combines high explosives with two incendiary 5g titanium pellets to set inflammable targets alight. After the bomb is released, the SUU-30 case blows open scattering the bomblets over a wide area. The CBU-58 is effective against infantry, lightly armored vehicles, parked aircraft and similar soft targets.
More than 17,000 CBU-52 and CBU-58 cluster bombs were dropped during Desert Storm.
The CBU-24, -49, -52, -58 and -71 all use SUU-30 dispensers, a metal cylinder divided longitudinally. One-half contains a strong back section that provides for forced ejection and sway-bracing. The two halves lock together. Four cast aluminum fins are attached at a 9~degree angle to the aft end of the dispenser and are canted 1.25 degrees to impart spin-stabilized flight. When released from the aircraft, the arming wire/lanyard initiates the fuze arming and delay cycle. At fuze function, the fuze booster ignites and unlocks the forward end of the dispenser. Ram air action on the dispenser forces the two halves apart, instantaneously dispensing the payload and allowing the bomblets to spin-arm and self-dispense. A total of 17,831 were expended during the Gulf War.

CBU-59/B Rockeye II

General Info:
Origin = USA
Type = Anti-Personnel/Anti-Materiel Cluster Bomb
Guidance method = free fall
Platforms = F-4, F-15, F-16, A-7, A-10, F-111



Performance:
Limitations = Maximum Carriage: Mach 1.3 / 700K KCAS,
Minimum Release Altitude = 500 Feet AGL or
400 Feet AGL with 4G Escape

Dimensions:
Length = 92in
Diameter = 13.2in
Weight = 766lb

Warhead:
Submunition = 717 BLU-77/B in Mk7 Mod3 dispenser

Description:

The CBU-59 APAM an antipersonnel, antimaterial weapon developed in the 1970s as a successor to Rockeye. It uses the same Rockeye dispenser, but has 717 smaller BLU-77 bomblets fitted into the case. In addition to its armor-piercing effect, it also has antipersonnel fragmentation and incendiary features. One hundred and eight-six were delivered during the Gulf war.

CBU-71/B

General Info:
Origin = USA
Type = Fragmentation Cluster Bomb
Guidance method = free fall
Platforms = F-16

Performance:
Limitations = Maximum Carriage: Mach 1.3 / 700K KCAS,
Minimum Release Altitude = 500 Feet AGL or
400 Feet AGL with 4G Escape

Dimensions:
Length = 93in
Diameter = 16in
Weight = 850lbs

Warhead:
815lbs
Submunition = 670 BLU-86/B in SUU-30A/B

Description:

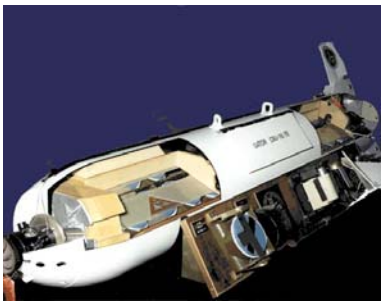
The CBU-71 is loaded with 650 BLU-68/B incendiary submunitions which use titanium pellets as the incendiary agent. The bomblet has two separate kill mechanisms, one fragmentation, the other incendiary. Both incorporate a time delay fuze, which detonates at random times after impact.

The CBU-52, -58 and -71 all use SUU-30 dispensers, a metal cylinder divided longitudinally. One-half contains a strong back section that provides for forced ejection and sway-bracing. The two halves lock together. Four cast aluminum fins are attached at a 9~degree angle to the aft end of the dispenser and are canted 1.25 degrees to impart spin-stabilized flight. When released from the aircraft, the arming wire/lanyard initiates the fuze arming and delay cycle. At fuze function, the fuze booster ignites and unlocks the forward end of the dispenser. Ram air action on the dispenser forces the two halves apart, instantaneously dispensing the payload and allowing the bomblets to spin-arm and self-dispense. A total of 17,831 were expended during the Gulf War.

CBU-72/B FAE

500lbs FAE (Fuel/Air Explosive)
Cluster Bomb (3 BLU-73/B in SUU-19/B)
Also see CBU-55/B FAE

CBU-78 GATOR



General Info:
Origin = USA
Type = Anti-personnel, Anti-armour
Guidance method = free fall
Platforms = F16, B52

Performance:
Release Alt. = 200ft - 40000ft

Dimensions:
Length = 85in
Diameter = 13in
Weight = 490lbs

Warhead:
Submunition = 45 BLU-91/B anti-tank, 15 BLU-92/B anti-personnel

Description:

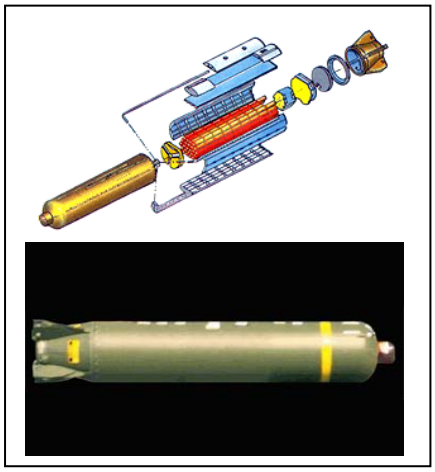
The CBU-78 Gator is a tri-Service weapon featuring anti-vehicle and antipersonnel land mines used adjacent to enemy forces to disrupt or deny use of selected areas. The 500 pound CBU-78 contains 45 antitank and 15 antipersonnel mines. These mines can be detonated by target sensors (magnetic field for antitank and trip line for antipersonnel) or by a disturbance- antidisturbance device. They also have a backup self-destruct time set before aircraft launch.

During Desert Storm the Navy and the Marine Corps dropped 209 CBU-78s.

The CBU-78/B gator weapon is delivered as an all-up-round (AUR) of the SUU-58/B dispenser, Mk 339 Mod 1 fuze, Kit Modification Unit KMU-428/B, and 60 mines (45 BLU-91/B and 15 BLU-92/B). The fuze initiation time is preset and is activated upon weapon release from the aircraft. Fuze time settings are primary mode (1.2 seconds) and option mode (4.0 seconds). The KMU-428/B adapts the mines to the dispenser; it also provides mine activation/self-destruct time selection.

The SUU-58/B Subsonic Free-Fall Dispenser consists of a cargo section with a nose fairing assembly attached, a tail cone assembly, and fuze arming wires with extractors. There are two observation windows-one for viewing the safe/arm indicator and the other to observe the fuze time-setting dials. The cargo section houses the BLU-91/B and BLU-92/B mines. The tactical weapons have two yellow bands around the nose cone fairing.

CBU-87 CEM



General Info:
Origin = USA
Manufacture = Aerojet General / Honeywell
Type = Anti-personnel, Anti-armour,
Combined Effects Munitions
Guidance method = free fall
Platforms = F-4, F-15, F-16, F-111, A-7, A-10, B-52

Performance:
Drag = 18
Min. Release Alt. = 530ft

Dimensions:
Length = 93in
Diameter = 16in
Weight = 950lbs

Warhead:
Submunition = 202 BLU-97/B (3 lbs.) in SW-65 Tactical Dispenser
Lethal Radius = 450ft
Armour = 0.47in

CBU-89 GATOR

General Info:
Origin = USA
Type = Anti-personnel, Anti-armour
Guidance method = free fall
Platforms = F16, B52, F18

Performance:
Drag = 18
Release Alt. = 200ft - 40000ft

Dimensions:
Length = 93in
Diameter = 16in
Weight = 710lbs

Warhead:
Submunition = 72 BLU-91/B anti-tank, 22 BLU-92/B anti-personnel

Description:

The CBU-89 Gator Mine, a 1,000-pound cluster munition containing antitank and antipersonnel mines, consists of a SUU-64 Tactical Munitions Dispenser with 72 antitank mines, 22 antipersonnel mines, and an optional FZU-39 proximity sensor. Mine arming begins when the dispenser opens. Mine detonation is initiated by target detection, mine disturbance, low battery voltage, and a self-destruct time-out. The antitank mine is a magnetic sensing submunition effective against tanks and armored vehicles. The antipersonnel mine has a fragmenting case warhead triggered by trip wires. The US Air Force employed 1,105 CBU-89s during the Gulf War.

The Gator mine system provides a means to emplace minefields on the ground rapidly using high-speed tactical aircraft. The minefields are used for area denial, diversion of moving ground forces, or to immobilize targets to supplement other direct attack weapons.

The GATOR family of scatterable mines is another favorite interdiction weapon by fighter aircrews. The dispenser holds 72 anti-armor mines and 22 anti-personnel mines. These mines arm immediately upon impact. The GATOR has two integrated kill mechanisms, a magnetic influence fuze to sense armor, and deployed trip wires that activate when personnel walk on or disturb it. Another feature of the GATOR is the random delay function detonating over several days for highly effective area denial and harassment operations.

Gator consists of two companion systems. The Air Force CBU-89/B is a 1000-pound class cluster weapon using the SUU-64/B Tactical Munitions Dispenser (TMD). The TMD is the same general configuration used for the CBU-87/B Combined Effects Munition. This commonality allows for high-rate, low-cost production of the dispenser. The Navy CBU-78/B is a 500-pound class cluster weapon that uses the Mk7 Rockeye dispenser. Rockeye has been in high-rate production for many years; the Mk7 dispenser is also a low-cost item.

Both systems contain a mix of BLU-91/B antitank (AT) and BLU-92/B antipersonnel (AP) mines -- 72 AT and 22 AP for the CBU-89/B; 45 AT and 15 AP for the CBU-78/B. Commonality of mines for both systems also contributes to high-rate, low-cost production. The BLU-91 /B AT mine is the heart of the Gator system. Microelectronics in each mine detect targets, discriminate armored vehicles, and detonate the mine when the target reaches the most vulnerable approach point. A Misznay-Schardin explosive charge defeats the belly armor of most vehicles. The BLU-92/B AP mine serves to discourage minefield clearing. Upon activation, the AP mine explosion sends high-velocity fragments in a horizontal plane over a wide area.

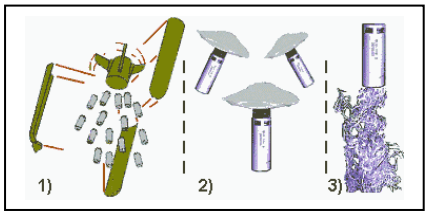
Both mines have a programmable self-destruct feature which permits the battlefield commander to control the timing of a counterattack or defensive maneuver. The self-destruct time is set just prior to aircraft takeoff using a simple selector switch on the dispenser. This feature permits a high degree of tactical flexibility during combat operations.

The size of the Gator minefield is determined by the opening height of the dispenser. After dispenser opening, the mines are self-dispersed using aerodynamic forces. The mine pattern on the ground is directly proportional to opening altitude, which is controlled by either the dispenser electromechanical faze or an optional proximity sensor.

Aerojet Ordnance Company (AOC) is the system integration prime contractor for Gator. All elements of the system are either procured by Aerojet or furnished by the US Government. The company is responsible for total system performance, including live testing. Each month three Gator systems are randomly selected from the production line and flight tested. Aerojet Ordnance Company warrants system performance for five years, assuring Gator reliability.

CBU-94/B

General Info:
Origin = USA
Type = "Blackout Bomb" Disrupt electrical installations
Guidance method = free fall
Platforms = F-117A



Dimensions:
Length = 92in
Diameter = 16in
Weight = 914lbs

Warhead:
900 lb
Submunition = 200 BLU-114/B in SUU-66/B

Description:

First used on 02 May 1999 as part of Operation ALLIED FORCE when F-117A Nighthawks attacked targets in Serbia. In the wake of these strikes lights went out in over 70 per cent of the country. The munition was used again on the night of 07 May 1999 to counter Serbian efforts to restore damage caused by the initial attack.

CBU-97/B

General Info:
Origin = USA
Type = 'Smart' Anti-Tank Sensor Fused Weapon
Guidance method = free fall
Platforms = A-10, B-1, B-2, B-52, F-15, F-16

Dimensions:
Length = 92in
Diameter = 16in
Weight = 914lbs

Warhead:
900lbs
Submunition = 10 BLU-108/B in SUU-66/B
Lethal Radius = 500-1200ft

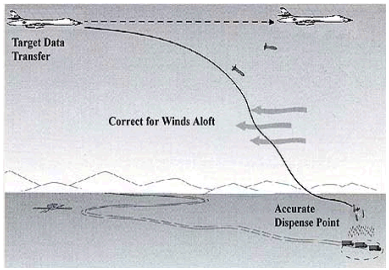
Description:

Each CBU-97/B covers 150 x 360 meters (500 ft by 1,200 ft) The weapon can be delivered from altitudes of 200 to 20,000 feet, and at speeds up to 650 knots. By incorporating a Wind Corrected Munition Dispenser (WCMD) tail kit on the CBU-97, the delivery altitude increases up to 40,000 feet and standoff ranges up to 12 miles can be achieved.

CBU-103, CBU-104, CBU-105 WCMD

General Info:
Origin = USA
Type = Wind Corrected Munition Dispenser
Guidance method = internal guidance
Platforms = B-1, B-52, F-15E, F-16, and F-117

CBU-103 (CBU-87)
CBU-104 (CBU-89)
CBU-105 (CBU-97)



Description:

While low altitude, high speed laydown deliveries are consistent with tactics used against heavily defended target sets such as the robust Soviet/Warsaw Pact threat envisioned in Central Europe, low altitude tactics were not the preferred option during Desert Storm where the USAF used medium/high altitude weapons employment to provide fighter and bomber aircraft a sanctuary against short range surface to air missiles and anti-aircraft artillery fire. The inexpensive tail kit inertially steers the munition from a known release point to precise target coordinates while compensating for launch transients, winds aloft, surface winds and adverse weather.

*The Wind Compensated Munitions Dispenser [WCMD "Wick-Mid"] is intended to remedy this current shortfall in Tactical Munition Dispenser munitions, such as the CBU-87 CEM [Combined Effects Munition], CBU-89 GATOR and CBU-97 SFW [Sensor Fuzed Weapon]. The weapon will use inertial guidance only (**no GPS**). The WCMD program develops a tail kit for these inventory dispenser weapons. These weapons will be capable of delivery from medium to high altitude delivery when equipped with a WCMD kit. The WCMD weapon will correct for wind effects and errors during the weapon's ballistic fall. The WCMD kit will turn these "dumb" bombs into accurate "smart" weapons. Currently, the dispenser is achieving an accuracy of within 30 feet. Both fighter and bomber aircraft will be able to employ WCMD from a wide range of altitudes, in adverse weather, using various tactics such as level, dive, and toss bombing, and bombing on coordinates.*

WCMD Limited Initial Operational Capability was achieved on the B-52 in November 1998. The first WCMDs were operationally fielded in 2000, when the weapon was certified for use on the B-52 and F-16. WCMD-equipped weapons are planned for employment on the B-1, B-52, F-15E, F-16, and F-117 aircraft. WCMD went into full production in April 2001. By the end of November 2001, a total of 600 cluster bombs had been dropped over Afghanistan, consisting of 450 BLU-103 and 150 BLU-87 munitions. As of September 2002 the Air Force had dropped about 700 WCMD bombs in Afghanistan from B-52 bombers and F-16 fighters, by which time about 7,000 of the specialized inertial guidance navigation tail kits remained in inventory.

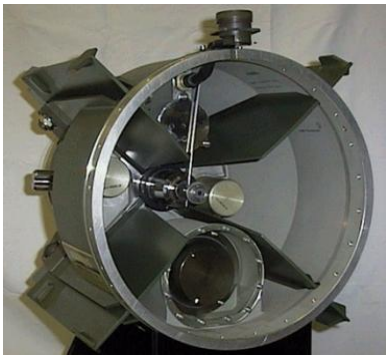
The WCMD is seen as one solution to four deficiencies identified in the Strategic Attack/Air Interdiction Mission Area Plan (MAP): multiple kills per pass, adverse weather capability, Cluster Bomb accuracy (mid-course wind correction), and the ability to carry/dispense future submunitions and US Army mines. With the addition of a guidance kit and "smart" aircraft stores stations, aircrew members should be able to independently target weapons and strike multiple targets on a single release/pass. WCMD will be targetable by on-board aircraft systems and be capable of being targeted on a coordinate reference system. To minimize aircraft heading, velocity, and position errors, all aircraft will have Global Positioning System (GPS) quality heading, velocity, and altitude data. This will provide aircraft an adverse weather capability for targets with known positions. GPS is not required on the WCMD. The guidance kit will provide WCMD an adverse weather capability and negate a need for electro-optical guidance systems which are severely degraded by adverse weather or man-made or battlefield obscurants such as smoke or dust. The WCMD kit will reduce susceptibility to wind induced errors, not fully compensated for by aircraft avionics, by providing mid-course wind correction. Finally, the modular design of the SUU-64/65/66 Tactical Munition Dispensers (TMD) allows for future incorporation of wide area anti-armor mines, anti-helicopter mines, and other future smart submunitions. The Air Force announced 27 January 1997 that Lockheed Martin had won the $21 million contract to complete development and begin production of the Wind-Corrected Munition Dispenser. The total value of the program, including development and production, is about $650 million. The Air Force plans to modify 40,000 tactical munitions dispensers -- 30,000 for CEM and 5,000 each for Gator and SFW.

Department of Defense officials originally predicted the dispenser tail kits would cost approximately $25,000 per unit. However, through the application of a no-nonsense acquisition strategy adopted by the Eglin WCMD team, the dispenser unit cost is $8,937.

Wind Corrected Munitions Dispenser Extended Range (WCMD-ER)

Wind Corrected Munitions Dispenser Extended Range (WCMD-ER) will increase the standoff range with GPS guidance maintaining current weapon effectiveness on both bombers and fighters. WCMD-ER significantly contributes to Air Force warfighting capability. This project extends range and improves accuracy of the Wind Corrected Munitions Dispenser (WCMD) by development of a wing kit and integration of a GPS equipped tail kit into the CBU-105 (anti-armor targets) and CBU-103 (soft and area targets) dispensers.
A $41 million contract was awarded to Lockheed Martin to design and develop wings for the WCMD and add Global Positioning System to aid its Inertial Guidance System. The Area Attack Systems Program Office began work to give the Wind Corrected Munitions Dispenser extended range capability and greater accuracy.
The SPO office was responsible for developing two new weapons used for the first time in Operation Iraqi Freedom, the CBU-103, or Sensor Fuzed Weapon, and the CBU-105, or Combined Effects Munition. WCMD is a guidance tail kit that can be attached to both of the unpowered weapons to give greater accuracy when each is launched from high altitudes.
The addition of wings will give the direct attack weapons greater range and standoff capability. The direct attack CBU-103 and CBU-105 weapons were used with great success in Operation Iraqi Freedom. There were no accuracy problems with these weapons reported in Operation Iraqi Freedom, but the need for a standoff version exists. In OIF, the US achieved air superiority, and later air supremacy, really quickly. The US was't faced with a significant air defense problem. So the use of direct attack weapons such as the CBU-103 and CBU-105 was not an issue.
In the future, however, when faced with more extensive integrated air defense systems for an area attack weapon, standoff capability will show itself. It also gives much more mission flexibility from a point in the sky because an aircraft can put a weapon in a bigger basket (meaning weapons hit their intended target with more accuracy and less collateral damage). That gives combat aircrews more flexibility and survivability.
The WCMD-ER is not currently programmed for use on the CBU-107 or Passive Attack Weapon, which was used in OIF after a rapid response development effort by an Eglin team. There is no reason why the WCMD-ER cannot be used on the CBU-107. The CBU-107 just didn't exist when plans to develop the WCMD-ER were made.
The Air Force planned to purchase 7,500 WCMD-ER kits. In addition to the F-16 and B-52, the weapon is expected to be integrated on the F-15E and other aircraft. Deliveries of the WCMD-ERs to Air Combat Command would begin in late 2006 and be completed in 2012. Flight testing is scheduled to begin in 2005 on the F-16 and B-52.

CBU-107 Passive Attack Weapon WCMD



General Info:
Origin = USA
Type = kinetic energy weapon for biological and chemical facilities
Guidance method = internal guidance

Performance:
Drag = 18
Min. Release Alt. = 530ft

Dimensions:
Length = 93in
Diameter = 16in
Weight = 950lbs

Warhead:
Submunition = 3,700 nonexplosive penetrator rods (350 14in rods, 1,000 7in rods, and 2,400 2in rods)

Description:

Eglin munitions experts gave America's warfighters a new weapon that destroys targets with kinetic energy rather than explosives, and they had the initial capability available a mere 98 days after receiving the request. The Passive Attack Weapon houses various sizes of penetrator rods inside what some called a "large water heater with fins." Guided by a Wind-Corrected Munitions Dispenser tail kit to help with accuracy, the munition's full production of weapons was completed in 180 days.

The way the PAW works is after being dropped from an aircraft, the weapon's outer skin separates at a preset altitude, allowing the individual penetrator rods to free fall to the earth and penetrate their target. With this munition, there is no explosive warhead and minimal collateral damage.

The CBU-107 Passive Attack Weapon can destroy suspected biological and chemical facilities without scattering dangerous debris. It is filled with 3,700 nonexplosive penetrator rods. The weapon is designed for use against targets such as biological weapons stockpiles or laboratories where explosives are undesirable. The weapon holds 350 14-in. rods, 1,000 7-in. rods, and 2,400 2-in. rods.

Given the initial tasking 10 September 2002, experts from the Air Armament Center, Air Force Operational Test and Evaluation Center, Air Force Research Laboratory Munitions Directorate and 53rd Wing had developed, tested and delivered the new CBU-107 Passive Attack Weapon by December. The weapon's full production was completed 09 March 2003. The Air Force used the new weapon following a 98-day, $40 million development program.

The new weapon is designed for use in an environment where warfighters need to disable a target without destroying its surroundings. Some examples include storage facilities, fuel storage depots, power substations or antenna fixtures. It's another way to achieve a battlefield effect without an explosion. They give the capability to attack non-hardened surface targets, and do so with a minimum of collateral damage.

The PAW could be dropped on a fuel drum, puncturing it and allowing the fuel to drain without catching on fire or leaving unexploded ordnance on the battle field for ground troops to worry about.
The $40 million rapid response development made its combat debut in Operation Iraqi Freedom, although specific uses of the PAW have not been disclosed. Two years earlier, Air Combat Command discussed a need for such a weapon like the PAW and Air Force Research Laboratory experts worked on an early design, but funding was never approved.

The rapid turn from concept to production weapon was possible due to a design philosophy the munitions directorate used from the beginning. Wherever possible, existing systems and sub-systems were used, saving dollars and the time required to certify the weapon for aircraft carriage and delivery. Most importantly, the effort showed that the munitions directorate, working with Team Eglin, was able to step-up to meet the warfighter's needs quickly and efficiently.

General Dynamics experts made the kinetic energy penetrator payload and all of its supporting structure to hold it inside. Lockheed Martin workers produced the WCMD guidance kit and people from Textron Systems produced the tactical munitions dispenser kit.

The CBU-107 has the same shape and weight as a CBU-103 or a CBU-105 bomb. This saved the developmental team time because they didn't have to perform flight separation checks on the new weapon and the aircraft software package is the same. From a load crew's standpoint, they know exactly how to do this because it's the same as the existing WCMD family of weapons. And same for the aircrews; they know how to deliver it, because they deliver it the same as the others.

Although the program was a success, there is nothing in the way of a follow-on program immediately coming from the Air Force. Right now all planned production has been completed. However, in the wake of the current combat operations, each of the services will be reviewing their performance and their capabilities versus what they needed.

MK-20D Rockeye

General Info:
Origin = USA
Type = Anti-Armour
Guidance method = free fall
Platforms = A-10, F-14, F-15, F-16, F/A-18

Performance:
Drag = 11
Min Release Alt. = 210ft

Dimensions:
Length = 88.8in
Diameter = 13in
Fin Span = 35in
Weight = 490lbs

Warhead:
900lbs
Submunition = 247 MK-118 (1 lbs.)
Lethal Radius = 450ft
Armour = 190mm

Description:

The MK-20 Rockeye is a free-fall, unguided cluster weapon designed to kill tanks and armored vehicles. The system consists of a clamshell dispenser, a mechanical MK-339 timed fuze, and 247 dual-purpose armor-piercing shaped-charge bomblets. The bomblet weighs 1.32 pounds and has a 0.4-pound shaped-charge warhead of high explosives, which produces up to 250,000 psi at the point of impact, allowing penetration of approximately 7.5 inches of armor. Rockeye is most efficiently used against area targets requiring penetration to kill. Fielded in 1968, the Rockeye dispenser is also used in the Gator air-delivered mine system. During Desert Storm US Marines used the weapon extensively, dropping 15,828 of the 27,987 total Rockeyes against armor, artillery, and antipersonnel targets. The remainder were dropped by Air Force (5,345) and Navy (6,814) aircraft.

BL-755

General Info:
Origin = UK
Manufacture = Hunting Engineering of Ampthill
Type = General Purpose Cluster Munitions
Targets = small hard and soft targets, Runways
Guidance method = Radar Altimeter, Free-fall
Platforms = Tornado GR1, Eurofighter, Harrier, Jaguar, Buccaneer and Phantom

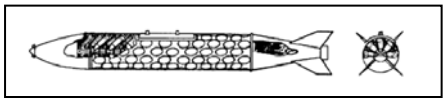
Dimensions:
Length = 98.5in
Diameter = 16in
Fin Span = 35.43in (0.90 m)
Weight = 600lb

Warhead:
Submunition = 147 High Explosive Anti Tank (HEAT) bomblets packed in seven sections of 21 rounds each
Fuse = Piezoelectric

Description:

The BL 755 is a system that was designed to cope with some of the very large area targets that might have been encountered on the Central Front, especially large Warsaw Pact armored formations of Regimental strength (90+ tanks) or more.
The weapon can be carried by Tornado GR1, Harrier, Jaguar, Buccaneer and Phantom and consists of a large container which is divided into seven compartments.
Each of these compartments contains 21 bomblets making a total of 147 bomblets in all. After the bomb has been released from the aircraft, the 147 bomblets are ejected and fall to the ground, covering a wide area. As each individual bomblet hits a target, a HEAT charge is detonated which can fire a large slug of molten metal through up to 250 mm of armor.
In addition, the casing of the bomblet disintegrates and hundreds of fragments of shrapnel are dispersed over a wide area, with resultant damage to personnel and soft- skinned vehicles.
The BL 755 can be released at very low altitude and this is essential if pilots are to survive in the high-density SAM conditions that will apply over the Central Front. Aircraft will only have the chance to make one pass over the target before the defenses are alerted, and for a pilot to make a second pass to ensure accuracy would be suicidal.

BLG-66 Belouga



General Info:
Origin = France
Type = general purpose
Manufacture = Matra/Thomson
Targets = small hard and soft targets, Runways
Guidance method = Free-fall
Platforms = Mirage, Eurofighter

Performance:
Min Release Alt. = >150ft
Lethal Radius = 220ft

Dimensions:
Length = 130in
Diameter = 14.1in
Fin Span = 21.6in
Weight = 672lbs

Warhead:
Submunition = 152 66mm bomblets
Fuse = Impact

Description:

The Matra/Thomson BLG 66 Belouga is a French air-launched cluster bomb developed in the 1970s as a replacement for the Giboulee cluster bomb. The Belouga carries 152 66 mm bomblets which are of three types: general purpose fragmentation for use against vehicles, parked aircraft and dumps; HEAT for use against AFVs; interdiction for use against airfields, harbors and marshalling yards.
This weapon is used by the USA as a short range unguided munition.

GUIDED BOMB UNITS

GBU-10 Paveway I & II

General Info:
Origin = USA
Type = High Explosive
IOC = 1976
Guidance method = Laser homing
Guidance System = MAU-157 Series (Paveway I), MAU-169 Series (Paveway II)
Mission = Air interdiction
Targets = Mobile hard, fixed soft, fixed hard
Platforms = A-10, F-15, F-16, F-117, F-14, F-18

Performance:
Accuracy = 30ft
Drag = 15
Min Release Alt. = 1480ft
Range = 8nm

Dimensions:
Length = 168in
Diameter = 18in
Fin Span = 66in
Weight = 2562lbs

Warhead:
BLU-109 for penetration (535 lbs. Tritonal) (GBU-10I/B)
MK 84 for Blast/Fragmentation (945 lbs. Tritonal) (GBU-10C/B)
Lethal Radius = 3000ft
Fuse = Contact (FMU-81 N/T)

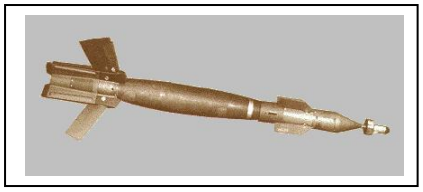
Description:

The Guided Bomb Unit-10 (GBU-10) utilizes the 2,000-pound general purpose or penetrating warhead. The operator illuminates a target with a laser designator and then the munition guides to a spot of laser energy reflected from the target. The GBU-10 consists of an MK-84 2,000 pound bomb with an added laser guidance package. The GBU-1OI mates a BLU-109B weapon with a Paveway II laser guidance kit. This improved 2,000-pound bomb is used against targets requiring deeper penetration.

The munition was used during Operation Desert Storm, and, according to the Air Force, hit 78 percent of its targets. In Operation Desert Storm, GBU-10/10Is were used extensively by F-15Es and F-111Fs mainly against bridges, Scuds, C3I (command, control, communications, intelligence) nodes, and bunkers. Of the 2,637 expended,'44 over one- third were dropped by F-111Fs, and the rest by F-117s, F-15Es, and Navy and Marine Corps aircraft.

There are two generations of GBU-10 LGBs: Paveway I with fixed wings and Paveway II with folding wings. Paveway II models have the following improvements: detector optics and housing made of injection-molded plastic to reduce weight and cost; increased detector sensitivity; reduced thermal battery delay after release; increased maximum canard deflection; laser coding; folding wings for carriage, and increased detector field of view. (Paveway II's instantaneous field of view is thirty percent greater than that of the Paveway I's field of view).

GBU-12 Paveway I & II



General Info:
Origin = USA
Type = High Explosive
IOC = 1976
Manufacture = Texas Instruments
Guidance method = Laser homing
Guidance System = MAU-157 Series (Paveway I),
MAU-169 Series (Paveway II)
Mission = Air interdiction
Targets = Mobile hard, fixed soft, fixed hard
Platforms = A-10, F-15, F-16, F-117, F-14, F-18

Performance:
Accuracy = 30ft
Drag = 7
Min Release Alt. = 320ft
Range = 8nm

Dimensions:
Length = 132in
Diameter = 11in
Fin Span = 52in
Weight = 800 lbs

Warhead:
MK-82 Blast/Fragmentation (192 lbs Tritonal, PBXN-109)
Lethal Radius = 750ft
Fuse = Contact (FMU-81)

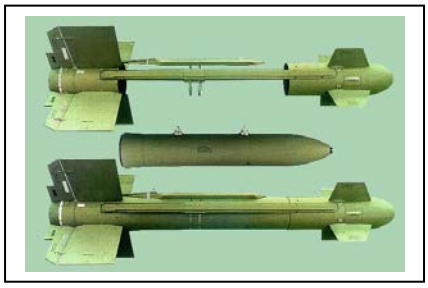
Description:

The Guided Bomb Unit-12 (GBU-12) utilizes a 500-pound general purpose warhead. The operator illuminates a target with a laser designator and then the munition guides to a spot of laser energy reflected from the target.

The munition was used during Operation Desert Storm, and, according to the Air Force, hit 88 percent of its targets. During Desert Storm the GBU-12 was dropped by F-lllFs, F-15Es, and A-6s, mostly against fixed armor. It was the F-111F tank-busting weapon of choice. Of the 4,493 GBU-12s employed, over half were dropped by the F-lllF.

There are two generations of GBU-12 LGBs: Paveway I with fixed wings and Paveway II with folding wings. Paveway II models have the following improvements: detector optics and housing made of injec- tion-molded plastic to reduce weight and cost; increased detector sensitiv- ity; reduced thermal battery delay after release; increased maximum canard deflection; laser coding; folding wings for carriage, and increased detector field of view. (Paveway II's instantaneous field of view is thirty percent greater than that of the Paveway I's field of view).

GBU-15



General Info:
Origin = USA
Type = Air-to-surface guided glide bomb
IOC = 1983
Manufacture = Rockwell
Guidance method = Television Electro Optical TV, Imaging Infrared Seeker
Mission = OCA, CAS, interdiction, naval anti- surface warfare
Targets = Mobile hard, fixed soft, fixed hard
Platforms = F-15E, F-111

Performance:
Drag = 18
Min Release Alt. = 320ft
Range = >5nm

Dimensions:
Length = 156in
Diameter = 18in
Fin Span = 59in
Weight = 3640 lbs

Warhead:
BLU-109 for penetration (535 lbs. Tritonal)
MK 84 for Blast/Fragmentation (945 lbs. Tritonal)
Lethal Radius = 3000ft
Fuse = Delayed (FMU-124A/B)

Description:

The GBU-15 bomb is an unpowered, glide weapon used to destroy high value enemy targets. It is designed to be used with F-15E and F-111F aircraft. The GBU-15 provides the capability for accurate (automatic or manual) guided delivery of a MK-84 bomb at increased ranges. The GBU-15's effective standoff range is greater than that of laser-guided munitions, since the GBU-15 does not need to have acquired the target before it is released. The weapon is remotely controlled by a datalink system, and the weapon systems opera- tor locates the target area and the specific aimpoint by observing the video transmitted from the weapon. The weapon's midcourse flight path can be adjusted either automatically or manually. Weapon video is either electro-optical (TV camera) or infrared, and generated in the nose of the weapon.

The weapon consists of consisting of various interchangeable guidance, fusing, and control systems designed to meet specific mission requirements, that are attached to either an MK-84 or BLU-109 penetrating warhead. Each weapon has five components -- a forward guidance section, warhead adapter section, control module, airfoil components and a weapon data link.

The guidance section is attached to the nose of the weapon and contains either a television guidance system for daytime or an imaging infrared system for night or limited, adverse weather operations. A data link in the tail section sends guidance updates to the control aircraft that enables the weapon systems operator to guide the bomb by remote control to its target.

An external electrical conduit extends the length of the warhead which attaches the guidance adapter and control unit. The conduit carries electrical signals between the guidance and control sections. The umbilical receptacle passes guidance and control data between cockpit control systems of the launching aircraft and the weapon prior to launch.

The rear control section consists of four wings are in an "X"-like arrangement with trailing edge flap control surfaces for flight maneuvering. The control module contains the autopilot, which collects steering data from the guidance section and converts the information into signals that move the wing control surfaces to change the weapon's flight path.

The GBU-15 may be used in direct or indirect attack. In a direct attack, the pilot selects a target before launch, locks the weapon guidance system onto it and launches the weapon. The weapon automatically guides itself to the target, enabling the pilot to leave the area. In an indirect attack, the weapon is guided by remote control after launch. The pilot releases the weapon and, via remote control, searches for the target. Once the target is acquired, the weapon can be locked to the target or manually guided via the date-link system. This highly maneuverable weapon has a low-to-medium altitude delivery capability with high accuracy. It also has a standoff capability.

During Desert Storm, all 71 GBU-15 modular glide bombs used were dropped from F-111F aircraft. Most notably, GBU-15s were the munitions used for destroying the oil manifolds on the storage tanks to stop oil from spilling into the Gulf. These GBU-15s sealed flaming oil pipeline manifolds sabotaged by Saddam Hussein's troops.

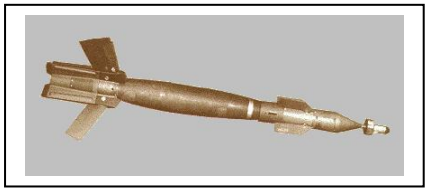
The Air Force Development Test Center, Eglin Air Force Base, Fla., began developing the GBU-15 in 1974. It was a product improvement of the early guided bombs used during the Southeast Asia conflict. Flight testing of the weapon began in 1975. The GBU-15 with television guidance, completed full-scale operational test and evaluation in November 1983. In February 1985, initial operational test and evaluation was completed on the imaging infrared guidance seeker.

In December 1987, the program management responsibility for the GBU-15 weapon system transferred from the Air Force Systems Command to the Air Force Logistics Command. The commands merged to become the Air Force Materiel Command in 1992.

The Inertial Terrain-Aided Guidance (ITAG) system is an adverse weather, precision guidance system for the GBU-15. It replaces the guidance system for this weapon. ITAG is an inertial navigator who uses updates from a radar altimeter correlated with terrain elevation maps. GPS is used to initialize the inertial navigator prior to weapon release. ITAG, being developed by Sandia National Laboratory, will give Joint Force Commanders the capability to accurately deliver weapons against NBC targets during a wide range of adverse weather conditions. The ITAG kit "straps on" to 2000-pound class conventional bombs to make a precision-guided weapon, and it will make it possible to plan attacks to take advantage of local weather conditions which may be favorable to minimizing the dispersal of released NBC agents. The ITAG uses GPS-initialized inertial navigation which is augmented by a terrain-reading, all-weather, high-altitude, precision radar altimeter. The real-time onboard navigation computer correlates radar altimeter data with previously acquired digitized, three-dimensional synthetic aperture radar terrain maps stored on board the weapon. Unlike current laser-guided bombs which can only be employed in clear air-mass conditions, the ITAG will be able to achieve 3-meter circular error probable (CEP) accuracy in adverse weather.

On 23 April 1999, the Chief of Staff of the Air Force gave direction to provide the GBU-15 air-to-surface weapon with Global Positioning System, or GPS, guidance giving it an all-weather capability. In early May 1999 contracts were signed with Applied Sciences Engineering International of Niceville FL and Raytheon Defense Systems of Tucson AZ. The two contractors' concepts are different but proven and compatible with the F-15E. The total quick reaction program including these two contracts and all government costs total $7 million for the first phase of additional GPS guidance to the GBU-15. An unreleased quantity of the enhanced weapon were delivered to combat units by 01 July 1999. During the second phase, the best concepts of both contractors will be adopted. They will then work as a team to upgrade an additional 1,200 to 1,500 GBU-15s, which is expected to cost approximately $50 million.

GBU-16 Paveway II



General Info:
Origin = USA
IOC = 1976
Guidance method = Laser homing
Guidance System = MAU-169 H/B or MAU-169 J/B
Mission = Air interdiction
Targets = Mobile hard, fixed soft, fixed hard
Platforms = A-6, A-10, F-14, F-15, F-16, F/A-18, F-111

Performance:
Accuracy = 30ft
Drag = 7
Min Release Alt. = 320ft
Range = 8nm

Dimensions:
Length = 145in
Diameter = 13.8in
Fin Span = 28.5in (extended 66in)
Weight = 1092 lbs

Warhead:
1000 lb MK 83 bomb with KMU-455/B guidance kit
Fuse = Contact

Description:

The Guided Bomb Unit-12 (GBU-16) utilizes a 1000-pound general purpose warhead. The operator illuminates a target with a laser designator and then the munition guides to a spot of laser energy reflected from the target. The GBU-16 consists of a MK-83 1,000-pound bomb modified with a common Paveway II laser guidance kit. During Desert Storm virtually all 219 GBU-16s were dropped by Navy A-6Es, which had the capability to lase the target themselves (self-designation).

FA/18 Hornet aircraft flying from USS Enterprise (CVN 65) dropped GBU-16 laser guided bombs during the waves of attacks against Iraq in support of Operation Desert Fox in December 1998.

GBU-22 Paveway III

General Info:
Origin = USA
IOC = 1996
Guidance method = Laser homing
Guidance System = Paveway III guidance kit (WGU-12/B)
Mission = Air interdiction
Targets = Mobile hard, fixed soft, fixed hard
Platforms = A-6, A-10, F-14, F-15, F-16, F/A-18, F-111

Performance:
Accuracy = 30ft
Range = 8nm
Lethal Radius = 750ft
Min Release Alt = 320ft
MSD, protected = 500ft
MSD, exposed = 1650ft

Dimensions:
Length = 11ft
Diameter = 111in
Fin Span = 52in
Weight = 611lbs

Warhead:
500 lb MK 82 bomb with BSU-82/B airfoil group
Fuse = Contact

Description:

This is a 500 lb Paveway III laser guided bomb used on many US aircraft as F/A-18, F-15, F-4's, F-16 and F-111 . In 1996 Texas Instruments announced that a privately funded development had used a Mk-82 warhead to the Paveway III and this new version was designated GBU-22/B
The Paveway III series does not have the bang-bang guidance of the Paveway II series, allowing for a much more efficient flight path extending the range of the weapons.
Engagement Sequence
The Paveway III series bombs have a much wider launch envelope, greater standoff range and a more sensitive seeker head than the Paveway II series. In addition, these newer bombs are programmed so they can be released during a low altitude, level attack run. If the bomb is dropped with a level release at low altitude, the weapon will perform a pull-up and gain roughly 300 ft, at which point it levels out and flies straight until it detects laser illumination from the target. Improvements in the Paveway III's seeker and guidance unit also correct the Paveway II's tendency to bleed away too much airspeed during maneuvering.

GBU-24/B Paveway III

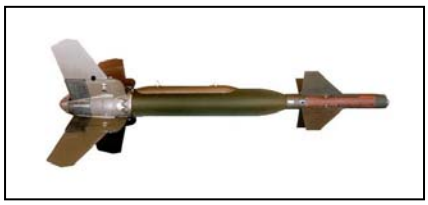
General Info:
Origin = USA
Type = High Explosive
IOC = 1983
Guidance method = Laser homing
Guidance System = WGU-12B/B or 39A/B or 43/B
Mission = CAS, interdiction, OCA,
naval anti- surface warfare
Targets = Mobile hard, fixed soft, fixed hard
Platforms = A-6, A-10, F-14, F-15, F-16, F/A-18, F-111

Performance:
Accuracy = 27ft
Air Foil Group = BSU-84A/B
Drag = 17
Min Release Alt. = 1500ft
Range = >10nm

Dimensions:
Length = 173in
Diameter = 25in
Fin Span = 37in (extended 78in)
Weight = 2315 lbs

Warhead:
MK 84 for Blast/Fragmentation (945 lbs. Tritonal)
Lethal Radius = 1300ft
Fuse = Contact
Armour = 3in

GBU-24A/B Paveway III



General Info:
Origin = USA
Type = penetration
IOC = 1983
Guidance method = Laser homing
Guidance System = WGU-12B/B or 39A/B or 43/B
Mission = CAS, interdiction, OCA,
naval anti- surface warfare
Targets = Mobile hard, fixed soft, fixed hard
Platforms = A-6, A-10, F-14, F-15, F-16, F/A-18, F-111

Performance:
Accuracy = 27ft
Air Foil Group = BSU-84A/B
Adapter Group = ADG-769/B
Drag = 17
Min Release Alt. = 1500ft
Range = >10nm

Dimensions:
Length = 170in
Diameter = 14.5in
Fin Span = 37in (extended 78in)
Weight = 2330 lbs

Warhead:
BLU-109 for penetration (535 lbs. Tritonal)
Lethal Radius = 1200ft
Fuse = Contact

Description:

The Guided Bomb Unit-24 (GBU-24) Low Level Laser Guided Bomb [LLLGB] consists of either a 2,000-pound MK-84 general purpose or BLU-109 penetrator bomb modified with a Paveway III low-level laser-guided bomb kit to add the proportional guidance in place of the bang-bang type used in the Paveway II. The LLLGB was developed in response to Sophisticated enemy air defenses, poor visibility, and to counter limitations in low ceilings. The weapon is designed for low altitude delivery and with a capability for improved standoff ranges to reduce exposure. The GBU-24 LLLGB/Paveway III has low-level, standoff capability of more than 10 nautical miles. Performance envelopes for all modes of delivery are improved because the larger wings of the GBU-24 increases maneuverability. Paveway III also has increased seeker sensitivity and a larger field of regard.

The operator illuminates a target with a laser designator and then the munition guides to a spot of laser energy reflected from the target. One way to deliver LGBs from low altitude is a loft attack. In this maneuver, the aircraft pulls up sharply at a predetermined point some miles from the target and the LGB is lofted upward and toward the target. However, if the LGB guidance system detects reflected laser energy from the target designator too soon after release, it tends to pull the LGW down below its required trajectory and the bomb will impact well short of the target.

This bomb is not nearly as delivery parameter sensitive as is the Paveway II LGB, nor is it affected by early laser designation. After a proper low altitude delivery, the LLLGB will maintain level flight while looking for reflected laser energy. If it does not detect reflected laser energy, it will maintain level flight to continue beyond the designated target, overflying friendly positions, to impact long, rather than short of the target.

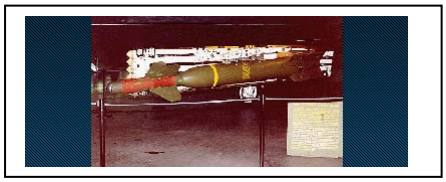
Unlike the Paveway II LGB, the LLLGB can correct for relatively large deviations from planned release parameters in the primary delivery mode (low-altitude level delivery). It also has a larger delivery envelope for the dive, glide and loft modes than does the earlier LGB. The wide field of view and midcourse guidance modes programmed in the LLLGB allow for a "Point Shoot" delivery capability. This capability allows the pilot to attack the target by pointing the aircraft at the target and releasing the weapon after obtaining appropriate sight indications. The primary advantage of this capability is that accurate dive/tracking is not required to solve wind drift problems.

In the Gulf War all of the 1,181 GBU-24s were released by F-111Fs.

In 1996 the Navy conducted tests of the F-14A Tomcat with the GBU-24B/B Hard Target Penetrator Laser-Guided Bomb at Naval Air Station Patuxent River, Md., as part of an air-to-ground development program to support clearance for use of the weapon in the fleet by F-14 Tomcats.

Key accomplishments in 1996 included demonstration of controlled weapon penetration and detonation depth using the Hard-Target Smart Fuse [HTSF] and successful integration of the GBU- 24/ HTSF with F-15E and F/A- 18 aircraft. The Hard-Target Smart Fuse, developed at the Wright lab, features an accelerometer that can be programmed to detonate the bomb at a precisely specified depth significantly enhancing munition lethality. The Defense Special Weapons Agency (DSWA) Counterproliferation Initiative (CPI) requires development, integration and certification of HTSF with GBU-24 B/B (Navy BLU-109) and GBU-24 D/B (Navy BLU-116) under this effort. Under a separate effort, CPI will integrate the GBU-24 B/B and GBU-24 D/B configuration HTSFs into the CPI modified Conventional Air Launched Cruise Missile (CALCM) and Tactical Land Attack Missile (TLAM) weapons.

GBU-27/B



General Info:
Origin = USA
Type = penetration
IOC = 1987
Guidance method = Laser homing
Mission = CAS, interdiction, OCA,
naval anti- surface warfare
Targets = Mobile hard, fixed soft, fixed hard
Platforms = F-117

Performance:
Accuracy = 27ft
Drag = 17
Min Release Alt. = 1500ft
Range = >10nm

Dimensions:
Length = 167in
Diameter = 14.5in
Fin Span = 28.3in (extended 66in)
Weight = 2170 lbs

Warhead:
BLU-109 for penetration (535 lbs. Tritonal)
Lethal Radius = 1200ft
Fuse = Contact

Description:

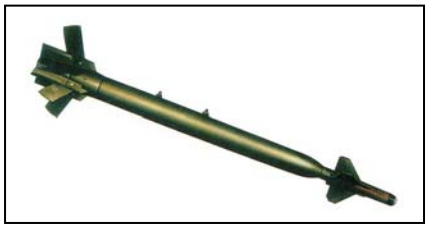
The Guided Bomb Unit-27 (GBU-27) is a GBU-24 modified for delivery by the F-117 stealth fighter. The operator illuminates a target with a laser designator and then the munition guides to a spot of laser energy reflected from the target. It uses a 2,000-pound penetrating warhead against hard targets. The GBU-27 was used in Operation Desert Storm. According to the Air Force, the GBU-27 hit 70 percent of its targets.

The GBU-27 was designed specifically for use by the F-117's advanced target acquisition/designator system. The GBU-27 uses a BLU-109 improved performance 2,000 pound bomb developed in 1985 under the project name HAVE VOID. The BLU-109 was designed for use against hardened structures and features a high-strength forged steel case and a new delayed-action tail fuze. It carries 550 pounds of high explosives and can penetrate more than six feet of reinforced concrete.

The GBU-27 uses a modified Paveway II guidance control unit which provides "terminal trajectory shaping" for optimum impact angle against various target structures. For example, it will hit an aircraft shelter with a vertical impact, but make a horizontal approach to a bridge support. A Paveway II tail assembly with folding wings completes the bomb.

The F-117 can carry two GBU-27s in two weapons bays and is reportedly capable of hitting a one square meter target from an altitude of 25,000 feet.

GBU-28



General Info:
Origin = USA
Type = Penetration, Blast/Fragmentation
Manufacture = Lockheed
IOC = 1991
Guidance method = Laser homing
Guidance System = WGU-36A/B
Mission = Offensive counter air, close air support, interdiction
Targets = fixed hard
Platforms = F-15E, F-111F

Performance:
Accuracy = 27ft
Drag = 19
Lethal Radius = 2,500ft
Min Release Alt = 3,000ft
Concrete = 22ft
Earth = 100ft
MSD, protected = 800ft
MSD, exposed = 800ft
Range = 8nm

Dimensions:
Length = 153in
Diameter = 15in
Fin Span = 28.3in (extended 66in)
Weight = 4414lbs

Warhead:
BLU-113 (647 lbs. Tritonal)
MK 84 for Blast/Fragmentation (945 lbs. Tritonal)
Lethal Radius = 2500ft
Fuse = Contact (FMU-143)

Description:

The Guided Bomb Unit-28 (GBU-28) is a special weapon developed for penetrating hardened Iraqi command centers located deep underground. The GBU-28 is a 5,000-pound laser-guided conventional munition that uses a 4,400-pound penetrating warhead. The bombs are modified Army artillery tubes, weigh 4,637 pounds, and contain 630 pounds of high explosives. They are fitted with GBU-27 LGB kits, 14.5 inches in diameter and almost 19 feet long. The operator illuminates a target with a laser designator and then the munition guides to a spot of laser energy reflected from the target.

The GBU 28 "Bunker Buster" was put together in record time to support targeting of the Iraqi hardened command bunker by adapting existing materiel. The GBU-28 was not even in the early stages of research when Kuwait was invaded. The USAF asked industry for ideas in the week after combat operations started. Work on the bomb was conducted in research laboratories including the Air Force Research Laboratory Munitions Directorate located at Eglin AFB, Florida and the Watervliet Armory in New York. The bomb was fabricated starting on 1 February, using surplus 8-inch artillery tubes as bomb casings because of their strength and weight. The official go-ahead for the project was issued on 14 February, and explosives for the initial units were hand-loaded by laboratory personnel into a bomb body that was partially buried upright in the ground. The first two units were delivered to the USAF on 16 and 17 February, and the first flight to test the guidance software and fin configuration was conducted on 20 February. These tests were successful and the program proceeded with a contract let on 22 February. A sled test on 26 February proved that the bomb could penetrate over 20 feet of concrete, while an earlier flight test had demonstrated the bomb's ability to penetrate more than 100 feet of earth. The first two operational bombs were delivered to the theater on 27 February.

The Air Force produced a limited quantity of the GBU-28 during Operation Desert Storm to attack multi-layered, hardened underground targets. Only two of these weapons were dropped in Desert Storm, both by F-111Fs. One weapon hit its precise aimpoint, and the onboard aircraft video recorder displayed an outpouring of smoke from an entrance way approximately 6 seconds after impact. After Operation Desert Storm, the Air Force incorporated some modifications, and further tested the munition. The Fy1997 budget request contained $18.4 million to procure 161 GBU-28 hard target penetrator bombs.

GBU-43/B (MOAB - Massive Ordinance Air Burst)

General Info:
Type = Very large HE Blast
Origin = U.S.A.
Manufacture = McAlester Army Amunition Plant
IOC = 2003
Guidance = Ballistic, GPS, Parachute stabilized
Platforms = C-130

Performance:
Range = Gravity bomb

Dimensions:
Length = 30ft
Diameter = 40.5in
Weight = 21000lbs

Warhead:
18000lbs H6 (mixture of RDX (Cyclotrimethylene trinitramine), TNT, and aluminium)
Blast yield = 11 tons

Description:

The MOAB (Massive Ordinance Air Burst) is new big brother to the BLU-82B (Daisy Cutter) bomb. It is dropped from the back of theC-130 AC with parachute and then precision guided by GPS to target. The weapon is dropped from a MC-130 since it is far too heavy for the bomb racks on any bomber. It is detonated by a 38in extender mounted to the nose fuze, optimized to create little or no crater. Minimum release altitude is 6,000ft due to blast effects.

In Desert Storm 11 BLU-82s were dropped. Initially to clear mines but since no reliable dabage assessments exists on mine clearing effectiveness later bombs were dropped for both psychological effect as for antipersonnel effects.

BGL-1000

General Info:
Origin = France
Constructor = Matra
Guidance method = Thomson-CSF TMV 630
Eblis semi-active laser homing
Platforms = Mirage 2000D

Performance:
Range = max. 10 km

Dimensions:
Length = 165.83in
Diameter = 18in
Fin Span = 35.43in
Weight = 2711lbs

Warhead:
2205lbs HE

BGL-400

General Info:
Origin = France
Constructor = Matra
Guidance method = Thomson-CSF TMV 630
Eblis semi-active laser homing
Platforms = Mirage 2000D

Performance:
Range = max. 10 km

Dimensions:
Length = 133.94in
Diameter = 15.87in
Fin Span = 31.06in
Weight = 1045lbs

Warhead:
882lbs HE bomb

Description:

Matra, now Matra BAe Dynamics, commenced development of a Laser-Guided Bomb (LGB) similar in principle to the US Paveway munitions in which laser seeking guidance packages are fitted as modifications kits to conventional free-fall bombs, to provide accuracy against laser marked targets. The laser guidance subsystem was derived from the Ariel seeker developed for the AS 30 laser-guided air-to-surface missile. The use of this seeker, produced by Thomson Both the 400 kg GP and 1,000 kg LGBs are in full production. The 400 kg version entered operational service with the French Air Force in 1985 and the 1,000 kg Arcole around 1992. The 400 kg LGB was used during the Gulf conflict in 1991 and the 1,000 kg Arcole was used in Bosnia in 1994. Some five hundred 400 kg and one hundred 1,000 kg LGBs have been ordered by the French Air Force. Both types of LGB have been ordered by a number of foreign customers including some 1,000 kg LGBs for the UK. In 1995, it was reported that Matra BAe Dynamics has received orders for over 1,000 Arcole 1,000 kg LGBs. The 250 kg bomb and the 400 kg PE bomb are reported to have completed development and to have entered production in 1995.
The LGB system consists of two major bolt-on subassemblies for the conversion of conventional free-fall bombs to a laser-guided bomb. All of the bombs will have the standard NATO 356 mm suspension lug spacing. The bolt-on front end guidance section is a streamlined container with four moving control clipped-tip delta fins and a long moving probe that acts like a wind vane. On the front end of the probe is a canister with a glass dome nose. The canister has two small swept rectangular wings fitted to it at mid-body. The bolt-on rear end assembly has four large, semi-folded, flip-out aerofoil surfaces arranged in a cruciform pattern. The nose guidance kit fitted to the 250 and 400 kg bombs weighs 45 kg and the tail wings weigh 80 kg. The units fitted to the 1,000 kg bomb weigh 60 and 110 kg respectively. When the system is fitted to the 250 kg GP bomb, the weapon will be 3.61 m long, have a maximum body diameter of 324 mm and a weight of 250 kg. The 400 kg GP LGB is 3.54 m long, has a body diameter of403 mm and weighs 470 kg. The 400 kg PE LGB under development will be 3.64 m long, have a diameter of 391 mm and weigh 450 kg. The closed tailspan of these three bombs is 0.79 m, and this extends to 1.43 m once the bomb has cleared the release aircraftt to bleed enehe highly sensitive seeker has only limited ICCM and is susceptible against flares and ground-clutter. Seeker tracking rate is very high, comparable to the AIM-9M.

BGL-250

General Info:
Origin = France
Constructor = Matra
Guidance method = Thomson-CSF TMV 630
Eblis semi-active laser homing
Platforms = Mirage 2000D

Performance:
Range = max. 10 km

Dimensions:
Length = 131.07in
Diameter = 8.98in
Fin Span = 25.2in
Weight = 661lbs

Warhead:
551lbs HE bomb

Description:

Several air forces have ordered more than 1,750 General Purpose and Penetration versions of the LGB. The weapon was used successfully in Bosnia (1994) and in the Balkans (1999) on French Mirage 2000D aircraft.

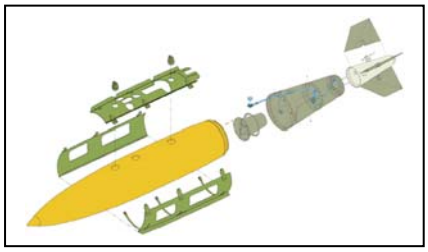
SAMP 400

General Info:
Origin = France
Constructor = Matra/ Société des Ateliers Mécanique de Port-sur-Sambre
Type = general purpose, laser guided
Platforms = Mirage 2000D

Dimensions:
Length = 5.4ft
Diameter = 8.6in
Weight = 880lbs

Warhead:
HE bomb

GBU-29 JDAM



General Info:
Origin = USA
Manufacture = Martin-Marietta
Guidance method = GPS/INS
Mission = CAS, interdiction, OCA, suppression of enemy air defence, naval anti-surface warfare, amphibious strike
Targets = Mobile hard/soft, fixed hard/soft, maritime
Platforms = B-52, B-1, B-2, F-22, F-16, F-15E, F- 117, F-14 A/B/D, F/A-18C/D, F/A-18E/F, AV-8B, P-3, S-3

Performance:
Weight = 250lbs
Accuracy = 42ft (INS) to 98ft (GPS/INS)
Range = 5nm to 15nm

Warheads:
250 pound, Mk-81 warhead
196lbs high explosive Tritonal
Fuse = Impact

GBU-30 JDAM

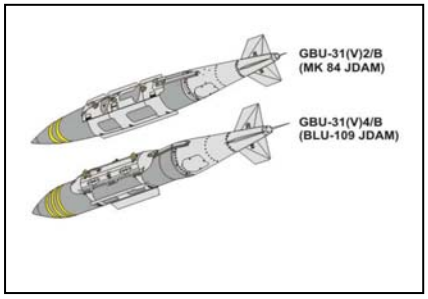
General Info:
Origin = USA
Manufacture = Martin-Marietta
Guidance method = GPS/INS
Mission = CAS, interdiction, OCA,
suppression of enemy air defence, naval anti-surface
warfare, amphibious strike
Targets = Mobile hard/soft, fixed hard/soft, maritime
Platforms = B-52, B-1, B-2, F-22, F-16, F-15E, F- 117, F-14 A/B/D, F/A-18C/D, F/A-18E/F, AV-8B, P-3, S-3

Performance:
Accuracy = 42ft (INS) to 98ft (GPS/INS)
Range = 5nm to 15nm

Dimensions:
Length = 90.5in
Diameter = 10.75in
Weight = 500lbs

Warhead:
500 pound, Mk-82 warhead
Fuse = Impact

GBU-31 JDAM



General Info:
Origin = USA
Manufacture = Lockheed Martin and
Boeing [McDonald Douglas]
Guidance method = GPS/INS
Mission = CAS, interdiction, OCA, suppression of enemy air defence, naval anti-surface warfare, amphibious strike
Targets = Mobile hard/soft, fixed hard/soft, maritime
Platforms = B-52, B-1B, B-2, F-15, F-16, F-117, F-14, F-18

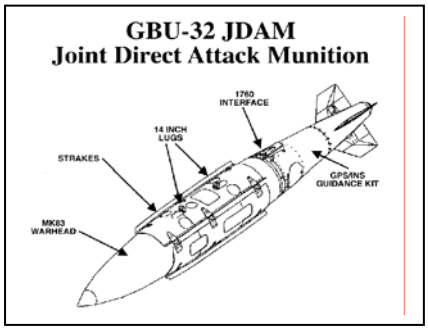
Performance:
Accuracy = 42ft (INS) to 98ft (GPS/INS)
Range = 5nm to 15nm

Dimensions:
Length = 177in
Weight = 2040lbs

Warhead:
2,000 pound, Mk84 HE (GBU-31 1B)or BLU109 PE (GBU-31 3B) warhead
2000lbs high explosive Tritonal
Fuse = Impact

GBU-32 JDAM

General Info:
Origin = USA
Manufacture = Lockheed Martin and
Boeing [McDonald Douglas]
Guidance method = GPS/INS
Mission = CAS, interdiction, OCA, suppression of enemy air defence, naval anti-surface warfare, amphibious strike
Targets = Mobile hard/soft, fixed hard/soft, maritime
Platforms = B-52, B-1B, F-15, F-16, F-117, F-14, F-18



Performance:
Accuracy = 42ft (INS) to 98ft (GPS/INS)
Range = 5nm to 15nm

Dimensions:
Length = 157.5in
Diameter = 17.7in
Fin span = 19.3in
Weight = 1015lbs

Warhead:
1,000 pound, Mk83 HE (GBU-32 JDAM 1B) or
BLU110 PE (GBU-32 JDAM 1B) warhead
1000lbs high explosive Tritonal
Fuse = Impact

Description:

The Joint Direct Attack Munitions (JDAM) GBU-31 is a tail kit under development to meet both USAF and Navy needs, with the Air Force as the lead service. The program will produce a weapon with high accuracy, all-weather, autonomous, conventional bombing capability. JDAM will upgrade the existing inventory of general purpose and penetrator unitary bombs, and a product improvement may add a terminal seeker to improve accuracy. JDAM can be launched from approximately 15 miles from the target and each is independently targeted.
JDAM is not intended to replace any existing weapon system; rather, it is to provide accurate delivery of general purpose bombs in adverse weather conditions. The JDAM will upgrade the existing inventory of Mk-83 1,000- and Mk-84 2,000-pound general purpose unitary bombs and the 2,000-pound hard target penetrator bomb by integrating a guidance kit consisting of an inertial navigation system/global positioning system guidance kit.
The 1,000-pound variant of JDAM is designated the GBU-31, and the 2,000-pound version of the JDAM is designated the GBU-32. JDAM variants for the Mk-80 250-pound and Mk-81 500-pound bombs are designated GBU-29 and GBU-30, respectively. Hard Target penetrators being changed into low-cost JDAMs included the 2,000 pound BLU-109 and 1,000 pound BLU-110.
Mission plans are loaded to the host aircraft prior to take off and include release envelope, target coordinates and weapon terminal parameters. The weapon automatically begins its initialisation process during captive carry when power is applied by the aircraft. The weapon performs bit, and aligns its INS with the host aircraft's system. Targeting data is automatically down loaded to the weapon from the host aircraft. When the host aircraft reaches the release point within the Launch Acceptable Region (LAR), the weapon is released. Weapon manoeuvrability and range are enhanced by fixed aerodynamic surfaces (mid-body strakes) attached to the bomb body.

Once released, the bomb's INS/GPS will take over and guide the bomb to its target regardless of weather. Guidance is accomplished via the tight coupling of an accurate Global Positioning System (GPS) with a 3-axis Inertial Navigation System (INS). The Guidance Control Unit (GCU) provides accurate guidance in both GPS-aided INS modes of operation (13 meter (m) Circular Error Probable (CEP)) and INS-only modes of operation (30 m CEP). INS only is defined as GPS quality hand-off from the aircraft with GPS unavailable to the weapon (e.g. GPS jammed). In the event JDAM is unable to receive GPS signals after launch for any reason, jamming or otherwise, the INS will provide rate and acceleration measurements which the weapon software will develop into a navigation solution. The Guidance Control Unit provides accurate guidance in both GPS-aided INS modes of operation and INS-only modes of operation. This inherent JDAM capability will counter the threat from near-term technological advances in GPS jamming.

The weapon system allows launch from very low to very high altitude and can be launched in a dive, toss, loft or in straight and level flight with an on-axis or off-axis delivery. JDAM also allows multiple target engagements on a single pass delivery. JDAM provides the user with a variety of targeting schemes, such as preplanned and in-flight captive carriage retargeting.

JDAM is being developed by Lockheed Martin and Boeing [McDonald Douglas]. In October 1995, the Air Force awarded a contract for EMD and for the first 4,635 JDAM kits at an average unit cost of $18,000, less than half the original $40,000 estimate. As a result of JDAM's pilot program status, low-rate initial production was accelerated nine months, to the latter half of FY 1997. On April 30, 1997, the Air Force announced the decision to initiate low-rate initial production (LRIP) of JDAM, with the first production lot of 937 JDAM kits. The JDAM Integrated Product Team achieved a phenomenal 53 guided JDAM weapon releases in the six months prior to the LRIP decision. JDAM demonstrated high reliability and outstanding accuracy. Twenty-two of the weapon releases were accomplished during an early Air Force operational assessment. Over a four-week period operational crews put JDAM through an operationally representative evaluation, including targets shrouded by clouds and obscured by snow. All 22 weapons successfully performed up to their operational requirements including overall accuracy of 10.3 meters, significantly better than the 13 meter requirement. Early operational capability JDAMs have been delivered to Whiteman Air Force Base, Mo., and low-rate, initial production JDAM deliveries begin on 02 May 1998. McDonnell Douglas Corporation of Berkeley, MO, was awarded on 02 April 1999, a $50,521,788 face value increase to a firm-fixed-price contract to provide for low rate initial production of 2,527 Joint Direct Attack Munitions kits. The work is expected to be completed by January 2001.

On 28 April 2000 McDonnell Douglas Corp., Berkeley, Mo., was awarded a $5,648,796 modification to a firm-fixed-price contract to provide for incorporation of Pin-Lock Tail Actuator System technology into the production effort for 8,163 Joint Direct Attack Munitions kits. The Pin-Lock Tail Actuator System provides a more durable and accurate method of manoeuvring the tail fins of the JDAM than the existing Friction Brake technology. Expected contract completion date was 31 March 2001.

The JDAM program is nearing the end of its development phase. More than 250 flight tests involved five Air Force and Navy aircraft. JDAM will be carried on virtually all Air Force fighters and bombers, including the B-1, B-2, B-52, F-15E, F-16, F-22, F-117, and F/A-18.

JDAM was certified as operational capable on the B-2 in July 1997. Limited Initial Operational Capability was achieved on the B-52 in December 1998.
The B-1B Lancer conventional mission upgrade program is configuring the B-1B to carry out its role as the primary Air Force long-range heavy bomber for conventional warfare. The 11 Feb 1998 drop from a B-1B was the 122nd guided JDAM launch. The depot at Oklahoma City Air Logistics Center will install the modification kits in the initial block of bombers by January 1999, giving Air Combat Command seven JDAM-capable B-1B bombers 18 months ahead of the initial program schedule.
Potential Upgrades

The JDAM product improvement program may add a terminal seeker for precision guidance and other system improvements to existing JDAMs to provide the Air Force with 3-meter precision and improved anti-jamming capability. The Air Force is evaluating several alternatives and estimates that the seeker could be available for operations by 2004. The seeker kit could be used by both the 2,000-pound blast fragmentation and penetrator JDAMs.

The Advanced Unitary Penetrator (AUP), a candidate to be integrated with a GBU-31 guidance kit, is a 2000 lb. class penetrator warhead intended as an upgrade/replacement for the BLU-109 warhead in applications requiring increased penetration. The AUP is designed to provide increased penetration capability over the BLU-109 warhead while maintaining the same overall weight, mass properties, dimensions, and physical interfaces associated with the BLU-109 warhead. This concept integrates the AUP warhead with the GBU-31, the JDAM tail kit for 2,000 lb class warheads. This concept uses the Hard Target Smart Fuze (HTSF), an accelerometer based electronic fuze which allows control of the detonation point by layer counting, distance or time. The accelerometer senses G loads on the bomb due to deceleration as it penetrates through to the target. The fuze can distinguish between earth, concrete, rock and air.

The boosted penetrator concept is based on achieving maximum penetration without sacrificing operational flexibility. Total system weight will be less than 2,250 pounds so that it can be carried by all AF tactical aircraft and bombers as well as the Navy's F/A-18. The goal is to achieve greater penetration than the GBU-28 with a near term, affordable design. A dense metal warhead will be used with a wraparound rocket motor to allow internal carriage in the F-117. Advanced explosives will be used to compensate for the reduced charge weight. This concept integrates the boosted penetrator warhead with a JDAM guidance kit with an adverse weather Synthetic Aperture Radar (SAR).

The Ballasted Penetrator in GBU-32 concept is a 1000 pound dense or ballasted penetrator integrated with a GBU-32 guidance kit using compressed carriage for internal carriage in advanced fighters (F-22, JSF) or carriage in cruise missiles (JASSM, CALCM, ACM, ATACMS, Tomahawk.) The warhead would either be designed with a dense metal case or contain dense metal ballast for maximum penetration. The warhead will be filled with an advanced insensitive explosive to compensate for the reduced charge weight. The warhead will be integrated with the GBU-32, the JDAM tail kit for 1,000 lb class warheads.

The Boosted Unitary Penetrator concept is based on achieving maximum penetration in a weapon that will fit internally in the F-22. Total system weight will be less than 1300 pounds. A dense metal warhead will be used with a wraparound rocket motor. Use of next generation compressed seekers and aero-control designs along with reaction jet control will allow the size to shrink sufficiently to fit inside F-22 and JSF. Advanced explosives will be used to compensate for the reduced charge weight. This concept integrates the boosted penetrator warhead with a JDAM guidance kit with an adverse weather Synthetic Aperture Radar (SAR).

The JDAM/BLU-113 concept improves the GBU-28 by enhancing the nose design of the BLU-113 warhead for improved penetration. The warhead nose reshape will improve BLU-113 penetration by more than 25%. The penetration could potentially be further improved by replacing the traditional HE fill with a dense explosive. The design involves integrating the improved BLU-113 warhead with a JDAM tail kit.

The Compressed Carriage GBU-32, J1K, enhanced fill concept is a JAST-1000 warhead with enhanced fill integrated with a GBU-32 guidance kit using compressed carriage for internal carriage in advanced fighters (F-22, JSF) or carriage in cruise missiles (JASSM, CALCM, ACM, ATACMS, Tomahawk.) The warhead is a combined penetrator and blast/fray warhead. The warhead shape is optimized for penetration and the enhanced fill and internal liner provide blast and controlled fragmentation capability. The warhead is shrouded to match the MK-83 mass properties and interfaces. The warhead will be integrated with the GBU-32, the JDAM tail kit for 1,000 lb class warheads. Use of aero-control designs along with reaction jet control will allow the size to shrink sufficiently to fit inside F-22 and JSF. This concept uses the Hard Target Smart Fuze (HTSF).

The Direct Attack Munitions Affordable Seeker (DAMASK) Fleet Advanced Demonstration (FAD) accuracy enhancement kit is a seeker of the lowest possible cost that will improve JDAM accuracy to three-meter circular error probability (CEP). The three-year FAD began in FY 98 and continued through FY 00. DAMASK includes a very low-cost sensor mounted to the front of a JDAM and an off-the-shelf signal processor mounted in the existing JDAM tail kit. It uses an uncooled imaging-infrared focal plane array (UIIFPA) sensor and low-cost optics, both developed for the consumer automobile market. An off-the-shelf, commercially available signal processor is the final component of the accuracy upgrade kit, estimated to cost less than $12.7 thousand per seeker in quantity. During the final stages of weapon flight, DAMASK's unique guidance system will image the target area, locate a mission-planned aim point and update the JDAM target location. The mission-planning image can come from satellite, uninhabited air vehicles or reconnaissance aircraft. A template is then automatically produced from the mission-planning image and loaded on board the aircraft with the baseline JDAM mission plan. Organic targeting is possible because the target area can be imaged with onboard synthetic aperture radar (SAR) or forward looking infrared (FLIR) sensors, and the pilot can then select the desired impact point using a heads-down display.

GBU-34 JDAM

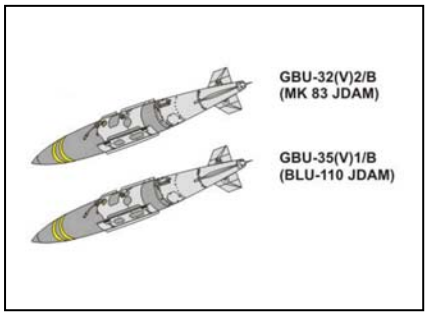
General Info:
Origin = USA
Manufacture = Lockheed Martin
Guidance method = GPS/INS
Mission = Close air support, interdiction, offensive counter air, suppression of enemy air defence, naval anti-surface warfare, amphibious strike
Targets = Mobile hard, mobile soft, fixed hard, fixed soft, maritime surface
Platforms = B-52, B-1B, B-2, F-15, F-16, F-117, F-14, F-18

Performance:
Accuracy = 42ft (INS) to 98ft (GPS/INS)
Range = 5nm to 15nm

Warheads:
2,000 lb. BLU-109 Penetration, Blast/Fragmentation

GBU-35 JDAM

General Info:
Origin = USA
Manufacture = Boeing [McDonald Douglas]
Guidance method = GPS/INS
Mission = CAS, interdiction, OCA, suppression of enemy air defence, naval anti-surface warfare, amphibious strike
Targets = Mobile hard/soft, fixed hard/soft, maritime
Platforms = B-2, F-16, F-18



Performance:
Accuracy = 42ft (INS) to 98ft (GPS/INS)
Range = 5nm to 15nm

Dimensions:
Length = 157.5in
Diameter = 17.7in
Fin span = 19.3in
Weight = 1030lbs

Warheads:
1,000 pound, BLU-110 warhead

GBU-36 GAM

General Info:
Origin = USA
Manufacture = NORTHROP GRUMMAN
Guidance method = GPS/INS
Mission = CAS, interdiction, OCA, suppression of enemy air defence, naval anti-surface warfare, amphibious strike
Targets = Mobile hard, mobile soft, fixed hard, fixed soft, maritime surface
Platforms = B-2, F-16, F-18

Performance:
Accuracy = 20ft (GPS/INS)
Range = 5nm to 15nm

Dimensions:
Length = 151in
Diameter = 18in

Warheads:
2,000-pound Mk84 general purpose warhead

GBU-37 GAM

General Info:
Origin = USA
Manufacture = NORTHROP GRUMMAN
Guidance method = GPS/INS
Mission = CAS, interdiction, OCA, suppression of enemy air defence, naval anti-surface warfare, amphibious strike
Targets = Mobile hard/soft, fixed hard/soft, maritime
Platforms = B-2, F-16, F-18

Performance:
Dimensions = Length from 9 ft. 11 in. to 12 ft. 8 in.,
Accuracy = 19ft (GPS/INS)
Range = 5nm to 15nm

Warheads:
4,500lbs BLU-113 penetration warhead

Description:

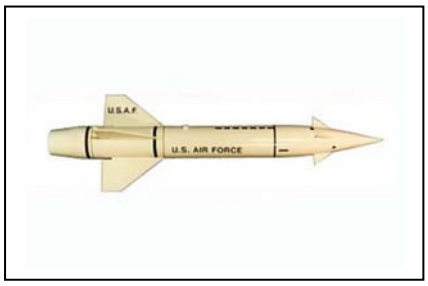
The Global Positioning System Aided Munitions (GAM) was developed by the Air Force and Northrop Grumman Corporation as an interim precision munitions for the B-2. GAM is a tail kit that fits on the 2,000-pound Mk84 general purpose bomb [GBU-36/B], or the 4,500 lb BLU-113 penetrator [GBU-37/B]. GAM uses GPS guidance to more accurately guide to target locations. The munitions is to be eventually replaced on the B-2 by the Joint Direct Attack Munitions. The GBU-37 was added to the B-2 arsenal in late 1997. This weapon is currently the only all-weather, near-precision "bunker busting " capability available.

The Global Positioning System (GPS) Aided Target System [GATS] is an all weather B-2 targeting system which reduces Target Location Error (TLE) normally associated with target coordinates. By exploiting the synergistic effects of the B-2's GPS navigation and Synthetic Aperture Radar (SAR) capabilities, which combine the SAR's excellent range and range rate capabilities with accurate GPS Position and velocity information, we provide the GAM highly accurate target location relative to current B-2 position.

The GATS/GAM system was developed to meet a B-2 Block 20 precision weapon requirement left unfulfilled by the cancellation of another munitions. All GAMs have been delivered to the 509th Bomb Wing, Whiteman AFB MO and are in operational use. Demonstrated accuracy by Air Combat Command aircrews has been under 20 feet.

AIR TO GROUND MISSILES

AGM-12B Bullpup A



General Info:
Origin = U.S.A.
Type = High explosive
Manufacture = W.L. Maxson
IOC = 1962
Guidance = Manual, control over radio link

Performance:
Speed = Mach 1.8
Range = 7nm

Dimensions:
Length = 126in
Diameter = 12in
Fin Span = 37in
Weight = 571lbs

Warhead:
Weight = 250lbs

AGM-12C/D Bullpup B

General Info:
Origin = U.S.A.
Manufacture = Lockheed Martin
IOC = 1965
Guidance = Manual, control over radio link

Performance:
Speed = Mach 1.8
Range = 10nm

Dimensions:
Length = 163.2in
Diameter = 18in
Fin Span = 48in
Weight = 1785lbs

Warhead:
AGM-12C Bullpup-B (Semi armour piercing 1,000lbs)
AGM-12D Bullpup-A (SAP or nuclear 1,000lbs)

Description:

The Bullpup was the U.S. Navy and the USAF's first successful guided tactical air-to-ground missile. It's development was a direct reaction to the frustration of the US Navy with unguided weapons during the Korean War. The two primary goals were to increas the probability of destroying targets which are hard to hit with general purpose bombs, like bridges, and to minimize exposure to enemy ground fire. Martin won the contract and the ASM-N-7 Bullpup entered service in the US Navy in 1959.
The ASM-N-7 was roll-stabilized, a simple standard 250lbs bomb was adapted as the warhead and it was powered by an Aerojet MK8 solid fuel motor. Two flares in the back of the missile allowed the pilot to optically track the missile and guide it to the target using a small control stick to transmit radio control commands. The main drawback was that the target, the missile and the launching aircraft had to remain in a straight line during guidance. That made the aircraft a vulnerable target for ground fire which was one thing to avoid as per the primary design goals.
US Air Force started its involvement in the Bullpup around 1955 with the goal of having a nuclear capable version of the Bullpup. The AGM-12D resulted which could optionally be armed with a 1-15kt W-45 fission warhead. For training a 5in rocket with tracking flares and radio guidance were developed.
In june 1963 all Bullpup versions were redesignated as the AGM-12 series. Over 30000 missiles where built mostly AGM-12A/B and the phase-out began in mid 1970s. The last AGM-12C were retired in the early 1980s.

AGM-62 Walleye II

General Info:
Origin = U.S.A.
Manufacture = Martin Marietta
IOC = 1967
Guidance = Electro-optic (TV with data link)

Performance:
Speed = Subsonic glide weapon
Range = 30nm

Dimensions:
Length = 159in
Diameter = 18in
Fin Span = 51in
Weight = 2400lbs

Warhead:
Walleye I: 825lbs
Walleye II: 2,000lbs

MODs:
MK 1 MOD 0/2/6/7/8/9Walleye I
MK 2 MOD 0/2/3/6Walleye I Trainer
MK 3 MOD 0Walleye I ER
MK 4 MOD 0/1/2/3/4/6/7Walleye I Trainer
MK 5 MOD 4/6/8/9Walleye II
MK 6 MOD 0Nuclear Walleye II
EX 11 MOD 1Walleye II Trainer
EX 12 MOD 0/1Walleye II
EX 13 MOD 0/1
MK 13 MOD 2/3Walleye II
EX 14 MOD 0Walleye I Trainer
EX 15 MOD 0Walleye II Trainer
EX 15 MOD 5Walleye II
EX 16 MOD 0Walleye II Trainer
MK 17 MOD 0Walleye II
MK 21 MOD 0/1/.../11Walleye I ERDL
MK 22 MOD 0/1/.../5Walleye I ERDL
MK 23 MOD 0/1/.../5Walleye II ERDL
MK 27 MOD 0/1/.../5Walleye I/II ERDL Trainer
MK 29 MOD 0/1/.../29Walleye I ERDL/DPSK
MK 30 MOD 0/1/.../9Walleye II ERDL/DPSK
MK 34 MOD 0/1/.../9Walleye I ERDL/DPSK
MK 37 MOD 0/1/2/3/4Walleye II ERDL/DPSK
MK 38 MOD 0/1/2Walleye I/II ERDL Phase I/II Trainer
MK 39 MOD 0/1/2Walleye I/II ERDL/DPSK Trainer

Description:

The AGM-62 WALLEYE is a guided glide bomb designed to be delivered on a surface target from an attack aircraft. It is used primarily against targets such as fuel tanks, tunnels, bridges, radar sites, port facilities, and ammunition depots. The weapon system consists of the weapon, the attack aircraft, the AN/AWW-9B data link pod, and the OK-293/AWW control group. The WALLEYE is unique in that it has no propulsion section and must rely on its ability to glide to the target after release from the aircraft.
There are three basic series of the WALLEYE weapon. The original WALLEYE I Extended Range Data Link (ERDL) utilizes a tone data link system while the newer version utilizes the differential phase shift keyed digital data link, designed to prevent signal jamming. The WALLEYE II and WALLEYE II ERDL are greater in diameter, length, and weight than the WALLEYE I ERDL weapons. The AGM- 62 designation for Walleye nomenclature is not in wide use.
China Lake designed and developed the first precision-guided antisurface weapon, the Walleye (AGM-62) TV-guided glide bomb. Related to Walleye but cancelled before completion was Condor (AGM-53), a rocket-powered TV-guided missile. Extended-range data links have also been developed for Walleye. China Lake also developed Bulldog (AGM-83), the first successful laser-guided missile, which was approved for service use in 1974 but cancelled in favor of the Air Force Maverick.
In January 1963 a Walleye television glide bomb, released from a YA-4B, made a direct impact on its target at the Naval Ordnance Test Station, China Lake in the first demonstration of its automatic homing feature. A contract for production of the Walleye television homing glide bomb was issued to the Martin Marietta Corporation in January 1966. An outgrowth of in-house China Lake technology efforts, Walleye was fielded in 1967 and proved its unsurpassed accuracy in combat.
Originally developed by the Navy, the Air Force began Walleye combat tests in Vietnam during August 1967 that achieved excellent results in good visibility against targets that gave a strong contrast and were lightly defended. Later Walleye operations in more demanding conditions were less successful. It continued to be used in Southeast Asia, but due to its operating restrictions, cost, and the appearance of laser-guided bombs (LGB), comprised only a small fraction (6 percent) of the total number of PGMs employed in Vietnam.
The ERDL weapon provides distinct advantages over the standard WALLEYE. With the ERDL version, the added data link permits the weapon to continue to send a video target display from launch of the weapon until target impact. The data link further allows the controlling aircraft to control the weapon in flight and to either retarget or redefine the target aim point. The controlling aircraft can be the launching aircraft or a second aircraft equipped with a data link pod (AN/AWW-9B).
The 1427-1435 MHz band is used for proficiency training using various guided weapon systems. The weapon systems and supporting data links that operate in this band include the AWW-13 Advanced Data Link, used in the Walleye and SLAM. The current Navy inventory includes approximately 200 Walleye and 800 SLAM weapon systems. The loss of this band for missile command operations would render Navy systems more susceptible to jamming and will impair their terminal guidance. Compounding the problem are developmental weapons, such as the Joint Standoff Weapon Unitary (JSOW Unitary), that will use the AWW-13. The AWW-13 requires spectrum for both command and video functions.

Electro-optical [EO] sensors such as used on Walleye depend on both light and optical contrast for target searching and identification. This obviates their use at night and in significantly adverse weather or visual conditions where the line of sight to a target was obscured. The requirement for visual contrast between the target and its immediate surroundings imposed problems during Desert Storm. For Walleye delivery, F/A-18 pilots reported that a target was sometimes indistinguishable from its own shadow. This made it difficult to reliably designate the actual target, rather than its shadow, for a true weapon hit. The the low-light conditions at dawn and dusk often provided insufficient light for the required degree of optical contrast. A "haze penetrator" version of Walleye used low-light optics to see through daytime haze and at dawn and dusk, permitting use in some of the conditions in which other optical systems were limited.

The SLAM is based on the highly successful and reliable Harpoon anti-ship missile, with a Global Positioning System-aided Inertial Navigation System (GPS/INS) for mid-course guidance, and a Maverick imaging infrared sensor and a Walleye data link for precise, “man-in-the-loop” terminal guidance.

AGM-65A/B Maverick

General Info:
Origin = U.S.A.
Manufacture = Raytheon (Hughes)
IOC = 1972/1975
Guidance = electro-optical

Performance:
Power Plant = Thiokol SR109-TC-1 solid-fuel rocket
Accuracy = 1.5m
Speed = Mach 1.2
Range = >12nm

Dimensions:
Length = 98in
Diameter = 12in
Fin Span = 28in
Weight = 462lbs

Warhead:
125lbs WDU-20/B

Description:

The AGM-65 Maverick is a standoff air-to-ground missile designed primarily as an anti-armor weapon, but is also capable of striking a variety of surface targets. The missile provides launch-and-leave capability to attack aircraft performing close air support, interdiction and defense suppression missions. First operational in 1972, several variants of the Maverick have been fielded both to incorporate improvements in technology and to accommodate special mission requirements.
A Model
The A model Maverick uses an electro-optical television seeker head. When commanded to lock, the missile's computer analyzes the scene to pick out a target from the background using contrast and edge detection. After lock-on, the target area and the background are continually sampled to determine if the target is still in the center of the scene. If the target moves or the missile line of sight drifts, the camera is slewed to recenter the target. The missile control surfaces then steer the missile back into alignment with the camera and back on a collision course with the target. As the missile closes on the target, the target's apparent size will increase. To compensate, the guidance unit continually redefines the target boundaries to include an ever-increasing area.
The A, B and D model Mavericks all use a contact fuze and a shaped charge warhead effective against all known armored vehicles.
About 5,000 Mavericks have been fired in combat, with a success rate of 90%.
Engagement Sequence
The first step in Maverick employment is to point the missile's seeker at the target. Depending on the avionics of the launching fighter, the Maverick seeker can be steered visually, slaved to a ground map radar or slaved to a laser detector. Once the missile is looking at or near the desired target, the pilot commands the missile to stabilize. The missile locks on autonomously once it is stabilized and detects a valid target. If necessary, the seeker can be slewed manually between stabilization and lock-on. Care must be taken that the lock is solid enough to survive post-launch transients. Once fired, the missile falls a few hundred feet below the launch point, then, as its rocket motor kicks in, it does an range-optimizing zoom climb to strike its target from above. The minimum slant range to avoid fragments from the missile blast is 3500 ft at 400 knots (assuming a 4-G wings-level pullout).

AGM-65D Maverick

General Info:
Origin = U.S.A.
Manufacture = Raytheon (Hughes)
IOC = 1986
Guidance = WGU-10/B imaging infrared

Performance:
Power Plant = Thiokol SR114-TC-1
or Aerojet SR115-AJ-1 solid-fuel rocket
Accuracy = 1.5m
Speed = Mach 1.2
Range = >12nm

Dimensions:
Length = 98in
Diameter = 12in
Fin Span = 28in
Weight = 485lbs

Warhead:
125lbs

Description:

The AGM-65 Maverick is a standoff air-to-ground missile designed primarily as an anti-armor weapon, but is also capable of striking a variety of surface targets. The missile provides launch-and-leave capability to attack aircraft performing close air support, interdiction and defense suppression missions. First operational in 1972, several variants of the Maverick have been fielded both to incorporate improvements in technology and to accommodate special mission requirements.
D Model
The D model uses a an imaging infrared detector to provide a thermal view of the target, but otherwise uses the same principles for target detection and tracking. An IR image allows the missile to be used in darkness, under hazy conditions and during bad weather. The A, B and D model Mavericks all use a contact fuze and a shaped charge warhead effective against all known armored vehicles.
About 5,000 Mavericks have been fired in combat, with a success rate of 90%.
Engagement Sequence
The first step in Maverick employment is to point the missile's seeker at the target. Depending on the avionics of the launching fighter, the Maverick seeker can be steered visually, slaved to a ground map radar or slaved to a laser detector. Once the missile is looking at or near the desired target, the pilot commands the missile to stabilize. The missile locks on autonomously once it is stabilized and detects a valid target. If necessary, the seeker can be slewed manually between stabilization and lock-on. Care must be taken that the lock is solid enough to survive post-launch transients. Once fired, the missile falls a few hundred feet below the launch point, then, as its rocket motor kicks in, it does an range-optimizing zoom climb to strike its target from above. The minimum slant range to avoid fragments from the missile blast is 3500 ft at 400 knots (assuming a 4-G wings-level pullout).

AGM-65E Maverick

General Info:
Origin = U.S.A.
Manufacture = Raytheon (Hughes)
IOC = 1986
Guidance = WGU-9/B laser guidance

Performance:
Power Plant = Thiokol SR114-TC-1
or Aerojet SR115-AJ-1 solid-fuel rocket
Accuracy = 1.5m
Speed = Mach 1.2
Range = >12nm

Dimensions:
Length = 98in
Diameter = 12in
Fin Span = 28in
Weight = 630lbs

Warhead:
300 lb WDU-24/B penetrating blast-fragmentation warhead

AGM-65F/G Maverick

General Info:
Origin = U.S.A.
Manufacture = Raytheon (Hughes)
IOC = 1986
Guidance = WGU-10/B imaging infrared

Performance:
Power Plant = Thiokol SR114-TC-1
or Aerojet SR115-AJ-1 solid-fuel rocket
Accuracy = 1.5m
Speed = Mach 1.2
Range = >12nm

Dimensions:
Length = 98in
Diameter = 12in
Fin Span = 28in
Weight = 670lbs

Warhead:
300 lb WDU-24/B penetrating blast-fragmentation warhead

AGM-69A SRAM

General Info:
Origin = U.S.A.
Manufacture = Boeing
IOC = 1972
Guidance = Inertia (with terrain clearance senser)
Platforms = B-52, FB-111A, B-1

Performance:
Power Plant = Thiokol SR114-TC-1
or Aerojet SR115-AJ-1 solid-fuel rocket
Speed = Mach 3
Range = 30nm – 88nm

Dimensions:
Length = 168.1in
Diameter = 17.5in
Wingspan = 35.4in
Weight = 2230lbs

Warhead:
W-69 200kT nuclear

Description:

The Boeing manufactored AGM-69A is the predecessor of the AGM-131 SRAM II.
The B-52 Stratofortress carries 8 SRAMs on a rotary launcher in the bomb bay and up to 12 more on external pylons.
The FB-111A carries up to 6 SRAMs.
With the AGM-69A it is possible to attack known, fixed air-defense installations en route to the primary target. The number of targets that can be attacked per single bomber greatly increased with the use of the AGM-69A.

AGM-84A Harpoon

General Info:
Origin = U.S.A.
Manufacture = Boeing (McDonnell-Douglas)
IOC = 1979
Type = Anti-ship strike
Guidance = AN/DSQ-28 J-band active radar seeker
Platforms = A-6, F/A-18, S-3, P-3, B-52H

Performance:
Power Plant = Teledyne/CAE J402
Speed = Mach 0.85
Thrust = 660 pounds
Range = 100nm

Dimensions:
Length = 151in
Diameter = 13in
Wingspan = 36in
Weight = 1145lbs

Warhead:
488lbs Destex WDU-18/B penetrating blast-fragmentation warhead
Fuse = Contact

Description:

The Harpoon is the only dedicated anti-ship missile in service with U.S. armed forces. It has been developed into several advanced versions, including the SLAM (Stand-off Land Attack Missile) derivatives for high-precision attacks on land targets. The Harpoon and SLAM will remain in service with the U.S. Navy for the foreseeable future.

In 1965 the U.S. Navy began studies for a missile in the 45 km (25 nm) range class for use against surfaced submarines. The name Harpoon was assigned to the project (i.e. a harpoon to kill "whales", a naval slang term for submarines). After the sinking of the Isreali destroyer Eilat in 1967 by Soviet-built anti-ship missiles, the U.S. Navy saw the need to develop a dedicated anti-shipping missile, and therefore Harpoon's primary mission became surface ship attack. The development project was formally begun in 1968, and the missile designator ZAGM-84A was allocated in 1970 after the Navy had issued a formal RFP (Request For Proposals). In June 1971, McDonnell-Douglas was awarded the prime contract for Harpoon, and the first test missile flew in October 1972. By that time it had already been decided to develop air-launched, ship-launched and submarine-launched Harpoon variants, designated AGM-84A, RGM-84A and UGM-84A, respectively. Because the range requirement was increased to 90 km (50 nm), turbojet propulsion was selected by McDonnell-Douglas. Production of the Harpoon began in 1975, and the first version to enter service was the shipborne RGM-84A in 1977, followed by the AGM-84A on P-3 aircraft in 1979. The UGM-84A became operational on attack submarines in 1981. There are also unarmed training versions of the AGM/RGM/UGM-84A, designated ATM-84A, RTM-84A and UTM-84A.

AGM-84E SLAM Block 1B

General Info:
Origin = U.S.A.
Manufacture = Boeing (McDonnell-Douglas)
IOC = 1988
Type = Anti-ship strike
Guidance = WGU-10/B IIR seeker
Sensor Range = 5nm
Field of View = 45º
Platforms = A-6, F/A-18, S-3, P-3, B-52H

Performance:
Power Plant = Teledyne/CAE J402
Speed = Mach 0.85
Thrust = 660 pounds
Range = 50nm

Dimensions:
Length = 177in
Diameter = 13in
Wingspan = 36in
Weight = 1385lbs

Warhead:
488lbs Destex WDU-18/B penetrating blast-fragmentation warhead
Fuse = Contact

Description:

AGM-84E SLAM-ER
A land attack version with infrared terminal guidance, extended range (100nm), and the facility for datalinked target updates. The SLAM-ER retains its anti-ship capability. SLAM-ER missiles were first used in the Gulf War. Seven were fired, and all hit their targets. They were also used against Bosnian Serb air defense and communications facilities in 1995.

AGM-86C CALCM

General Info:
Origin = U.S.A.
Manufacture = Boeing (McDonnell-Douglas)
IOC = 1986
Type = Ground attack
Guidance = GPS/INS
Platforms = B-52H

Performance:
Speed = 430kts
Range = 650nm

Dimensions:
Length = 249in
Diameter = 24.5in
Wing Span = 144in
Weight = 3,250lbs

Warhead:
Block 0: 2,000lbs (Blast fragmentation)
Block 1 & 1A: 3,000lbs (Blast fragmentation)
Block 2: 1,200lbs (Advanced Unitary Penetration)
Fuse = Contact

Description:

In the late 1980s arms limitation treaties eliminated ALCMs as nuclear weapons but did allow for their conversion into conventionally armed missiles.
The new-production missiles were designated Block 1. The GPS system got improved cutting the CEP (circular error probability) in half an dthe warhead was switched to a larger 3,000lbs one.
To further improve accuracy the Block 1A evolved equipped with a precision accuracy kit that uses a third generation GPS reciever, a GPS anti-jam module and a new antenna to lessen the jamming vulnerability. It also incorporates enhanced shallow or steep terminal dive capability.

AGM-114 Hellfire

General Info:
Origin = U.S.A.
Manufacture = Hellfire Systems, Ltd.
IOC = 1986
Type = Anti-tank
Guidance = Semi-active homing
Sensor 1 Type = Laser
Field of View = 18º
Gimbal Limit = 30º
Sensor 2 Type = Radar
Field of View = 20º
Gimbal Limit = 60º
Platforms = AH-64, AH-1, Blackhawk, Kiowa and Defender helicopters

Performance:
Range = 4.3nm
Speed = Mach 1.1
Max g = 13

Dimensions:
Length = 72in
Diameter = 7in
Fin Span = 13in
Weight = 106lbs

Warhead:
17.6lbs (15.7in Armor)
Fuse: Contact

Description:

The Hellfire is the primary anti-tank weapon of the U.S. AH-64, AH-1, Blackhawk, Kiowa and Defender helicopters. Although normally fielded as a laser-guided weapon, the Hellfire is capable of using an Imaging Infrared seeker, a Radio Frequency/IR seeker and a millimeter wave seeker. The missile has both a Lock-On Before Launch (LOBL) mode and a Lock-On After Launch (LOAL) mode.

In the opening hours of Operation Desert Storm, eight Apaches armed with Hellfires were tasked to attack early-warning radar sites in western Iraq. The mission was a success, and within two minutes of engaging the targets, had scored 15 hits with Hellfire missiles. During the entire war, Apaches fired an estimated 5,000 Hellfires, and destroyed an estimated 500 tanks with them.

AGM-119 Penguin

General Info:
Origin = Norway
Manufacture = Kongsberg Vaapenfabrik
IOC = 1972
Type = Anti-ship Semi armour piercing
Guidance = INS with waypoints midcourse, passive IR terminal

Performance:
Range = 25nm
Speed = Mach 1.2

Dimensions:
Length = 120.48in
Diameter = 11.2in
Fin Span = 55in
Weight = 847lbs

Warhead:
110lbs high explosive
Fuse: Contact

Description:

The Penguin is a Norwegian ship-, coast- and (in later versions) air-launched anti-ship weapon, which was developed in the 1960s as NATO's first modern dedicated anti-ship guided missile. An air-launched variant is also used by the U.S. Navy under the designation AGM-119.

Development of the original Penguin Mk 1 began in the mid-1960s by the Kongsberg Våpenfabrikk (later renamed Norsk Forsvarsteknologi, and still later Kongsberg Defence & Aerospace (as a division of Kongsberg Gruppen)) in Norway, helped by financial support from the U.S. Navy. It was designed for use from small missile boats and coastal batteries and entered service with the Royal Norwegian Navy in 1972. Because the Scandinavian coastal waters with its deep narrow fjords would have presented the radars of the time with too much clutter, the Penguin used infrared homing only. Initial bearing and speed data on the target was provided before launch by the launch platform's sensors and fire-control system. The additional advantage of the passive IR homing was the reduced warning time for the attacked ship. The missile used the 113 kg (250 lb) MK 19 warhead very similar to that used by the AGM-12 Bullpup missile. The Penguin Mk 1 is no longer in service.

AGM-123 Skipper

General Info:
Origin = U.S.A.
Manufacture = Emerson Electric
IOC = 1985
Type = Anti-ship Semi armour piercing
Guidance = Laser homing

Performance:
Range = 13nm
Speed = 600kts

Dimensions:
Length = 169.2in
Diameter = 20in
Fin Span = 63in
Weight = 1,183lbs

Warhead:
1,000lbs Mk 83 bomb
Fuse: Contact

Description:

In 1984, the Naval Weapons Center (NWC) in China Lake created the AGM-123A Skipper II laser-guided standoff missile using off-the-shelf components. The GBU-16/B Paveway II LGB (Laser-Guided Bomb), consisting of a 450 kg (1000 lb) MK 83 bomb, an MXU-667/B airfoil group, and an MAU-169/B guidance section, was combined with a MK 78 rocket motor (taken from obsolete AGM-45B Shrike missiles) in a WPU-5/B propulsion section. The first test launches were conducted in June 1984, and in March 1985 a contract for full-scale production of 2500 AGM-123As was awarded to Emerson Electric. The Skipper II (there was no "Skipper I", the "II" was derived from the Paveway II guidance) achieved Initial Operational Capability with the U.S. Navy in late 1985. The ATM-123A was an inert training variant of the AGM-123A.
The AGM-123A was primarily employed by the A-6E Intruder in the anti-shipping role. It was a simple and effective weapon, which could lock on a laser-designated target before or after launch. The powered glide-bomb could theoretically reach a range of 55 km (30 nm), but in practice this was usually limited to about 25 km (13.5 nm) by the range of the laser designator (which was normally carried by the launching aircraft).

AGM-129 ACM

General Info:
Origin = U.S.A.
Manufacture = Raytheon (General Dynamics)
IOC = 1991
Type = Long-range Cruise Missile
Guidance = Inertia with laser and radar
Platforms = B-52H

Performance:
Range = 1600nm
Speed = Mach 0.8

Dimensions:
Length = 250in
Diameter = 25.2in (height), 27.7in (width)
Wingspan = 122in
Launch Weight = 2755lbs

Warhead:
W80 with 200kT nuclear or HE
Fuse: Contact

Description:

The AGM-129 ACM cruise missile is a significant improvement over the ALCM-B. It is superior in range, accuracy and survivability. It has a reduced IR profile and low radar cross section and can therefore be called a "stealthy" missile.
The designation AGM-123B was allocated to a variant described as "forward fit version of the AGM-123A". The AGM-123B is described by source [4] as having a WCU-10A/B control section and MXU-737A/B airfoil group, and the manufacturer is quoted as Texas Instruments. I have no information how many (if any) Skipper IIs were actually built as AGM-123B. The Skipper II is no longer in service with the U.S. Navy, having been phased out in the mid-1990s.

AGM-130

General Info:
Origin = U.S.A.
Manufacture = Rockwell
IOC = 1994
Type = Powered PGM
Guidance = Imaging optical or IR or manual
Sensor Range = 15nm
Field of View = 25º
Gimbal Limit = 50º

Performance:
Drag = 19
Range = 26nm
Speed = high supersonic

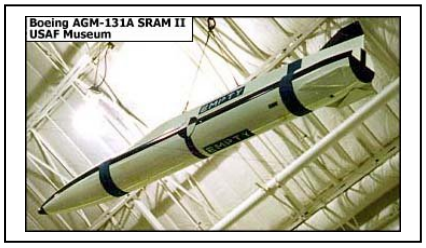
Dimensions:
Length = 153in
Diameter = 18in
Fin Span = 59in
Weight = 2980lbs

Warhead:
2000lbs Mk-84 or BLU-109/B
Fuse: Contact

Description:

The AGM-130A is a powered version of the GBU-15 glide bomb. A rocket booster has been attached to the weapon to extend its range; it jettisons after the motor is spent. Otherwise, the AGM-130 operates the same as the GBU-15. The extra range drastically improves the aircraft's survivability in high threat environments since the launching platform doesn't even need to unmask to put the weapon on target with pinpoint accuracy.

AGM-131 SRAM II



General Info:
Origin = U.S.A.
IOC = 1991 cancelled
Type = Short-range attack missile
Platforms = B-1B

Performance:
Power Plant = Thiokol solid-fuelled rocket
Range = 220nm
Speed = Mach 2+

Dimensions:
Length = 125.2in
Diameter = 15.3in
Launch Weight = 1984lbs

Warhead:
W-89 thermonuclear (200 kT) (AGM-131A)
W-91 thermonuclear (10 kT, 100 kT) (AGM-131B)

Description:

The SRAM II short-range attack missile was planned as a replacement for the AGM-69B SRAM B but was never produced in quantity.
With resurrection of the B-1 Program (B-1B) in 1981, development of a complete new weapon, the SRAM II, started. This missile had only 2/3 the size of the AGM-69A, so that the B-1B could carry 36 missiles instead of 24 AGM-69As. The new missile was lighter and simpler, with a more reliable rocket motor with increased range. Its new W-89 thermonuclear warhead was also much safer to operate then the previous W-69.
The program was cancelled in 1991 because of technical difficulties with the rocket motor and because of the nuclear arms reduction policy.

AGM- 142A Raptor

General Info:
Origin = Israel
Manufacture = Lockheed Martin (Rafael)
IOC = 1992
Type = Ground attack
Guidance = INS midcourse, Television or imaging infrared terminal

Performance:
Power Plant = Solid-fuelled rocket
Range = 43nm
Speed = supersonic

Dimensions:
Length = 15ft 10in
Diameter = 1ft 9in
Fin Span = 5ft 8in
Weight = 3000lbs

Warhead:
750lbs blast-fragmentation (AGM-142A/B)
770lbs "I-800" penetration (AGM-142C/D)

Description:

AGM-142 was the first missile to provide precision guided munition capability to the B-52H platform. It does so by having an INS with datalink and TV or imaging infrared systems. It may be controlled by the launching aircraft or handed over to a second allowing the launching aircraft to leave the area. It is propelled by a constant thrust solid-fuel rocket.
The weapon was in service at the time of the Gulf War but was never fired during the crisis due to the Israeli origins that would have offended USA's Arab allies. There are rumors that are denied by the authorities about a few operational test firings.

AGM-154A JSOW

General Info:
Origin = U.S.A.
IOC = 1999
Manufacture = Raytheon (Texas Instruments)
Type = anti-tank
Guidance = GPS/INS
Platforms = B-1, F-16, F-15E, F/A-18C/D, F/A-18E/F, AV-8B, P-3, S-3

Performance:
Accuracy = 3m
Range = 40nm (for high-altitude launches) or 12nm (for low-altitude launches)
Speed = Subsonic glide weapon

Dimensions:
Length = 14ft
Wingspan = 8ft 10in
Width = 13.3in
Weight = 1065lbs

Warhead:
145 BLU-97A/B CEM (3.4lbs each)

Description:

The AGM-154 JSOW (Joint Standoff Weapon) is a modular precision-attack glide bomb, which is included in this missile directory because of its guided missile designation (future versions of JSOW will possibly be powered, though).

In 1986, the U.S. Navy started the AIWS (Advanced Interdiction Weapon System) program to develop a new precision guided short-range standoff attack weapon to replace laser guided weapons like the Paveway series guided bombs, the AGM-123 Skipper II and the AGM-65E Maverick. The primary development goal was a pure fire-and-forget weapon without any post-launch target designation, like a laser designator or a command data link. The AIWS competition was won by Texas Instruments (now Raytheon), who received a contract for the AGM-154A weapon in June 1992. In the same year, the AIWS program was combined with Air Force standoff weapons programs and renamed JSOW (Joint Standoff Weapon). The JSOW requirements called for a low-cost, light-weight weapon with at least 9 km (5 nm) range for low-altitude launches. A lock-on after launch (LOAL) capability was also desired, so that the launching aircraft would not have to put itself into line-of-sight from the target. Another requirement was "quiet launch" capability, i.e. the propulsion system (in any) was to be activated only some time after the release. Because the JSOW was to be used against different kinds of targets, a modular warhead section for cluster and unitary warheads was also required. As a solution to these requirements, Texas Instruments designed a GPS/INS guided unpowered glide bomb. The first guided drop of an AGM-154A occurred In December 1994, and in February 1997 operational evaluation by the U.S. Navy began. Initial Operational Capability (IOC) was reached in 1999, when full-scale production of the AGM-154A began. The AGM-154A JSOW uses flip-out wings and four cruciform (plus two small horizontal) tailfins for flight control. The glide range is 28 km (15 nm) for low-altitude and up to 74 km (40 nm) for high-altitude launches. Accuracy of the GPS/INS guidance system is better than 3 m (10 ft) CEP. As a warhead, the AGM-154A variant uses a cluster bomb dispenser with 145 BLU-97/B CEM (Combined Effects Munition) bomblets (1.54 kg (3.4 lb) each) for use against soft targets. The DATM-154A is a completely inert shape for JSOW ground handling training.

AGM-154B JSOW

General Info:
Origin = U.S.A.
IOC = 2002 (now cancelled)
Manufacture = Raytheon (Texas Instruments)
Type = anti-tank
Guidance = GPS/INS
Platforms = B-1, F-16, F-15E, F/A-18C/D, F/A-18E/F, AV-8B, P-3, S-3

Performance:
Accuracy = 3m
Range = 40nm (for high-altitude launches) or 12nm (for low-altitude launches)
Speed = Subsonic glide weapon

Dimensions:
Length = 14ft
Wingspan = 8ft 10in
Width = 13.3in

Warhead:
6 BLU-108/B SFM

Description:

The warhead section of the AGM-154B carries 6 BLU-108/B SFM (Sensor Fuzed Munition) dispensers, each of which can release four "Skeet" terminally guided anti-tank submunitions. Development of the AGM-154B lagged slightly behind that of the AGM-154A, and operational testing was not completed before 2001. IOC was planned for late 2002, but the weapon has now been cancelled. The USAF pulled out of the AGM-154B program because it selected a winged derivative of the CBU-105/B WCMD (Wind-Corrected Munitions Dispenser) as its future standoff anti-armor weapon (the CBU-105/B can carry ten BLU-108/B compared to JSOW's six), and the Navy couldn't afford to fund the AGM-154B on its own.

AGM-154C JSOW

General Info:
Origin = U.S.A.
IOC = 2003
Manufacture = Raytheon (Texas Instruments)
Type = blast fragmentation/penetration
Guidance = GPS/INS and IIR seeker and
ATA (Automatic Target Acquisition)
Platforms = B-1, F-16, F-15E, F/A-18C/D, F/A-18E/F, AV-8B, P-3, S-3

Performance:
Accuracy = 3m
Range = 40nm (for high-altitude launches) or 12nm (for low-altitude launches)
Speed = Subsonic glide weapon

Dimensions:
Length = 14ft
Wingspan = 8ft 10in
Width = 13.3in
Weight = 975lbs

Warhead:
500lbs BLU-111/B

Description:

The AGM-154C (developed for the Navy only) uses a "BROACH" multi-stage blast fragmentation/penetrator warhead, developed by BAE Systems. It also features an IIR seeker and ATA (Automatic Target Acquisition) technology (similar to that of the AGM-84H/K SLAM-ER ATA). The ATA feature allows the missile to find the target without intervention of an operator, because the internal logic compares the IIR seeker's image with preset reference images. ATA made it possible to drop the two-way data link which was originally planned for the AGM-154C. Operational testing for the AGM-154C is currently scheduled for early 2003, with Initial Operational Capability planned for late 2003. The first LRIP (Low-Rate Initial Production) contract for the AGM-154C was awarded to Raytheon in July 2003.

JSOW can currently be used by the F-16, F/A-18 and B-2 aircraft, with the B-52, B-1, and F-15E planned to follow. More than 100 AGM-154As were already used in combat, including Operation Allied Force in Kosovo and Operation Enduring Freedom in Afghanistan. The original total requirement for the USAF and U.S. Navy was for more than 20000 JSOW missiles of all variants, but this will most likely be reduced after cancellation of the AGM-154B.

AGM-158 JASSM

General Info:
Origin = U.S.A.
IOC = 2003
Manufacture = Lockheed Martin
Type = stand-off Air-to-Ground missile
Guidance = GPS aided inertial navigation,
IR target selection and homing
Platforms = F-16, B-52, B-1, B-2, F-18

Performance:
Power Plant = Teledyne CAE J402-CA-100 turbojet; 3.0 kN (680 lb)
Accuracy = 3m
Range = 205nm
Speed = Subsonic glide weapon

Dimensions:
Length = 14ft
Wingspan = 7ft 11in
Weight = 2250lbs

Warhead:
1000lbs WDU-42/B penetration

Description:

The AGM-158 JASSM is a stealthy cruise missile for stand-off attacks. It is guided by a jamming resistant GPS-aided inertial navigation system with an accuracy quoted as 2.4 m CEP. It uses an imaging infrared seeker to identify and home in on its target. A data link is available for status and position reports for better bomb damage assessment.
The JASSM is planned to be integrated into all U.S. strike aircrafts in the future. Many kinds of upgrades are also considered, including a sub-munition dispenser warhead, new types of seekers and an extended range version of the missile. Service entry is expected for 2003.

AJ-168 Martel

General Info:
Origin = U.K.
IOC = 1984
Manufacture = Matra
Type = standoff anti-ship/anti-radar missile
Guidance = TV guidance or Active Radar Homing

Performance:
Power Plant = two stage solid propellant rocket motors, 2.4 s boost, 22.2 s sustain
Range = 66nm
Speed = Mach 1

Dimensions:
Length = 153.5in
Wingspan = 47.2in
Diameter = 15.75in
Weight = 1212lbs

Warhead:
330lbs proximity-fuzed with delayed impact high-explosive blast fragmentation

Description:

Developed in the 1960s and used mainly on Buccaneers, with the option of fitting to Nimrods, the Martel (Missile Anti-Radar TELevision) had the option of TV guidance (developed as AJ.168) or anti-radiation variants. Various sub-types were proposed including CL.137, the Sub-Martel. This was originally known as USGW and was a development of the Ondine concept intended for launch from submerged submarines but the American Sub-Harpoon was acquired.
Active-Radar Martel was a longer ranged air-breathing Martel with a Marconi active seeker. This used a Microturbo turbojet giving a range of 60miles. This led to the development of P3T, which ultimately became Sea Eagle.
Cluster Martel was intended to carry cluster bombs, while Megaton Martel was to carry a nuclear warhead.
Ship-Martel was to be launched from surface vessels. This was essentially a stretched Martel with rocket booster, but lost out to Exocet.
As can be seen in the image above, TV camera technology has come on since Martel was designed. This image shows both the anti-radiation and TV-guided versions of Martel that are on display at the Aerospace Museum at RAF Cosford.

AM-39 Exocet

General Info:
Origin = F
IOC = 1977
Manufacture = Aerospatiale
Type = anti-ship missile
Guidance = ESD ADAC X-band monopulse active radar

Performance:
Power Plant = Condor solid propellant booster, 2 s burn;
Helios solid propellant sustainer, 150 s burn
Range = 36nm
Speed = Mach 0.93

Dimensions:
Length = 22.8in
Diameter = 1.3in
Wingspan = 4.4in
Weight = 1884lba (?)

Warhead:
363lbs impact with delay- and proximity-fuzed high-explosive shaped charge

Description:

Exocet missiles started in development in 1967, originally as the ship-launched variant MM 38 which entered service in 1975. The air-launched version, AM 39, was developed later starting in 1974 and entering service with the French Navy in 1979. The missile is designed to attack large warships. A block 2 upgrade programme was carried out from the late 1980s until 1993, and introduced an improved digital active radar seeker and upgraded inertial navigation and control electronics.

The Exocet has four clipped delta wings at mid-body and four raked clipped-tip moving delta control fins at the rear. The missile is 4.7 m long, has a body diameter of 350 mm and a wingspan of 1.1 m. The missile weighs 670 kg and has a 165 kg HE shaped charge fragmentation warhead. Guidance in the mid-course phase is inertial, followed by an active radar terminal phase. There is also a radar altimeter to control the sea-skimming trajectory, at around 10.0 m until the terminal phase when, in calm sea conditions, the missile can descend to 3.0 m or so. The solid propellant motor gives Exocet a range of about 50 km, but when released from 10,000 m (32,800 ft) the range achieved was reported to be 70 km.

AS-30L

General Info:
Origin = F
IOC = 1988
Manufacture = Aerospatiale
Type = short- to medium-range standoff missile
Guidance = semi-active laser homing
Platforms = Mirage 2000D, Mirage 2000-5, F 16, Jaguar, Mirage F1

Performance:
Power Plant = two stage solid propellant rocket motors, composite booster, double-based sustainer
Range = 1.5nm (Min), 6nm (Max)
Speed = Mach 1.7

Dimensions:
Length = 143.7in
Diameter = 13.4in
Wingspan = 39.3in
Weight = 1146lbs

Warhead:
530lbs impact-fuzed high-explosive semi-armour piercing (Can pierce 2 meters of concrete before blowing up)

Description:

The AS-30L missile (launch weight 520 kg, warhead weight 240 kg) has a maximum airspeed of Mach 1.5 and a range of fire from 3 to 10 km. The power plant is a solid- propellant missile engine with two degrees of thrust. Missile control is hydrodynamic with the help of jet stream reflectors. Employment of the missiles from French Jaguar aircraft in the Persian Gulf war proved very effective. In the course of combat sorties, AS-30L launches usually were made from a dive at an altitude of 1.3 km (dive entry altitude 2.2 km).

AS-34 Kormoran

General Info:
Origin = Germany
IOC = 1977
Manufacture = EADS (European Aeronautic Defense And Space Company)
Type = radar-guided missile against sea targets
Guidance = active-radar homing
Platforms = Tornado, Eurofighter 2000, Mako, F-104G

Performance:
Range = 17nm
Speed = Mach 0.9

Dimensions:
Length = 173.2in
Diameter = 13.5in
Fin Span = 39.4in
Weight = 1322lbs

Warhead:
352lbs delayed fused (Penetrates up to 90mm of steel)

Description:

The Kormoran combines range, accuracy, and hard-hitting power in one smooth, aerodynamic package. Air launched against ships or land targets, the Kormoran employs inertial guidance for cruising. When it reaches its target at the end of its 23 mile range, active radar homing takes over. Kormoran's 352 lb. warhead is delay fused, to allow it to penetrate up to 90mm of steel plate before detonating
Kormoran 2 is the upgunned version of the successful Kormoran 1 guided missile. It has been adapted to the German Navy plane Tornado and can be deployed as a standoff weapon against surface vessels. The system utilizes top-notch seeker technology for target selection and works on the fire-and-forget principle; the range exceeds 30 kilometers.

Storm Shadow CALCM

General Info:
Origin = U.K and France
IOC = 2003
Manufacture = Matra
Type = Air-to-ground stealth precision-guided stand-off missile
Guidance = inertial and GPS, IR seeker
Platforms = Tornado, Typhoon, Harrier, Eurofighter

Performance:
Range = 140nm
Speed = Mach 0.8
Accuracy = 98ft

Dimensions:
Length = 200in
Diameter = 19.7in
Fin Span = 118.1in
Weight = 2860lbs

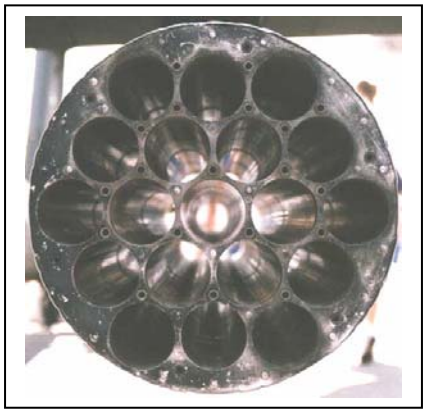
Warhead:
Conventional

Description:

The Matra BAe Dynamics (MBD) Storm Shadow missile system has been selected for the RAF to meet SR (A) 1236, the Conventionally Armed Stand Off Missile (CASOM). The contract was awarded to MBD in February 1997 after an international competition with six other companies. The Storm Shadow missile system proposed by MBD is based on the flight-proven Apache air vehicle, and is optimised to meet UK requirements.
Storm Shadow is an air-launched, conventionally-armed, long-range, stand-off, precision weapon, which is deployable at night or day, in most weather and operational conditions. It is being developed to attack and destroy a wide spectrum of static, high value targets as listed below:
C3 (Command, Control and Communication) facilities, airfield facilities, port facilities, ASM/ammo storage, ships/submarines in port, bridges.
Storm Shadow will be integrated onto Tornado GR4/4A, Harrier GR/9 and Eurofighter. It will be capable of employment in all theatres of conflict, and the warhead is optimised for use against hardened targets.
The Storm Shadow missile requirement embodies the following key features:
very long range
fire and forget, with fully autonomous guidance
low level terrain following
stealth design
effective penetrator warhead
high reliability
all up round [ensures high system readiness]
low cost of ownership.

The Storm Shadow weapon system comprises:
The operational missile and its All Up Round Container (AURC)
Mission Planning Infrastructure
Data Programming System
the Ground/Air Training missile (GATM) and its AURC.
The Storm Shadow missile is derived from the Apache Anti Runway missile. Key elements of this proven technology have been retained for Storm Shadow, but the following major modifications are being introduced to meet the particular Storm Shadow requirements:
new guidance and navigation based on TERPROM [TERrain PROfile Matching] terrain navigation with an integrated GPS;
terminal guidance using imaging infra-red sensor and autonomous target recognition system;
the high lethality of the system is achieved by the use of a BROACH [Bomb Royal Ordnance Augmented Charge] unitary warhead.
The missile weighs approximately 1,300 kilograms and is just over five metres long. Its maximum diameter is under one metre, and with its wings deployed, under three metres.
The first phase of the mission planning regime ensures that the missile navigates to the target with maximum survivability and then enters a robust target acquisition and terminal guidance phase. For complex and pre-determined missions, much of this data would have been pre-prepared earlier at the Command Headquarters. Following an Air Tasking Order, the Squadron would prepare the mission data file with the pre-planned data, together with the latest operational intelligence.
On approaching the terminal phase, the missile will initiate a bunt manoeuvre, pre-selected during mission planning, to obtain the best combination of acquisition probability and lethality against the target. As the missile climbs, it will jettison its nose cover, thereby enabling the missile high resolution imaging infra-red sensor to view the target area ahead.
The missile's image processor will compare the actual image features with a reference set of features, determined during mission planning. When a feature match is achieved the target will be acquired and the required aim point selection tracked and used as the reference for the missile terminal guidance.
As the missile closes in on the target the acquisition process will be repeated with a higher resolution data set to refine the aim point. Tracking will continue against this refined aim point until the precise target location is identified.
When engaging hard targets, such as Hardened Aircraft Shelters or bunkers, the missile will strike the target at the estimated optimum dive angle, selected during mission planning. On impact the detonation sequence commences. The precursor charge will perforate the target structure, and any soil covering, and the follow through penetrator warhead will continue to penetrate inside the target to be detonated after a pre-selectable fuse delay.
Should the mission be against a target with potential high collateral damage, the mission will be aborted if the target identification and acquisition process is unsuccessful. In this case the missile will fly to a predetermined crash site.
The programme value is for £981 million.
The contract for the development and production of Storm Shadow was placed with Matra BAe Dynamics (UK) Ltd in February 1997 after a competitive tender exercise. This was one of the first contracts to be placed with this contractor. Matra BAe Dynamics (UK) Ltd is a subsidiary of Matra BAe Dynamics SAS, a company jointly owned by BAe plc and Lagardere SCA.
Matra BAe Dynamics (France) Ltd has won the SCALP EG contract from the French Government. SCALP EG is the same weapon as Storm Shadow apart from national aspects related to both countries.

LAU-3



General Info:
Origin = U.S.A.
IOC = 1940s
Type = 2.75 Rocket launcher

Performance:
Drag = 14
Lethal Radius = 15ft
MSD, protected = 725ft
MSD, exposed = 725ft

Dimensions:
Length = 72in
Diameter = 15in
Weight = 496lbs

Warhead:
19 Mk1 HE FFAR (18lbs each, 7.8in Armour)
Fuse = Contact

Description:

Unguided rockets are a cheap, unsophisticated means of scattering explosives around a target area. They are neither accurate nor particularly effective. Rockets are primarily a weapon for attacking infantry, but cluster bombs do the job better. White phosphorous (Willie Pete) rockets are often used by airborne Forward Air Controllers (FACs) to visually mark targets for attack aircraft.

LAU-10

General Info:
Origin = U.S.A.
IOC = 1973
Type = 5in Rocket launcher

Performance:
MSD, protected = 725ft
MSD, exposed = 725ft

Warhead:
4 Mk-16 or MK-71

Description:

The 5.0 Inch Rocket System uses the four round LAU-10C/A (shore-based use only) and LAU-10D/A (shore-based or shipboard use) rocket launchers. The LAU-10C/A and LAU-10D/A launchers can be fired in single or ripple mode. The difference between the LAU-10C/A and LAU-10D/A reusable rocket launchers is the external thermal coating on the LAU-10D/A that greatly prolongs cook-off protection time. Full production of these launchers began in September 1973.
The 5.0 Inch Rocket launchers are a cylindrical construction of four aluminium launch tubes. These launch tubes are held together with metal ribs and are covered by an aluminium skin. Launchers can be fitted with forward and aft frangible fairings depending on overall rocket length and fuzing for airborne configuration.
The launchers are mated mechanically to the aircraft by way of suspension lugs. The 5.0 Inch Rocket launchers use either a 14 inch or 30 inch suspension. Electrical connection between the aircraft and the launcher is made through an electrical receptacle located on top of the launcher center section to the aircraft's 28 volt armament circuit. The launchers may be shipped and stored pre-loaded with rocket motors.

LAU-61

General Info:
Origin = U.S.A.
IOC = 1985
Type = 2.75 Rocket launcher

Performance:
MSD, protected = 725ft
MSD, exposed = 725ft

Warhead:
19 MK4, MK40, MK6, C16 or C17

Description:

Launchers convey and provide a suitable platform from which rockets are carried and launched. The Navy 2.75 Inch Rocket System uses the 19 round LAU-61C/A and LAU-69 series, and the seven round LAU-32 series and LAU-68 D/A rocket launchers. These reusable launchers have an external thermal coating that greatly prolongs cook-off protection time. Full production of these launchers began in June 1985. In the US Army, these Hydra 70 rockets are fired from the AH-64A Apache/AH-64D Apache Longbow using M261 19-tube rocket launchers, while the Air Force uses the LAU-130/A Rocket Launcher. The AH-1G Cobra and the UH-1B "Huey" used M200 19-tube rocket launchers. The F-5 Tiger II carried the LAU-3, which is also currently carried by the AV-8B Harrier II
The LAU-61C/A (19 rounds) rocket launcher is thermally coated. The launcher can be fired in single (one at a time) or ripple (one after the other in multiple shots) mode. In ripple mode, the LAU-61C/A can fire 19 rounds in about one second. There are no service life requirements on the launcher. The launchers are mated mechanically to the aircraft by way of suspension lugs. The 2.75 Inch Rocket launchers use 14-inch suspension. Electrical connection between the aircraft and the launcher is made through an electrical receptacle located on top of the launcher center section to the aircraft's 28 volt armament circuit. The launchers may be shipped and stored pre-loaded with rocket motors. The launchers are a cylindrical construction of 19 aluminium launch tubes. These launch tubes are held together with metal ribs and are covered by an aluminium skin. Launchers can be fitted with forward and aft frangible fairings depending on overall rocket length and fuzing for airborne configuration.
The U.S. Army Lightweight Launchers (LWL) are the M260, 7-tube and the M261, 19-tube launchers. The aluminium launchers are inexpensive enough to be disposable, yet durable enough to be reused after as many as 32 firings. The weight savings over the previous Army launchers allows the Army to add other features to the aircraft's rocket system for improved performance. The launcher permits fuze-timing selection from the cockpit and will launch rockets using either the MK 40 or the MK 66 motors. The aft end of each tube in the launcher is fitted with a pivoting igniter arm which imparts the ignition current from the firing switch to the rocket motor. A side contact is lowered inside the launch tube for MK 66 ignition with the actuation of the pivoting arm. When the rocket is fired, the igniter arm is pushed back and a mechanical link assists in releasing the rocket from the rocket retainer. However, the primary mode of release is rocket override of the retainer in the launcher. The rocket retention force is specified to be between 170 and 600 pounds, easily overridden by the rocket thrust of over 1300 pounds.
Weight saving was achieved for the LWL design by minimizing the use of rivets, welding and adhesive. Instead, the launchers are assembled using electromagnetic force to swage the aluminium skin and tubes around the four bulkheads. The center two bulkheads are welded to the aluminium strongback. This strongback establishes the rigidity of the launcher and is designed in accordance with MIL-A-8591 for interface with aviation suspension racks and sway braces. The 19-tube launcher has since been redesigned to implement a floating solid bulkhead at the front of the launcher. This solid bulkhead was necessary to minimize the warping from heat built up during ripple launches. All other bulkheads are a laminated stack of plates. The front bulkhead of the 7-tube launcher continues to use a laminated stack.

LAU-68

General Info:
Origin = U.S.A.
IOC = 1985
Type = 2.75 Rocket launcher

Performance:
MSD, protected = 725ft
MSD, exposed = 725ft

Warhead:
7 MK4, MK40, MK66, C16 or C17

Description:

Launchers convey and provide a suitable platform from which rockets are carried and launched. The Navy 2.75 Inch Rocket System uses the 19 round LAU-61C/A and LAU-69 series, and the seven round LAU-32 series and LAU-68 D/A rocket launchers. These reusable launchers have an external thermal coating that greatly prolongs cook-off protection time. Full production of these launchers began in June 1985. In the US Army, these Hydra 70 rockets are fired from the AH-64A Apache/AH-64D Apache Longbow using M261 19-tube rocket launchers, while the Air Force uses the LAU-130/A Rocket Launcher. The AH-1G Cobra and the UH-1B "Huey" used M200 19-tube rocket launchers. The F-5 Tiger II carried the LAU-3, which is also currently carried by the AV-8B Harrier II
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2.75in Rockets (MK-4, MK-66)

General Info:
Origin = U.S.A.
Type = 2.75 Rocketmotors

Performance (MK-4):
Power Plant = Solid-fueled rocket; 3.3 kN for 1.3 s
Range = 3.2nm
Speed = Mach 0.5

Dimensions (MK-4):
Length = 39.3in
Diameter = 2.75in
Weight = 11lbs

Performance (MK-66):
Power Plant = Solid-fueled rocket; 6.7 kN for 1.1 s
Range = 5.4nm
Speed = Mach 0.8

Dimensions (MK-66):
Length = 41.7in
Diameter = 2.75in
Weight = 13.6lbs

Warhead:
M151: 8.7lbs anti-personnel fragmentation warhead
M156: White phosphorus smoke warhead
M229: 16.1lbs anti-personnel fragmentation warhead (elongated version of M151)
M247: Shaped-charge anti-armour warhead
M255: Flechette warhead; contains about 2500 28-grain (1.8 g) flechettes (M255E1 has 1180 60-grain (3.8 g) flechettes)
M257: Parachute-retarded battlefield illumination flare
M259: White Phosphorus smoke warhead
M261: High-explosive MPSM (Multipurpose Submunition) warhead; contains nine M73 anti-personnel/anti-materiel bomblets, which are released in mid-air, and drag-retarded to fall vertically to the ground
M264: Red phosphorus smoke warhead
M267: Practice warhead for M261; contains three M75 practice submunitions
M274: Practice warhead for M151; contains a smoke signature charge
M278: Parachute-retarded infrared illumination flare
MK 67 MOD 0: White phosphorus smoke warhead
MK 67 MOD 1: Red phosphorus smoke warhead
WDU-4A/A: Flechette warhead; contains about 2200 20-grain (1.3 g) flechettes
WTU-1/B: Inert practice warhead

5in Rockets (MK-16, MK-71)

General Info:
Origin = U.S.A.
Type = 5 Rocketmotors

Performance (MK-16):
Power Plant = Solid-fueled rocket; 3.6 kN for 1.3 s
Range = 5nm
Speed = Mach 2

Dimensions (MK-16):
Length = 77in
Diameter = 5in
Weight = 59lbs

Performance (MK-71):
Power Plant = Solid-fueled rocket
Range = 5nm
Speed = Mach 2

Dimensions (MK-71):
Length = 76.3in
Diameter = 5.12in
Weight = 80lbs

Warhead:
MK 24 MOD 0/1 (GP, Length = 98.18in, Weight = 125.2 lbs)
MK 32 MOD 0 (APAM, Length = 109.41in, Weight = 124.13lbs)
MK 33 MOD 1 (Illumination Flare, Length = 108.12in, Weight = 125.4 lbs)
MK 34 MOD 0 (Smoke, Length = 97.28in, Weight = 128.33lbs)
MK 34 MOD 2 (Smoke, Length = 97.28in, Weight = 128.33lbs)
MK 63 MOD 0 (Fragmentation, Length = 113.19in, Weight = 138.3 lbs)
MK 84 MOD 4 (Chaff/Countermeasures, Length = 94.48in, Weight = 125.2 lbs)
MK 6 MOD 7 (Practice, Length = 93.58in, Weight = 128.33 lbs)
MK 24 MOD (Practice, Length = 95.25in, Weight = 127.84lbs)
WTU-11/B (Practice, Length = 105.71in, Weight = 124.13 lbs)

ANTI RADIATION MISSILES

AGM-45 Shrike

General Info:
Origin = U.S.A.
Manufacture = Texas Instruments
IOC = 1963
Type = Anti-radiation, Fire and forget
Guidance = Single band radar detector

Performance:
Range = 10nm
Speed = Mach 2
TOF = 300sec
Lethal Radius = 100ft
Frag Radius = 350ft

Dimensions:
Length = 120in
Diameter = 8in
Fin Span = 36in
Weight = 390lbs

Warhead:
145lbs HE Fragmentation
Fuse = Proximity and contact

Description:

The Shrike was developed by the Naval Weapons Center at China Lake in 1963. It is an antiradiation missile designed to home in on hostile anti-aircraft radars. Several versions of the radar exist, each covering a different part of the RF spectrum. The fixed seeker frequency coverage limits the operational flexibility of the weapon since each missile can only attack specific radar systems. In addition, the Shrike will go ballistic if the target radar shuts down before the missile impacts.

Shrikes were used extensively in Vietnam. The Israeli Air Force has also employed Shrike missiles effectively in various wars with the Arab states. 78 Shrikes were fired during Operation Desert Storm. The Shrike has been replaced by the HARM in the U.S. Air Force inventory.

AGM-78 Standard

General Info:
Origin = U.S.A.
Manufacture = General Dynamics
IOC = 1968
Type = Anti-radiation, Fire and forget
Guidance = Gimbaled passive radar seeker antenna

Performance:
Range = 30nm
Speed = Mach 2.5

Dimensions:
Length = 180in
Diameter = 13.5in
Wing Span = 3ft 7in
Weight = 1400lbs

Warhead:
223lbs Blast fragmentation
Fuse = Active optical proximity

Description:

The AGM-78 Standard ARM (STARM) was developed due to certain deficiencies in the Shrike design. The missile is a modified Standard ship-to-air missile fitted with a gimbaled seeker and a smoke flare. The use of a gimbaled seeker meant that the pilot did not have to boresight the missile/aircraft on the target before launch which enabled him to pass the target at a much safer distance. The smoke flare provided a mark for other aircraft allowing them to take out the air-defense site with HE and cluster munitions once the radar was blinded.
Further improvements resulted in the AGM-78C and D models which could operate closer in conjunction with the targeting avionics in the launch aircraft.

AGM-88 HARM

General Info:
Origin = U.S.A.
Manufacture = Texas Instruments
IOC = 1984
Type = Anti-radiation, Fire and forget
Guidance = Multi-band passive radar seeker
Field of View = 45º

Performance:
Range = 25nm
Speed = Mach 2
Lethal Radius = 125ft

Dimensions:
Length = 13.75ft
Diameter = 10in
Fin Span = 44in
Weight = 807lbs

Warhead:
145lbs HE Fragmentation
Fuse = Proximity

Description:

The AGM-88 HARM (High Speed Anti-Radiation Missile) is designed to destroy enemy air defense radar systems. The missile uses a directional radar antenna and sophisticated signal processing to locate, identify and prioritize enemy radar threats. The missile can work without input from its parent aircraft, but gain additional flexibility with the addition of specialized avionics. Units such as the HTS pods for the F-16C and the APR-47 carried by the F-4G allow highly selective targeting even in the densest threat environments. The EA-6B is the most capable HARM platform in the U.S. Navy arsenal, but all Navy strike aircraft are equipped to shoot HARMs.
The HARM missile was developed based on the combat experiences of Wild Weasel crews during the Vietnam War. Its main advancements over previous ARMs were a broadband detector, computerized signal processing with a programmable threat library, and a Mach 2 speed. The retirement of the F-4G leaves the F-16C tasked with Wild Weasel missions. Since the F-16 lacks the specialized avionics of the F-4G as well as the expertise of a specialized "guy-in-back", much of the onus for successfully suppressing enemy air defenses will fall on the CPU and sensors of the HARM weapon system.
About 2,000 HARM missiles have been fired in combat. Success rates are classified, but are probably high.

ALARM (Air-Launched Anti-Radar Missile)

General Info:
Origin = U.K.
Manufacture = British Aerospace
IOC = 1991
Type = Anti-radiation, Fire and forget
Guidance = Passive radar seeker with memory
Platforms = Tornado, Jaguar

Performance:
Range = 24nm
Speed = Mach >1

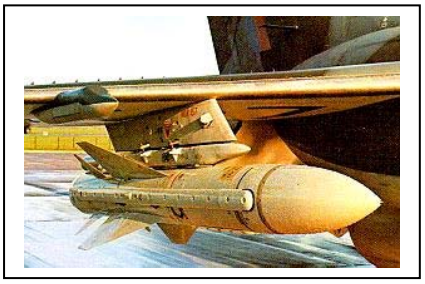
Dimensions:
Length = 169in
Diameter = 10.6in
Wing Span = 2ft 10in
Weight = 590lbs

Warhead:
Fragmentation

Description:

The ALARM may be launched in a standard ARM mode, climbing a bit, then homing in on the target. If the target emitter is turned off the missile homes in on the last known position.
The ALARM was in acceptance trials when the Gulf War broke out and was then rushed into operation in RAF. 121 ALARMs were fired and the results were as expected although there were a few defective missiles in the initial production batch. The steep climb in the loiter mode of operation did look a lot like a SAM lauch to near-by aircraft and ALARM capable aircraft were modified to transmit a coded signal to tell others that an ALARM was beeing launced.

AS-37 Martel



General Info:
Origin = U.K. and France
Manufacture = Matra
IOC = 1970
Type = Medium Range Anti-Radar missile
Guidance = Passive radar

Performance:
Power Plant = two-stage solid (2.4 s boost and 22.2 s of sustained thrust.)
Range = 11nm
Speed = Mach >1

Dimensions:
Length = 165.4in
Diameter = 15.8in
Wingspan = 47.2in
Weight = 1179lbs

Warhead:
330lbs HE fragmentation effect
Fuse = Proximity with delayed impact

Description:

The AS-37 was developed and produced by Martel (France) and Hawker-Siddely (UK). An updated version, the AS 37 Armat, was introduced in 1984. It has an updated seeker head. Another shorter, TV guided version, the AJ.168 by Martel, is used only by the UK.
The missile usually travels at high sub-sonic speeds but can break the sound-barrier in steep dives. Its two-stage solid rocket motor produces a 2.4 s boost and 22.2 s of sustained thrust.

AIR TO AIR MISSILES

AIM-4C Falcon

General Info:
Origin = U.S.A.
Type = rear aspect IR missile
Manufacture = Hughes Aircraft (exported as the HM-58, and RB-28 (manufactured by SAAB)
IOC = 1956
Guidance = IR homing
Platforms = F-89H, F-102, F-101, F-106, SAAB Draken

Performance:
Range = 6nm
Speed = Mach 3
Max Target g = 4

Dimensions:
Length = 80in
Diameter = 6.4in
Fin Span = 20in
Weight = 134lbs

Warhead:
29lb proximity fused High explosive

Description:

The AIM-4 Falcon was the first guided AAM to enter operational service, as an anti- bomber weapon for the F-89H, the -4B was an IR guided development of the original radar guided version, and the AIM-4C was an improved IR missile with a more advanced seeker head, better able to distinguish the target from thebackground, and was less prone to failures due to temperature and weather conditions

AIM-4D Falcon

General Info:
Origin = U.S.A.
Type = all aspect IR missile
Manufacture = Hughes Aircraft
IOC = 1968
Guidance = IR homing
Platforms = F-4J, F-101, F-102, F-106, F-4, SAAB Draken

Performance:
Range = 6nm
Speed = Mach 3
Max Target g = 8

Dimensions:
Length = 80in
Diameter = 6.4in
Fin Span = 20in
Weight = 134lbs

Warhead:
29lb proximity fused High explosive

Description:

The AIM-4D was the last version of the Falcon seried of missile to be developed, it had an identical weight and size to the AIM-4C version, but had the improved IR seeker of the AIM-4G Super Falcon, confering all aspect engagement capability, and the ability to track manouvering fighter sized targets. production began in 1968, and the missile went into service immediatly, many AIM-4C missiles were converted to -4D standards.

AIM-4F/G Super Falcon

General Info:
Origin = U.S.A.
Manufacture = Hughes Aircraft
IOC = 1959
Guidance = IR homing

Performance:
Power Plant = Thiokol M46 dual-thrust solid-fuel rocket
Range = 7nm
Speed = Mach 4

Dimensions:
Length = 81.1in
Diameter = 6.6in
Fin Span = 24in
Weight = 145lbs

Warhead:
29lb high-explosive

Description:

Late model of Falcon series, IR homing.

AIM-7D Sparrow

General Info:
Origin = U.S.A.
Type = medium range air-to-air missile
Manufacture = Raytheon
IOC = 1958
Guidance = semi-active radar homing
Platforms = F-110A Spectre, F-4C, F-14, F/A-18, F-4, F-15, F-16, F-4, F/A-18

Performance:
Power Plant = Thiokol MK 6 MOD 3 (LR44-RM-2) storable liquid-propellant rocket motor
Range = 6nm
Speed = Mach 4

Dimensions:
Length = 144in
Diameter = 8in
Fin Span = 32in
Weight = 380 lb

Warhead:
65lbs MK 38 continuous rod

Description:

Development of the modern Sparrow began in 1955 by Raytheon, the new missile being designated XAAM-N-6 Sparrow III. The AAM-N-6 and all subsequent versions of Sparrow used semi-active radar homing. After production of the AAM-N-2 Sparrow I had been completed in 1956, Raytheon took over the missile production facilities, and has since been prime contractor for the whole Sparrow program. After tests with YAAM-N-6 R&D missiles, production of the tactical AAM-N-6 began in January 1958, and it entered service in August 1958. The missile had an Aerojet solid-fueled rocket motor, and a 30 kg (65 lb) MK 38 continuous-rod warhead. About 2000 AAM-N-6 missiles were built. The TAAM-N-6, developed via XTAAM-N-6 prototypes, was an inert training version of the AAM-N-6.

The next version was the AAM-N-6a, developed via XAAM-N-6a and YAAM-N-6a prototype and test models, and produced from 1959. It had a new Thiokol MK 6 MOD 3 (LR44-RM-2) storable liquid-propellant rocket motor, which increased effective range and ceiling. It also had an improved guidance system for higher closing-rates and anti-jammer capability. There were also XTAAM-N-6a and TAAM-N-6a inert training versions of the AAM-N-6a.

The USAF adopted the AAM-N-6a for its new F-110A Spectre (F-4C Phantom II after 1962) interceptor, and assigned the designation AIM-101.

AIM-7E Sparrow

General Info:
Origin = U.S.A.
Type = medium range air-to-air missile
Manufacture = Raytheon
IOC = 1963
Guidance = semi-active radar homing
Platforms = F-110A Spectre, F-4C, F-14, F/A-18, F-4, F-15, F-16, F-4, F/A-18

Performance:
Power Plant = solid-fueled rocket by Rocketdyne (either a MK 38 or later a MK 52)
Range = 3-20nm
Speed = Mach 4

Dimensions:
Length = 144in
Diameter = 8in
Fin Span = 32in
Weight = 435lbs

Warhead:
65lbs MK 38 continuous rod

Description:

In 1963, production switched to the AIM-7E version. It used a new propulsion system, a solid-fueled rocket by Rocketdyne (either a MK 38 or later a MK 52). The new motor again significantly increased range and performance of the missile. Effective range of course depended greatly on firing parameters like launch speed and relative velocity of the target. In head-on attacks under optimal conditions, it could be as high as 35 km (20 nm), while in stern attacks, maximum effective range was more around 5.5 km (3 nm).
Inert training versions of the AIM-7E include the ATM-7E for firing practice, the captive (non-launching) CATM-7E, and the non-flying DATM-7E for handling and loading practice. There is also a captive-carry version designated CAEM-7E, which is equipped with special telemetry electronics.
About 7500 AIM-7D and 25000 AIM-7E missiles were built, and the Sparrow was used heavily in Vietnam by the USAF and the U.S. Navy. The first combat kill was scored on 7 June 1965, when USN F-4B Phantoms shot down 2 MiG-17s. However, the initial combat results were very disappointing. The potentially long range of the AIM-7 could not be used, because unreliable IFF capabilities of the time effectively required visual identification of all targets. Coupled with the high minimum range of the missile of 1500 m (5000 ft) and poor performance against manoeuvering and/or low-flying targets, this led to a kill probability of less than 10%. Therefore, the improved AIM-7E-2 was introduced in 1969 as a "dogfight missile". It had a shorter minimum range, clipped wings for higher manoeuverability, and improved autopilot and fuzing. The AIM-7E-3 had further improved fuzing and higher reliability, and the AIM-7E-4 was specially adapted for use with high-power fighter radars (like the F-14's AN/AWG-9). Despite all problems, more than 50 aircraft were shot down by Sparrow missiles during the Vietnam air war.

AIM-7E-2 Sea Sparrow

General Info:
Origin = U.S.A.
Type = short-range air-defense weapon
Manufacture = Raytheon
IOC = 1967
Guidance = semi-active radar homing
Platforms = modified ASROC launchers designated MK 25

Performance:
Power Plant = solid-fueled rocket by Rocketdyne (either a MK 38 or later a MK 52)
Range = 3-20nm
Speed = Mach 4

Dimensions:
Length = 144in
Diameter = 8in
Fin Span = 32in
Weight = 435lbs

Warhead:
65lbs MK 38 continuous rod

Description:

In the early 1960s, the U.S. Navy planned to provide a short-range missile defense system (called BPDMS - Basic Point Defense Missile System) for ships much smaller than then current missile defense ships. Initially the RIM-46 Sea Mauler missile was to be used for the BPDMS, but when this was cancelled in 1964, attention turned towards a derivative of the AIM-7E Sparrow. This missile was known as RIM-7E Sea Sparrow. The missile was essentially an unchanged AIM-7E, and was fired from modified ASROC launchers designated MK 25. The RIM-7E entered service in 1967.

AIM-7F Sparrow

General Info:
Origin = U.S.A.
Type = medium range AAM
Manufacture = Raytheon
IOC = 1975
Guidance = solid-state electronic (pulse-doppler radar)
Platforms = F-4C, F-14, F/A-18, F-4, F-15, F-16, F-4, F/A-18

Performance:
Power Plant = Hercules MK 58 dual-thrust solid rocket
Range = 38nm
Speed = Mach 4
Max Target g = 7
Lethal Radius = 75ft

Dimensions:
Length = 144in
Diameter = 8in
Fin Span = 32in
Weight = 510lbs

Warhead:
86lbs MK 71continuous rod

Description:

In January 1972, Raytheon began development of the vastly improved AIM-7F. It featured a new dual-thrust (boost/sustain) rocket motor (usually a Hercules MK 58, but sometimes an Aerojet MK 65), which greatly increased the missile's range. The AIM-7F also had a completely new solid-state electronic guidance and control system (GCS), designated AN/DSQ-35, which was also compatible with modern pulse-doppler radars. Continued improvement of the GCS resulted in versions from AN/DSQ-35A through -35H (used in the AIM-7F-11). The smaller GCS permitted the use of a larger 39 kg (86 lb) MK 71 warhead in the new WAU-10/B warhead section. Production began in 1975, and continued through 1981. With the AIM-7F, the official name of the missile was changed from Sparrow III to plain Sparrow.

AIM-7M Sparrow

General Info:
Origin = U.S.A.
Type = BVR Missile
Manufacture = Raytheon
IOC = 1968
Guidance = SARH
Sensor Type = Passive radar seeker
Intercept = Lead pursuit

Performance:
Power Plant = Hercules MK 58 dual-thrust solid rocket
Range = 30nm (max. 50nm)
Speed = Mach 4
Max Target g = 7
Lethal Radius = 75ft
Fuel = 133lbs

Dimensions:
Length = 12ft
Diameter = 8in
Fin Span = 40in
Weight = 510lbs

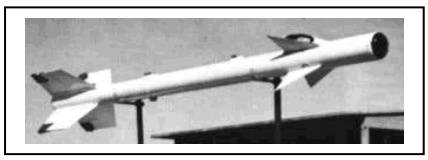
Warhead:
86lbs (Mk71) HE Fragmentation
Fuse = Contact and proximity

Description:

Originally developed in the 1950s as the harbinger of a new era in air-to-air combat in which fighter aircraft would use radar and missiles to destroy targets without ever getting close enough to see them, the AIM-7 Sparrow's performance in real combat was disappointing at best. The failure of Beyond Visual Range (BVR) combat in the Vietnam War sent both U.S. Air Force and Navy fliers back to the drawing boards in search of better tactics and better training. Even as late as 1989, the missile's performance has been underwhelming; out of eight missiles fired in various engagements during the 1980s, only two hit their targets. Modern versions of the missile share little more than the name and air frame with its Vietnam-era brethren, and performed somewhat better during Operation Desert Storm. Out of 88 Sparrow missiles fired in the Gulf War, 23 destroyed their targets, representing 70% of Coalition aerial victories. The reasons for the improved performance are thought to be better U.S. pilot training, new solid-state electronics and the abysmal performance of Iraqi pilots (the Sparrow has always done well against non-manoeuvring targets).

Engagement Sequence
The Sparrow operates by semi-active radar homing. The missile can home on both pulse-Doppler and continuous wave radar signals, enabling it to be fired by most radar equipped U.S. warplanes. Reliability aside, the main tactical weakness of the Sparrow is that the launching fighter must maintain a lock until the missile hits its target. This requirement allows the missile to be defeated by a turn into the beam and can force the attacker into an undesirable situation since his maneuvers are constrained while he maintains a lock.

AIM-9B Sidewinder



General Info:
Origin = U.S.A.
Type = short-range rear aspect IR Missile
Manufacture = Raytheon (Philco/General Electric)
IOC = 1963
Sensor Type = uncooled PbS seeker
Field of View = 4º
Tracking rate = 11°/sec

Performance:
Power Plant = Thiokol MK 17 solid-fuel rocket motor
(17.8kN (4000lbs) thrust for 2.2sec
Range = 2.6nm
Speed = Mach 1.7
Max Target g = 12
Leathal Radius = 30ft

Dimensions:
Length = 111.5in
Diameter = 5in
Fin Span = 22in
Weight = 155lbs

Warhead:
10lbs blast-fragmentation
Fuse = IR proximity or contact

Description:

The AIM-9 Sidewinder is the world's most successful short-range air-to-air missile, and will remain the U.S. military's main "dogfight" AAM for the foreseeable future.

Development of Sidewinder began in 1950 at the NOTS (Naval Ordnance Test Station) - later renamed as NWC (Naval Weapons Center) - at China Lake. The idea was to create a very simple heat-seeking air-to-air missile by equipping a 12.7 cm (5 in) air-to-air rocket with a lead sulphide (PbS) photo cell in a hemispherical glass nose to detect IR radiation. Another simple, yet effective, idea was the use of "Rollerons" (sliptream-driven wheels at the fin trailing edges acting as stabilizing gyros) as roll-stabilizing devices. The first test missiles were fired in 1951, and on 11 September 1953, the first air-to-air hit on a drone was scored. In the same year, the prototype missile received the offical designation XAAM-N-7.

General Electric began low-rate production in 1955, and in May 1956, the AAM-N-7 Sidewinder I entered U.S. Navy service. Only 240 Sidewinder I missiles were built, and full-rate production missiles (built by Ford Aerospace (Philco) and General Electric) were known as AAM-N-7 Sidewinder IA. I have found no evidence that the AAM-N-7 designations ever used suffix letters (like AAM-N-7a, etc.). For ease of reference, I will use the post-1963 designations of AIM-9A (Sidewinder I) and AIM-9B (Sidewinder IA) throughout this text, even when referring to pre-1963 events.

The AIM-9A/B used a 4.5 kg (10 lb) blast-fragmentation warhead. This was triggered by an IR proximity or contact fuze, and had an effective kill radius of about 9 m (30 ft). The uncooled PbS seeker of these early missiles had a 4° angle of view and a tracking rate of 11°/s, and the missile itself could turn at 12G. Propulsion was provided by a Thiokol MK 17 solid-fuel rocket motor (17.8 kN (4000 lb) thrust for 2.2 s), which could propel the missile to a speed of Mach 1.7 above launch speed. Because of the limitations of the seeker, the AIM-9A/B could only be used for tail-on engagements of non-manoeuvering(!) targets at ranges between 900 m (3000 ft) and 4.8 km (2.6 nm). The missile was also very susceptible to other heat sources (sun, ground reflections).

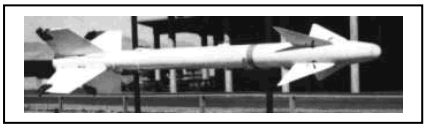
Because of the usual inter-service rivalry, the USAF did not adopt the Sidewinder, until a "fly-off" against the USAF's GAR-2/AIM-4B Falcon in June 1955 showed the superiority of the Sidewinder. The USAF subsequently procured the AIM-9B under the designation GAR-8. More than 80000 AIM-9B missiles were produced until 1962.

On 24 September 1958, the Sidewinder achieved the world's first successful use of air-to-air guided missiles, when Taiwanese F-86Fs shot down Communist Chinese MiG-15s using AIM-9Bs supplied by the U.S. Navy.

The limited performance of the AIM-9B prompted the Navy to look for improvements. The AAM-N-7 Sidewinder IC was developed in two version: a semi-active radar homing version (called Sidewinder IB in source [1]), designated AIM-9C in 1963, and an IR guided version, later designated as AIM-9D. Improvements common to both IC versions include a new Hercules MK 36 solid-fuel rocket motor for significantly increased speed and 18 km (9.7 nm) range, a larger MK 48 continuous-rod warhead, and slightly larger fins.

The SARH AIM-9C was only used with the Navy'S F8U Crusader fighters to provide these with an all-weather capability without having to fit a Sparrow-compatible radar. However, the AIM-9C was not very successful, and only 1000 were built by Motorola between 1965 and 1967. Many were later converted into AGM-122A Sidearm anti-radiation missiles.

AIM-9D Sidewinder



General Info:
Origin = U.S.A.
Type = short-range rear aspect IR Missile
Manufacture = Raytheon (Philco/General Electric)
IOC = 1965
Sensor Type = nitrogen-cooled PbS seeker
Field of View = 2.5º
Tracking rate = 12°/sec

Performance:
Power Plant = Hercules MK 36 solid-fuel rocket
Range = 9.6nm
Speed = Mach 2.5+
Max Target g = 12

Dimensions:
Length = 113in
Diameter = 5in
Fin Span = 24.8in
Weight = 195lbs

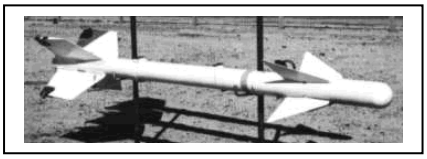
Warhead:
25lbs MK 48 continuous rod

Description:

The IR seeker of the AIM-9D (in a more pointed nose) featured a new nitrogen-cooled PbS seeker, which had field of view of only 2.5° (reduced background noise) and a higher traking rate of 12°/s. However, only about 1000 AIM-9D missiles were built (by Philco-Ford and Raytheon) between 1965 and 1969.

A training version of the AIM-9D for captive flight target acquisition, which had the warhead replaced by a WDU-9/B dummy warhead, was later designated as ATM-9D. The WDU-9/B is also used in all subsequent inert ATM/CATM/NATM-9 versions. Early training Sidewinders for firing practice were designated GDU-1/B.

AIM-9E Sidewinder



General Info:
Origin = U.S.A.
Type = short-range rear aspect IR Missile
Manufacture = Raytheon (Philco/General Electric)
IOC = 1963
Sensor Type = Peltier cooled PbS seeker
Field of View = 4º
Tracking rate = 16.5°/sec

Performance:
Power Plant = Thiokol MK 17 solid-fuel rocket motor
(17.8kN (4000lbs) thrust for 2.2sec
Range = 2.3nm
Speed = Mach 2.5+
Max Target g = 12
Leathal Radius = 30ft

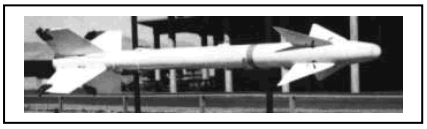
Dimensions:
Length = 118in
Diameter = 5in
Fin Span = 22in
Weight = 164lbs

Warhead:
10lbs blast-fragmentation
Fuse = IR proximity or contact

Description:

The AIM-9E was the first version specifically developed by the USAF. It was an improved AIM-9B with a new seeker with thermoelectric (Peltier) cooling, and a higher tracking rate of 16.5°/s. The Peltier cooling method allowed unlimited cooling time while the missile was on the launch rail. Externally, the AIM-9E differed from the AIM-9B by its longer conical nose section. About 5000 AIM-9Bs were converted to AIM-9E. The AIM-9E-2 is a variant with a reduced-smoke motor.

AIM-9G Sidewinder



General Info:
Origin = U.S.A.
Type = short-range rear aspect IR Missile
Manufacture = Raytheon (Philco/General Electric)
IOC = 1970
Guidance = SEAM (Sidewinder Expanded Acquisition Mode) IR homing
Sensor Type = nitrogen-cooled PbS seeker
Field of View = 2.5º
Tracking rate = 12°/sec

Performance:
Power Plant = Hercules MK 36 solid-fuel rocket
Range = 9.6nm
Speed = Mach 2.5+
Max Target g = 12

Dimensions:
Length = 113in
Diameter = 5in
Fin Span = 24.8in
Weight = 195lbs

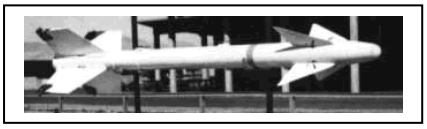
Warhead:
25lbs MK 48 continuous rod

Description:

Another Navy variant was the AIM-9G, an improved AIM-9D. It featured SEAM (Sidewinder Expanded Acquisition Mode), which allowed the optics either to be slewed through a search pattern, or to be slaved to the aircraft's radar to acquire a target. 2120 AIM-9G were built by Raytheon from 1970 to 1972. Equivalent to ATM-9D, there was also an ATM-9G training version of the AIM-9G.

The Sidewinder was of course used extensively over Vietnam by both the USAF and the Navy. The Air Force scored 28 AIM-9 air-to-air kills using the AIM-9B/E versions, achieving a kill probability for this missile of about 16%. The USN's most successful Sidewinder variants in Vietnam were the AIM-9D and -9G, which were resposible for the majority of USN air-to-air kills in this conflict. A total of 82 air-to-air kills over Vietnam are attributed to the AIM-9.

AIM-9H Sidewinder



General Info:
Origin = U.S.A.
Type = short-range rear aspect IR Missile
Manufacture = Raytheon (Philco/General Electric)
IOC = 1972
Guidance = solid-state electronics IR homing
Sensor Type = nitrogen-cooled PbS seeker
Field of View = 2.5º
Tracking rate = 20°/sec

Performance:
Power Plant = Hercules MK 36 solid-fuel rocket
Range = 9.6nm
Speed = Mach 2.5+
Max Target g = 12

Dimensions:
Length = 113in
Diameter = 5in
Fin Span = 24.8in
Weight = 195lbs

Warhead:
25lbs MK 48 continuous rod

Description:

To increase the reliability of the AIM-9G, the Navy developed the AIM-9H. The main difference to the AIM-9G were solid-state electronics in the guidance and control system. The seeker tracking rate was also increased to 20°/s to complement the more powerful actuators. Only a few AIM-9Hs were fired over Vietnam, but they were credited with a higher kill rate than any other AIM-9 version in Vietnam. About 7700 AIM-9Hs were produced by Philco-Ford and Raytheon between 1972 and 1974. The ATM-9H was a training version for captive flight target acquisition.

AIM-9J Sidewinder

General Info:
Origin = U.S.A.
Type = Dogfighting missile
Manufacture = Raytheon and Loral Martin
IOC = 1977
Guidance = Solid-state IR homing
Platforms = F-15, other Sidewinder-compatible aircraft

Performance:
Power Plant = Hercules and Bermite Mk 36 Mod 11
Range = 9.7nm
Speed = Mach 2.5+
Lethal Radius = 30ft

Dimensions:
Length = 9ft 5in
Diameter = 5in
Finspan = 2ft 3/4in
Weight = 170lbs

Warhead:
10lbs blast-fragmentation
Fuse = IR proximity or contact

Description:

The USAF's AIM-9J was an improved AIM-9E. It had partial solid-state electronics, a longer-burning gas generator (increasing flight time), and more powerful actuators which drove new square-tipped double-delta canards. The latter feature doubled the single-plane "G"-capability of the missile. About 10000 AIM-9Js were eventually built from 1972 on, mostly by converting existing AIM-9B/E missiles.

AIM-9M Sidewinder

General Info:
Origin = U.S.A.
Type = Dogfighting missile
Manufacture = Raythean
IOC = 1978
Guidance = All-aspect IR
Sensor Type = Cooled IR
Sensor Range = 6.5nm
Field of View = 3º
Tracking Rate = 18°/sec
Gimbal Limit = 25º
Intercept = Lead pursuit

Performance:
Range = 9.7nm (max 18nm)
Speed = Mach 2
Max Target g = 12
TOF = 13sec
Lethal Radius = 20ft
Fuel = 60lbs

Dimensions:
Length = 9.5ft
Diameter = 5in
Fin Span = 25in
Weight = 191lbs

Warhead:
20.8lbs Annular blast fragmentation
Fuse = Proximity

Description:

The AIM-9M is a development of the AIM-9L and replaced the latter on the production line. It features a reduced-smoke rocket motor, an improved guidance section designated WGU-4/B, better countermeasures resistance (IRCCM - Infrared Counter-Countermeasures), and improved overall reliability. Production began in 1982, and so far more than 7000 missiles have been built by Raytheon in subtypes numbered AIM-9M-1 through AIM-9M-10. The principal current production versions are the AIM-9M-8 (USN) and AIM-9M-9 (USAF). They have further improved IRCM detection circuitry, and the latest versions of the rocket motor (MK 36 MOD 11), guidance section (WGU-4E/B), and AOTD (DSU-15B/B). The AIM-9M-10 is a slightly modified -9M-8 for use by the F/A-18E/F Hornet. Most existing AIM-9Ms will be upgraded to -9M-8/9 standard. In Operation Desert Storm in 1991, 13 air-to-air kills were attributed to the Sidewinder, all of which were probably AIM-9M missiles.

AIM-9P Sidewinder

General Info:
Origin = U.S.A.
Type = Dogfighting missile
Manufacture = Philco-Ford
IOC = 1977
Guidance = Solid-state IR homing

Performance:
Power Plant = Hercules and Bermite Mk 36 Mod 11
Range = 9.7nm
Speed = Mach 2.5+
Lethal Radius = 30ft
Fuel = 60lbs

Dimensions:
Length = 9ft 5in
Diameter = 5in
Finspan = 2 ft ¾in
Weight = 190lbs

Warhead:
10lbs blast-fragmentation
Fuse = AOTD laser proximity

Description:

The AIM-9P, an improved version of the J model, has greater engagement boundaries, enabling it to be launched farther from the target. The more maneuverable P model also incorporated improved solid-state electronics that increased reliability and maintainability. Deliveries began in 1978.
The AIM-9P-1 has an active optical target detector instead of the infrared influence fuse; the AIM-9P-2 added a reduced-smoke motor. The most recently developed version, the AIM-9P-3, combined both the active optical target detector and the reduced-smoke motor. It also has added mechanical strengthening to the warhead as well as the guidance and control section. The improved warhead uses new explosive material that is less sensitive to high temperature and has a longer shelf life.

AIM-9X Sidewinder

General Info:
Origin = U.S.A.
Type = High Off-boresight Dogfighting missile
Manufacture = Raytheon
IOC = 2004
Guidance = Off-boresight IR
Sensor Type = Self Cooled IR
Focal Plane Array Technology. (FPA)
Field of view = 3°
Gimbil limit = 90°
Platforms = F16C, F15C/E, FA18C/D/E, F22

Performance:
Power Plant = Hercules and Bermite Mk 36 Mod 11
Range = 9.7nm (max. 22nm)
Speed = Mach 2.5
Max Target g = 13
Fuel = 60lbs

Dimensions:
Length = 9ft 5in
Diameter = 5in
Finspan = 2 ft ¾in
Weight = 190lbs

Warhead:
20.8lbs WDU-17/B Annular blast fragmentation

Description:

For many years Eastern Block forces had superior WVR- IR missiles. The AA-11 Archer with it's off-boresite capabilities was a serious threat to western fighters.
The British developed a new missile to counter this, the Asraam. The Israeli's developed the Python 4.
The United States contracted the makers of the Sidewinder, then Hughes to expand the capabilites of the Aim-9M.
The result was the Aim-9X, with shot capabilties up to 65 degrees off-boresight and a seeker range that exceeds all other IR missiles. Increased IRCCM, lower drag airframe and thrust vectoring controls make the 'missile tremendously lethal even on manoeuvring targets.
Its small motor is it's only drawback, since a fast burnout allows only one chance to hit its intended target.

AIM-54A Phoenix

General Info:
Origin = U.S.A.
Type = long range Intercept Missile
Manufacture = Hughes
IOC = 1974
Guidance = SARH (semi-active radar homing) midcourse; active terminal
Sensor Type = Pulse doppler radar
Sensor Range = 130nm
Intercept = Lead pursuit
Platforms = F-14

Performance:
Power Plant = Rocketdyne MK 47 or Aerojet MK 60 solid-fueled rocket motor
Range = 73nm (max. 150nm)
Speed = Mach 4.3
Ceiling = 81400ft
Max Target g = 7
Drag = 8
Lethal Radius = 100ft
Fuel = 400lbs

Dimensions:
Length = 13ft
Diameter = 15in
Fin Span = 36in
Weight = 1000lbs

Radar:
Range = 11nm
Sweep rate = 11 deg/sec
Beam width = 4 deg
Max scan angle = 49 deg
Doppler radar

Warhead:
132lbs MK 82 blast-fragmentation
Fuse = radar proximity, IR proximity, impact

Description:

The AIM-54 Phoenix is the only long-range air-to-air missile currently in service with the U.S. armed forces, and is exclusively used by the U.S. Navy's F-14 Tomcat fighters.

Development of the Phoenix began in late 1960, after the U.S. Navy's projected F6D Missileer and the associated AAM-N-10 Eagle long-range interception missile had been cancelled. Hughes then started to develop a new long-range missile, designated AAM-N-11 by the Navy, together with the AN/AWG-9 FCS (Fire Control System). The new missile and FCS used technology previously tested by the AIM-47 Falcon and AN/ASG-18, respectively, in the USAF's YF-12A program. The Phoenix/AWG-9 combination was originally intended as the main armament for the F-111B, then planned to become the Navy's new air superiority fighter and long-range interceptor. In June 1963, the AAM-N-11 was redesignated as AIM-54A. Flight tests of XAIM-54A prototypes began in 1965, and the first guided interception succeeded in September 1966. While the Phoenix test program continued, the F-111B was cancelled, and the AIM-54 and AN/AWG-9 were incorporated into the new F-14 Tomcat, which was to take over the role of the F-111B. The first production AIM-54A missiles were delivered in 1973, ready for deployment with the first F-14A squadron in 1974.

An F-14 can carry up to 6 Phoenix missiles, on LAU-93/A (F-14A/B) or LAU-132/A (F-14D) launchers, respectively. The AN/AWG-9 FCS uses a TWS (Track While Scan) pulse-doppler radar, and can track up to 24 targets simultaneously at ranges of up to 240 km (130 nm). Therefore, an F-14 can effectively attack 6 targets simultaneously. When an AIM-54A is launched, its Rocketdyne MK 47 or Aerojet MK 60 solid-fueled rocket motor (in an MXU-637/B propulsion section) propels it to a speed of Mach 4+. For mid-course guidance, the missile's AN/DSQ-26 guidance section employs an autopilot, which gets regular target position updates by semi-active radar tracking. The FCS radar periodically illuminates every target to which a missile has been dispatched. For maximum range, the missile flies an optimized high-altitude trajectory for reduced drag, and the AIM-54A can engage head-on targets at a distance of up to 135 km (72.5 nm). For the final 18200 m (20000 yds) of the interception, the Phoenix switches to active radar homing for high terminal accuracy. Minimum engagement range is about 3.7 km (2 nm), in which case active homing is used from the beginning. The 60 kg (132 lb) MK 82 blast-fragmentation warhead is detonated by a fuzing system consisting of a MK 334 radar proximity, an IR proximity, and an impact fuze.

There are several non-tactical variants of the AIM-54A. The ATM-54A is a version with inert warhead for firing exercises, the CATM-54A is the captive (non-launching) version for target acquisition practice, and the DATM-54A is a completely inert dummy missile for ground handling training. The AEM-54A is a variant with special telemetry electronics for test and evaluation purposes.

AIM-54C Phoenix

General Info:
Origin = U.S.A.
Type = Intercept Missile
Manufacture = Hughes
IOC = 1982
Guidance = WGU-11/B guidance and WCU-7/B control sections
SARH midcourse; active terminal
Sensor Type = Pulse doppler radar
Intercept = Lead pursuit
Platforms = F-14

Performance:
Power Plant = Rocketdyne MK 47 or
Aerojet MK 60 single-stage solid-fueled rocket motor
Range = 80nm (max. 200nm)
Speed = Mach 5
Ceiling = 100000ft
Max Target g = 7
Drag = 8
Lethal Radius = 100ft
Fuel = 337lbs

Dimensions:
Length = 13ft
Diameter = 15in
Fin Span = 36in
Weight = 1020lbs

Radar:
Range = 11nm
Sweep rate = 11 deg/sec
Beam width = 4 deg
Max scan angle = 49 deg
Doppler radar

Warhead:
132lbs WDU-29/B blast-fragmentation
Fuse = radar proximity, IR proximity, impact

Description:

In 1977, development of the significantly improved AIM-54C began. The AIM-54C features completely new digital WGU-11/B guidance and WCU-7/B control sections. The missile incorporates a programmable digital signal processor, and the autopilot now uses a strap-down inertial navigation system. One very important feature of the AIM-54C is its vastly improved ECCM capability. Improvements in the rocket motor increase speed and range, and the new DSU-28/B target detection device improves fuzing accuracy in high-clutter environments and for small and low-altitude targets. The first XAIM-54C prototypes were delivered in August 1979, and after tests with YAIM-54C missiles, production of the Phoenix switched to the AIM-54C in 1982. Initial Operational Capability of the AIM-54C was reached in 1986. Non-tactical variants include the ATM-54C for firing exercises, the CATM-54C captive (non-launching) version for target acquisition practice, and the AEM-54C with special telemetry electronics for test and evaluation purposes. There is no DATM-54C, because the DATM-54A is also suitable for AIM-54C ground handling training.

The AIM-54C was continually upgraded during production. Early in the production run, the MK 82 warhead was replaced by a new WDU-29/B warhead in a WAU-16/B or WAU-20/B warhead section. The WDU-29/B offers a 20 to 25 percent increase in effectiveness. Another improvement was the addition of internal temperature compensation, which eliminated the need for the F-14 to provide temperature compensation liquid during captive flight. Missiles with this feature, first delivered in 1986, are called "sealed", and are sometimes referred to as AIM-54C+. During the production, the ECCM capabilities were still further improved, and "sealed" AIM-54C missiles with improved ECCM are known in the U.S. Navy as AIM-54C ECCM/Sealed. This variant reached IOC in 1988. The guidance and control sections of the ECCM/Sealed missile are the WGU-17/B and WCU-12/B, respectively, and the available warhead sections are the WAU-19/B and WAU-21/B. Other improvements, which can be retrofitted to older AIM-54C rounds, include a reprogrammable memory, and new software for the signal processor.

When production ceased in the early 1990s, more than 5000 AIM-54 missiles of all versions had been built, about half of these being AIM-54Cs. Because the Phoenix is used only by the F-14 Tomcat, it will remain in service as long as this aircraft, and the F-14 will be phased out by 2007 approximately. All operational Phoenix missiles are now of the AIM-54C variant, and the remaining AIM-54As have been placed in storage. The AIM-54 was primarily designed for long-range fleet defense against incoming bomber streams, a threat which has dimished nowadays. Although it can theoretically also be used against low-flying high-speed anti-ship missiles, there are more effective weapons for this role. Currently, there are no plans to field any other missile with Phoenix-like performance characteristics when the AIM-54 is retired. The fleet defense role after the retirement of the F-14/AIM-54 combination will be taken by the F/A-18E/F Hornet armed with AIM-120C AMRAAM missiles.

AIM-120B AMRAAM

General Info:
Origin = U.S.A.
Type = BVR Missile
Manufacture = Hughes
IOC = 1991
Guidance = Inertial with mid-course updates; active radar terminal phase
Sensor Type = Active radar
Sensor Range = 8nm
Intercept = Lead pursuit
Platforms = F-14D, F-15, F-16, F/A-18, EF-2000, and Tornado ADV.

Performance:
Range = 40nm (max. 75nm)
Speed = Mach 4
Fuel = 117.3lbs
Lethal Radius = 40ft

Dimensions:
Length = 12ft
Diameter = 7in
Fin Span = 25in
Weight = 345lbs

Radar:
Range = 9nm
Sweep rate = 11 deg/sec
Beam width = 4 deg
Max scan angle = 54 deg
Sensor Range = 8nm

Warhead:
45lbs High explosive
Fuse = Variable

Description:

The AIM-120 AMRAAM was developed in the 1980s to replace the AIM-7 Sparrow. One of the chief disadvantages of the Sparrow missile was that the launching fighter had to maintain a radar lock on the target for the entire flight of the missile. Besides giving the target plenty of opportunity to defeat the missile by breaking the radar lock, it also left the shooter vulnerable to counterattack since his maneuvers were constrained while he maintained a lock on a single bandit. In addition, a SARH missile needs a fairly strong radar return to guide on, which is guaranteed to give away an attack on any Radar Warning Receiver- (RWR) equipped target. Part of the solution to this problem was to put an entire radar set into the missile itself, but since the range of any radar is limited by the size of its antenna, simply using the missile's own radar would diminish the potential range considerably. These problems were solved in the AMRAAM by both putting a miniature active radar into the missile nose for use in the missile's terminal phase, and also using a datalink from the launching fighter's Fire Control Radar (FCR) to provide mid-flight course corrections. Furthermore, the shooter doesn't need to continually paint the target with his radar to fire the AMRAAM, but can be in a more stealthy Track While Scanning (TWS) mode.

AIM-120C-4 AMRAAM

General Info:
Origin = U.S.A.
Type = BVR Missile
Manufacture = Hughes
IOC = 1991
Guidance = Inertial with mid-course updates;
active radar terminal phase
Sensor Type = Active radar
Sensor Range = 8nm
Intercept = Lead pursuit
Platforms = F-14D, F-15, F-16, F/A-18, EF-2000, and Tornado ADV.

Performance:
Range = 37nm (max. 68nm)
Speed = Mach 4
Fuel = 117.3lbs
Lethal Radius = 40ft

Dimensions:
Length = 12ft
Diameter = 7in
Fin Span = 25in
Weight = 345lbs

Radar:
Range = 9nm
Sweep rate = 11 deg/sec
Beam width = 4 deg
Max scan angle = 54 deg
Pulse radar; Doppler radar
Sensor Range = 8nm

Warhead:
45lbs High explosive
Fuse = Variable

Description:

The differences between the Aim-120B and Aim-120C-4 are as follows:
The wings are now clipped with allows for carriage of the Aim-120C in weapons bays for aircraft such as the F/A-22 Raptor and the JSF.
The Guidance was upgraded to the WGU-44/B standard and the warhead was improved to the WDU-41/B warhead.
The engine was switched from a sustain/boost to a pure boost design. While it does cause the missile to loose some of it's range, it allows the missile to get out onto it's target quicker as the missile accelerates quicker than the previous versions that used the boost/sustain engine.

AIM-120C-5 AMRAAM

General Info:
Origin = U.S.A.
Type = BVR Missile
Manufacture = Hughes
IOC = 2000
Guidance = Inertial with mid-course updates;
active radar terminal phase
Sensor Type = Active radar
Sensor Range = 8nm
Intercept = Lead pursuit
Platforms = F-14D, F-15, F-16, F/A-18, EF-2000, and Tornado ADV.

Performance:
Range = 43nm (max. 82nm)
Speed = Mach 4
Fuel = 127.3lbs
Lethal Radius = 40ft

Dimensions:
Length = 12ft
Diameter = 7in
Fin Span = 25in
Weight = 345lbs

Radar:
Range = 9nm
Sweep rate = 11 deg/sec
Beam width = 4 deg
Max scan angle = 54 deg
Pulse radar; Doppler radar
Sensor Range = 8nm

Warhead:
45lbs High explosive
Fuse = Variable

Description:

The Aim-120C-5 offers the following improvments over the Aim-120C-4
Has a slightly larger motor (pure boost) in the new WPU-16/B propulsion secion
A new shorter WCU-28/B control section with compressed electronics and ECCM upgrades.
Deliveries began in July of 2000.

AIM-132 ASRAAM

General Info:
Origin = U.K.
Type = Dogfighting missile
Manufacture = British Aerospace
IOC = 1998
Guidance = All aspect IR
Intercept = Off boresight lead pursuit
Sensor Type = trapdown Inertial/ and Imaging infrared
Intercept = Lead pursuit
Platforms = Eurofighter, Harrier GR7, Tornado, RAAF FA18A

Performance:
Range = 8nm (max. 15mn)
Speed = Mach >3
Fuel = 60lbs

Dimensions:
Length = 8ft 11.5in
Diameter = 6.6in
Fin Span = 17.7in
Weight = 220.5lbs

Description:

The Advanced Short Range Air to Air Missile is a state of the art highly maneuverable WVR dogfighting missile. the British Government spent 636 million pounds developing the project. The first ASRAAM was delivered to the RAF in 1998, and will equip the Tornado F3 and Harrier GR7 before it becomes the EF 2000's standard short range weapon.

IRIS-T

General Info:
Origin = Germany.
Type = Dogfighting missile
Manufacture = DIEHL BGT Defence
IOC = 2004
Guidance = All aspect IR
Intercept = Off boresight lead pursuit
Sensor Type = trapdown Inertial/ and Imaging infrared
Intercept = Lead pursuit
Platforms = Eurofighter, Tornado

Performance:
Range = 8nm (max. 15mn)
Speed = Mach >3
Fuel = 60lbs

Dimensions:
Length = 9.84in
Weight = 185lbs

Warhead:
19.8lbs Active radar fuze

Description:

The IRIS-T is joint developement between many European countries for a advance IR missile. Some of the features are Thrust vectoring, under development, 90 deg off boresight seeker, 64x64 scanning indium-antimonide 3-5 micron seeker. Sidewinder interoperable.
Capable of 60G turns and 60deg AoA. Active radar fuze, 9kg warhead.

BVRAAM Meteor

General Info:
Origin = Europe
Type = Beyond Visual Range Air to Air Missile
Manufacture = Matra BAe Dynamics (UK), MBD (France)
Daimler Chrysler Aerospace (Germany),
Alenia Marconi Systems (Italy), CASA (Spain),
Saab Dynamics (Sweden)
Guidance = inertial mid-course with data linking
IOC = 1998
Intercept = high off-bore-sight
Platforms = Eurofighter, Rafale, Gripen

Performance:
Range = >50nm
Speed = supersonic

Dimensions:
Length = 145in

Warhead:
Blast fragmentation
Fuse = proximity (Saab Bofors Dynamics/Sweden) impact

Description:

The MBDA solution
METEOR will engage air targets autonomously (whether fighters, bombers, transport aircraft, AWACS or cruise missiles) by using its active radar seeker by day or night and in all weather or dense electronic warfare environments.

METEOR will be developed under the prime contractorship of MBDA and the Meteor team comprising Europe's leading guided weapons companies.

METEOR's ramjet propulsion system will ensure a range in excess of 100 km and a speed of more than Mach 4. Even when launched from extreme stand-off ranges, the missile will have the energy in the end game to defeat fast, manoeuvring targets. To ensure total target destruction, the missile is equipped with both proximity and impact fuzes and a fragmentation warhead that is detonated at the optimum point to maximise lethality.

The METEOR system will be compatible with Eurofighter Typhoon, Rafale and Gripen and with other advanced European fighter aircraft.

Status of programme
The METEOR contract has involved agreement by all six nations and was signed on 23t December 2002. This agreement covers a fixed price contract for the development of METEOR and production requirements will then be met on a nation by nation basis.

A full development programme, agreed by all six nations, is already in place and includes the key project milestones that will measure both progress and success. Development will be completed by 2010 followed by the introduction to service on Typhoon, Rafale and Gripen soon afterwards.

Skyflash

General Info:
Origin = U.K.
Type = SARH
Manufacture = British Aerospace
IOC = 1978
Guidance = SARH
Sensor = Marconi XJ521
Sensor Type = monopulse Semi-Active Radar homing
Platforms = F-4

Performance:
Range = 28nm
Speed = Mach 4

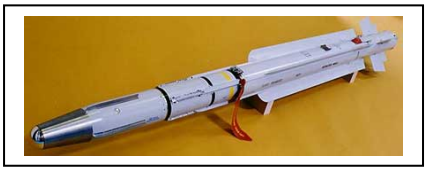
Dimensions:
Length = 12ft 1in
Diameter = 8in
Fin Span = 3ft 4in
Weight = 425lbs

Warhead:
87lbs HE Fragmentation
Fuse = Contact and proximity

Description:

Skyflash is a medium-range radar-guided Air to Air Missile. Designed to operate within severe electronic countermeasure conditions, the Skyflash is the Royal Air Force's major air defence weapon. Four are carried by the Tornado F.3 under the fuselage. The Skyflash was a development of the AIM-7E2 Sparrow. The weapon entered service with the RAF in 1978, originally for use by the F.4 Phantom.

Mica IR



General Info:
Origin = French
Manufacture = BAe Dynamics
Type = medium range
Guidance = IR homing
Sensor Type = passive imaging IR seeker
IOC = 2004
Platforms = Mirage, Eurofighter

Performance:
Propellant = Solid propellant
Range = 30nm (max. 50nm)
Speed = Mach 4
Fuel = 80lbs

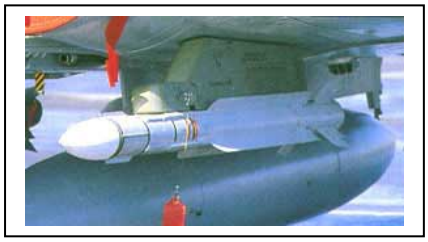
Dimensions:
Length = 122in
Diameter = 6.3in
Weight = 247lbs

Warhead:
26.5lbs HE
Fuse = impact

Description:

Since the 90's, MBDA and the French Air Force have been developing the MICA which is an air-to-air missile that was to revolutionise air combat because it is the only missile in the world capable of performing all air defence missions.
pilot can engage several targets simultaneously, in close up fighting or in self-defence from all directions, while maintaining maximum efficiency within an electronic warfare environment and with saturation jamming. These elements give it a very good cost/efficiency ratio compared with existing specialised missiles. Another advantage of MICA's innovative concept is its flexibility to be guided by an active radar electromagnetic homing head (MICA RF) or by an infrared imagery homing head (MICA IR). The IR homing head is unique for a missile with this range, and its many features include an excellent angular resolution (dual band imagery) and total stealth: the passive homing head enables absolutely "silent" interceptions when it is used with an OSF (Front Sector Optronics). The pilot can also use the MICA IR for discrete optronics monitoring, in addition to the active monitoring radar on his aircraft throughout the mission duration.
MICA's homing system makes it both independent and versatile. When the target has been designated by the launching aircraft radar, it makes its first flight phase in inertial guidance, possibly refreshed, and then latches onto the target in flight using its homing head. Thus it has a "Fire and Forget" capability, so that the pilot can fire several missiles simultaneously on different targets. With two available homing head versions RF and IR, the pilot can handle all eventualities. Each of the two types of homing head has its own counter-countermeasures system.
MICA has excellent manoeuvrability, confirmed in more than 100 test firings carried out so far. A jet deviation system combined with aerodynamic control surfaces and its long fin provides MICA with exceptional agility (load factors up to 50 kg).
Lightweight and compact, MICA was originally designed as a "multi-aircraft" missile that could easily be integrated onto any modern fighter aircraft. It does not significantly reduce the aircraft speed or its aerodynamic characteristics; a significant number may be carried under the fuselage or under the wings, and it may be fired by ejection or by rail.

Mica RF



General Info:
Origin = French
Manufacture = BAe Dynamics
Type = medium range
Guidance = radar homing
Sensor Type = active RF monopulse doppler seeker
IOC = 2002
Platforms = Mirage, Eurofighter

Performance:
Propellant = Solid propellant
Range = 30nm (max. 50nm)
Speed = Mach 4
Fuel = 80lbs

Dimensions:
Length = 122in
Diameter = 6.3in
Weight = 247lbs

Radar:
Range = 9nm
Sweep rate = 11 deg/sec
Beam width = 4 deg
Max scan angle = 54 deg

Warhead:
26.5lbs HE
Fuse = RF proximity impact

Description:

Since the 90's, MBDA and the French Air Force have been developing the MICA which is an air-to-air missile that was to revolutionise air combat because it is the only missile in the world capable of performing all air defence missions.
pilot can engage several targets simultaneously, in close up fighting or in self-defence from all directions, while maintaining maximum efficiency within an electronic warfare environment and with saturation jamming. These elements give it a very good cost/efficiency ratio compared with existing specialised missiles.
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MICA has excellent manoeuvrability, confirmed in more than 100 test firings carried out so far. A jet deviation system combined with aerodynamic control surfaces and its long fin provides MICA with exceptional agility (load factors up to 50 kg).
Lightweight and compact, MICA was originally designed as a "multi-aircraft" missile that could easily be integrated onto any modern fighter aircraft. It does not significantly reduce the aircraft speed or its aerodynamic characteristics; a significant number may be carried under the fuselage or under the wings, and it may be fired by ejection or by rail.

R.530D Super Matra

General Info:
Origin = French
Type = medium range
Manufacture = Matra BAe Dynamics
Guidance = radar homing
IOC = 1963
Sensor Type = Doppler semi-active seeker

Performance:
Power Plant = Solid propellant
Range = 40km (Max)
Speed = Mach 5
Ceiling = 80000ft

Dimensions:
Length = 150in
Diameter = 10.4in
Fin Span = 24.4in
Weight = 595lbs

Warhead:
66lbs HE-FRAG
Fuse = Active radar

Description:

The Super 530D retains the same general aerodynamic features and internal layout as its Super 530F predecessor, with cruciform low aspect ratio wings and cruciform aft controls. However, the stainless steel body is longer to accommodate a new radome & seeker assembly and a new and more powerful dual-thrust solid propellant motor. The missile is 3.80 metres long, has a body diameter of 263mm, a wing span of 0.62 metres and with the same warhead as the Super 530F missile, weighing 270 kg.

Guidance is by the mono-pulse AD26 CW Doppler semi-active seeker, which has improved ECCM capability, and improved capability against low-flying targets. The missile's guidance unit is also fitted with digital micro-processing, which enables the seeker to be reprogrammed against new threats. The missile has a claimed maximum interception altitude of 80,000 feet (24,400 metres), with a snap-up capability of 40,000 feet (12,200 metres), and a snap-down capability to targets at 200 feet (60 metres). The missile has a range of 40 km and a maximum speed of Mach 5.

R.550 Magic/Magic II

General Info:
Origin = French
Type = Dogfighting missile
Manufacture = atra
Guidance = All aspect IR
Intercept = Lead Pursuit
IOC = 1988
Platforms = Mirage series

Performance:
Range = 8nm
Speed = Mach 2.7

Dimensions:
Length = 108.3in
Diameter = 6.3in
Weight = 196lb

Warhead:
24.25lbs Fragmentation
Fuse = Radio frequency proximity

Description:

The Magic 2 is the largest single competitor in Europe for the sidewinder. The R550 has better performance and design requirements than the aim9. It can be fired from any speed, and can carry it's 24lb warhead up to 6.2 miles.

Derby AAM

General Info:
Origin = Israel
Type = BVR
Manufacture = Rafael and MBT
IOC = in progress
Guidance = active radar
Platforms = F-16, F-5, Mirage

Performance:
Range = 50km
Speed = supersonic

Dimensions:
Length = 150in
Diameter = 5.9in
Fin Span = 19.7in

Description:

Variously known as Alto or Derby, this Israeli active radar-guided air-to-air missile (AAM) is a collaborative effort between Rafael, the state's armament development agency, and Israel Aircraft Industries MBT. Officially acknowledged in 1998, the project has been underway for at least a decade. This missile's design shares considerable commonality with Python 4, though adding mid-body wings.A new beyond visual range (BVR) radar seeker, which was developed by Israel Aircraft Industries' MBT Division, has been incorporated into Rafael's Derby air-to-air missile.The seeker for the Derby missile is a state of the art active radar seeker for all weather, all aspect air-to-air missiles. Advanced seeker performance enables engagement of several targets from short ranges to BVR with autonomous search, acquisition and tracking airborne targets, as well as look down capability.

Python 3

General Info:
Origin = Israel
Type = medium range
Manufacture = RAFA'EL Armament Development Authority
IOC = 1985
Guidance = IR homing
Platforms = F-15, F-16, all types of Mirage, F-5, F-4

Performance:
Power Plant = double-base solid propellant rocket motor
Range = 15km
Speed = Mach 3.5

Dimensions:
Length = 9ft 10.1in
Diameter = 6.3in
Fin Span = 2ft 9.9in
Weight = 264lbs

Warhead:
24.25lbs HE

Description:

PYTHON-3 is a third-generation short to medium range air-to-air missile adapted to the F-15, F-16, all types of Mirage, F-5, F-4 and Kfir C-2 and C-7 aircraft. The missile upgrades the capability of its carrier and gives it air superiority in modern air combat scenarios, such as:
Head-on interceptions
Beam interceptions
Dogfights involving high-g maneuvers
Low-altitude interceptions of helicopters and light aircraft
Self-defense air combat during penetration missions.

MAIN FEATURES
All-aspect capability, including head-on interception
Effective against most evasive tactics
Capable of intercepting low-signature and low-altitude threats
15 km maximum effective range at high altitude
Active proximity fuze, based on lead bias navigation system
Highly efficient warhead
Versatile target acquisition modes, including slaving to advanced radar system
Reliability greater than 95%
Full ILS, including combat doctrine manual, training and ground support equipment

The Python 3, RAFA'EL's [Arms Development Authority] air-to-air missile, has intercepted dozens of Syrian planes. The pilot can launch the missile only after steering his plane at the enemy plane at a 30-40 degree cone.

Python 4

General Info:
Origin = Israel
Type = Dogfighting Missile
Manufacture = Rafael Armament Dev.
IOC = Mid 1980s
Guidance = All aspect IR
Sensor Type = Cooled IR, Multiple detector array
Sensor Range = 7nm
Field of View = 4 degrees
Tracking rate = 90 deg/sec
Gimbal limit = 90 deg
Intercept = Off-Boresight
Platforms = F16IAF

Performance:
Range = 6.8nm
Speed 0 Mach 3.5
Max Target g = 13
TOF = 13sec
Lethal Radius = Classified

Dimensions:
Length = 9ft 10.1in
Diameter = 6.3in
Fin Span = 2ft 9.9in
Weight = 264.6lbs

Warhead:
24.25lbs Blast Fragmentation
Fuse = Laser proximity Backup impact

Description:

The Python 4 is a fourth generation WVR IR guided missile with unique aerodynamics for superior agility and a novel No-escape volume. It has an advanced homing head, with lateral squint capabilites to receive signals from a pilots line of sight with a special helmet.
Its reported that it can be launched as far as 15nm, and its effective 11kg warhead is electronically fused, making it one of the best in the world.

SURFACE MISSILES

BGM-71 TOW ATGM

General Info:
Origin = U.S.A.
Type = ATGM
Manufacture = Hughes
IOC = 1970
Guidance = SACLOS via wire
Sensor Type = Optical or IR sight with IR missile tracker

Performance:
Range = 4100yrds
Speed = Mach 0.85
Engine Burn = 5sec
TOF = 12sec

Dimensions:
Length = 4ft
Diameter = 6in
Weight = 62lbs

Warhead:
13lbs HEAP
Fuse: Standoff probe
Armor = 800mm
Concrete = 4ft

Description:

The TOW is a heavy tripod-based anti-tank infantry missile that can also be equipped on armored vehicles and aircraft. This weapon is designed to make big holes in tanks and has a maximum penetration of more than 2.5 feet of armor plating. In addition, the missiles fired by the launchers have been upgraded several times, making these weapons effective even against reactive tank armor.

M47 Dragon

General Info:
Origin = U.S.A.
Type = Medium Anti-Tank Weapon
Manufacture = McDonnell Douglas
IOC = 1971
Guidance = SACLOS via wire
Sensor Type = Optical or IR sight with IR missile tracker

Performance:
Range = 65m (Min) 1000m (Max)
Speed = Mach 0.85
Engine Burn = 5sec
TOF = 12sec

Dimensions:
Length = 4ft
Diameter = 6in
Weight = 62lbs

Warhead:
13lbs HEAP
Fuse: Standoff probe
Armor = 800mm
Concrete = 4ft

Description:

The Dragon system contains a launcher, tracker and missile. The launcher is an expendable, smooth bore, fiberglass tube with tracker and support bipod, battery, sling and front and back shock absorbers. The warhead power of Dragon makes it possible for a single soldier to defeat armored vehicles, fortified bunkers, concrete gun emplacements, or other hard targets. The Dragon uses a cone-shaped charge for maximum penetration, and the wire guidance allows the gunner to hit his target by keeping the cross hairs on the target until detonation.
The missile is installed in the launcher during final assembly by the manufacturer and is received in a ready-to-fire condition. The launcher consists of a smoothbore fiberglass tube, breech/gas generator, tracker and support, bipod, battery, sling, and forward and aft shock absorbers. Non-integral day and night sights are required to utilize the Dragon. The launcher is expendable. The day and night tracker sights can be reused.

MIM-14 Nike Hercules

General Info:
Origin = U.S.A.
Type = Fixed Surface to Air missile
Manufacture = Western Electric
IOC = 1958
Guidance = Radio command link
Sensor Range = 75nm

Performance:
Range = 88nm
Speed = Mach 3.65
Power Plant = Booster: Hercules M42 solid-fueled rocket cluster (4x M5E1 *Nike* boosters); 978 kN total; Sustainer: Thiokol M30 solid-fueled rocket; 44.4 kN
Ceiling = 150000ft
Max G = 7

Dimensions:
Length (missile) = 26ft 10in
Length (booster) = 14ft 3in
Diameter (missile) = 21in
Diameter (booster) = 31.5in
Fin Span (missile) = 6ft 2in
Fin Span (booster) = 11ft 6in
Weight (missile) = 5530lbs
Weight (booster) = 5180lbs

Warhead:
M17 (1100lbs) blast-fragmentation or W-31 nuclear (2 kT, 40 kT)

Description:

*The Nike Hercules was the only nuclear-armed surface-to-air weapon, which was operational with the U.S. Army. Development of an improved Nike missile began in 1952, with the primary goal to develop a missile with a significantly higher performance than MIM-3 Nike Ajax (then known simply as Nike), which could still be used with the existing Nike ground equipment. After it had been shown that the Nike Ajax could not be equipped with then existing nuclear warheads, nuclear armament became another goal for the new missile. The **SAM-A-25** Nike B program was formally established in June 1953. As with Nike Ajax, Western Electric was prime contractor, and Douglas was responsible for the missile airframe.*
The Nike B (renamed Nike Hercules on 15 December 1956) used many components of the Nike I (Nike Ajax). The booster consisted of four Nike Ajax boosters, and the original design used 4 of Ajax' liqued-fuel rockets as sustainer propulsion. However, the first flight tests with the liquid-fuel sustainer in 1955 proved very troublesome, and a solid-fueled sustainer rocket was eventually used. The first successful interception of a drone target occurred in 1956, and in 1957 the new solid-fuel sustainer flew for the first time. Nike Hercules used the same command guidance as the MIM-3 Nike Ajax, with essentially the same ground components.
*The first production Nike Hercules missiles were delivered in 1958, and quickly replaced the Ajax on many Nike sites. By then, the Nike Hercules had been designated as Guided Missile, Air Defense **M6**. The M6 could be equipped with either an M17 (a.k.a. T45) blast-fragmentation warhead, or a W-31 nuclear fission warhead with yield selectable as 2 kT or 40 kT. The missile performance was such that even very high-flying bombers could not escpe the Nike Hercules. Capability against low-level targets remained rather limited, however.*

MIM-23A Hawk

General Info:
Origin = U.S.A.
Type = Surface to Air missile
Manufacture = Raytheon
IOC = 1960
Guidance = SARH
Sensor Range = 1.25-15nm

Performance:
Range = 15nm
Speed = Mach 2.5
Power Plant = Aerojet M22E8 dual-thrust solid-fueled rocket
Ceiling = 45000ft
Lethal Radius = 40ft

Dimensions:
Length = 16ft 8in
Diameter = 14.5in
Fin Span = 3ft 11in
Weight = 1290lbs

Warhead:
119lbs High explosive blast fragmentation

Description:

The Hawk was the first mobile medium-range guided anti-aircraft missile deployed by the U.S. Army, and was the oldest SAM system still in use by U.S. armed forces in the late 1990s. Development studies for a semi-active radar homing medium-range surface-to-air missile system were begun by the U.S. Army in 1952 under the designation SAM-A-18 Hawk (Homing All the Way Killer). In July 1954, development contracts were awarded to Raytheon for the missile, and to Northrop for launcher, radars, and fire-control system. The first launch of an XSAM-A-18 test missile occurred in June 1956, and the initial development phase was completed in July 1957. By that time, the Hawk had been redesignated as Guided Missile, Aerial Intercept, XM3 (and XM3E1). Initial Operational Capability of the M3 Hawk was achieved with the U.S. Army in August 1959, and in 1960 the M3 was also fielded by U.S. Marine Corps units. The Hawk system was used by many NATO and other countries, and the missile was license-built in Western Europe and Japan. There were two training versions of the original Hawk missile, designated XM16 and XM18.
The M3 Hawk surface-to-air missile is powered by an Aerojet General M22E8 dual-thrust (boost/sustain) solid-propellant rocket motor, and is controlled in flight by its large triangular fins with trailing-edge control surfaces. It is armed with a 54 kg (119 lb) high-explosive blast-fragmentation warhead, which is equipped with both impact and radar proximity fuzes. The missile is guided by an X-band CW (Continuous Wave) monopulse semi-active radar seeker, and has an effective engagement range of 2-25 km (1.25-15 miles). A Hawk unit uses several different ground radars and control systems. The radar systems include the AN/MPQ-35 C-band PAR (Pulse Acquisition Radar) for high/medium-altitude threat detection, the AN/MPQ-34 CWAR (Continuous Wave Acquisition Radar) for low-level threat detection, the AN/MPQ-33 (or -39) HPI (High-Power Illuminator) which tracks designated targets and provides target illumination for the missile's seeker, and the AN/MPQ-37 ROR (Range Only Radar) which is a K-band pulse radar to provide ranging data when the other radars are jammed by countermeasures (the ROR reduces jamming vulnerability by transmitting only when designated).

MIM-23B Hawk

General Info:
Origin = U.S.A.
Type = Surface to Air missile
Manufacture = Raytheon
IOC = 1971
Guidance = SARH
Sensor Range = 1.25-15nm

Performance:
Range = 25nm
Speed = Mach 2.5
Power Plant = Aerojet M112 dual-thrust solid-fueled rocket
Ceiling = 58000ft
Lethal Radius = 40ft

Dimensions:
Length = 16ft 6in
Diameter = 14.5in
Fin Span = 3ft 11in
Weight = 1400lbs

Warhead:
163lbs High explosive blast fragmentation

Description:

To counter advanced low-altitude threats, the Army began a Hawk Improvement Program (HAWK/HIP) in 1964. This involved numerous upgrades to the Hawk system, including the addition of a digital data processing central information coordinator for target processing, threat ordering, and intercept evaluation. The AN/MPQ-35 PAR, AN/MPQ-34 CWAR, AN/MPQ-33/39 HPI, and AN/MPQ-37 ROR were replaced by upgraded variants designated AN/MPQ-50, AN/MPQ-48, AN/MPQ-46, and AN/MPQ-51, respectively. The Hawk missile itself was upgraded to MIM-23B I-HAWK (Improved Hawk) configuration. The MIM-23B had a larger 74 kg (163 lb) blast-fragmentation warhead, a smaller and improved guidance package, and a new M112 rocket motor. The I-HAWK system was declared operational in 1971, and by 1978 all U.S. Hawk units had converted to the new standard. The effective range envelope of the MIM-23B is extended to 1.5-40 km (5000 ft - 25 miles) at high altitude (2.5-20 km (8200 ft - 12.4 miles) at low altitude), and minimum engagement altitude is 60 m (200 ft). There is also a training version of the I-HAWK designated MTM-23B. The XMEM-23B is a variant with a full telemetry equipment for test and evaluation purposes.
Beginning in 1977, the U.S. Army started an extensive multi-phase Hawk PIP (Product Improvement Plan), mainly intended to improve and upgrade the ground equipment. PIP Phase I involved replacement of the CWAR with the AN/MPQ-55 Improved CWAR (ICWAR), and the upgrade of the AN/MPQ-50 PAR to Improved PAR (IPAR) configuration by the addition of a digital MTI (Moving Target Indicator). The first PIP Phase I systems were fielded in 1979. PIP Phase II, developed from 1978 and fielded between 1983 and 1986, upgraded the AN/MPQ-46 HPI to AN/MPQ-57 standard by replacing some tube electronics with modern solid-state circuits, and added a TAS (Tracking Adjunct System). The TAS, designated OD-179/TVY, is an electro-optical (TV) tracking system to increase Hawk operability and survivability in a high-ECM environment. The PIP Phase III development was started in 1983, and was first fielded by U.S. forces in 1989. Phase III is a major upgrade which significantly enhanced computer hard- and software for most components (new CWAR is designated AN/MPQ-62), added single-scan target detection capability, and upgraded the HPI to AN/MPQ-61 standard by addition of a Low-Altitude Simultaneous Hawk Engagement (LASHE) system. LASHE allows the Hawk system to counter saturation attacks by simultaneously intercepting multiple low-level targets. The ROR is no longer used by Phase III Hawk units.

MIM-104 Patriot

General Info:
Origin = U.S.A.
Type = Transportable SAM
Manufacture = Raytheon, Lockheed Martin, Siemens
IOC = 1985
Guidance = Command guidance and semi-active homing, track-via-missile (TVM)

PAC 1
Patriot Advanced Capability-1

Performance:
Power Plant = Single-sage solid propellant rocket motor
Range = 38nm
Speed = Mach 3 max

Dimensions:
Length = 17.4ft
Diameter = 16.1in
Weight = 2011lbs
Fins = four delta shaped fins

Warhead:
198lbs HE

PAC 2
Patriot Advanced Capability-2

Performance:
Power Plant = Single-sage solid propellant rocket motor
Range = 38nm (max. 86nm, min. 1.6nm)
Speed = Mach 5
Ceiling = 78000ft

Dimensions:
Length = 17ft
Wingspan = 36.2in
Diameter = 16.1in
Weight = 1980lbs
Fins = four delta shaped fins

Warhead:
200lbs HE blast/fragmentation with proximity fuze

Description:

Patriot can be transported worldwide via C5 cargo plane. Built in diagnostic software; the computer tells you what's wrong with the system, making maintenance and repair much easier. Patriot battalions can interface with Hawk battalions and with the Air Force AWACS.
Major Components
1. Phased array radar. It's beam is electronically aimed at a different piece of the sky every few microseconds. No moving parts. Extremely difficult to jam.
2. Engagement Control Station (ECS). Where the computer and the operators fight the air battle. Man-machine interaction options here can range from letting the computer assist in target identification and prioritization to leaving the ECS and letting the computer fight the entire air battle itself.
3. 6 to 8 missile launchers. Missiles come factory packed in containers which are loaded directly onto the launcher. The Launcher can be located up to 1 kilometer away from the ECS/Radar, receiving commands automatically via microwave data link.
4. Patriot missile. Achieves supersonic speed within 20 ft of leaving the launcher. Range: 100+ km. It can outmaneuver any manned aircraft and most missiles. It is controlled in flight automatically by the computer.
Patriot-unique equipment at the Headquarters and Headquarters Battery (HHB) includes the information and coordination central (ICC), communications relay groups (CRGs), antenna mast groups (AMGs), trailer mounted electric power units (EPUs), and guided missile transporters (GMT). The Patriot firing battery equipment includes the AMG, radar set (RS), engagement control station (ECS), truck mounted electric power plant (EPP), and up to sixteen launching stations (LSs). Both the battalion and firing batteries are equipped with a semitrailer maintenance center.
(1) The ICC is manned during air battle operations and provides necessary command and control links to interface with higher echelon, lateral and subordinate battalions, and its own firing units.
(2) The ECS is the only manned station in the battery during the air battle and is the operations control center of the Patriot battery. The ECS contains the weapons control computer (WCC), man/machine interface and various data and communication terminals. Its prime mover is a 5-ton tactical cargo truck.
3) The RS is a multifunction, phased-array radar mounted on an M860 semitrailer. The prime mover is an M983 10-ton heavy expanded mobility tactical truck (HEMTT) tractor.
(4) The LS is a remotely operated, fully self-contained unit, carrying integral on-board power. The launcher is mounted on an M860 semitrailer towed by a M983 HEMTT 10-ton tractor. Each LS may be loaded with four PAC-2 missile rounds (MRs), or 16 PAC-3 missile rounds if the LS is PAC-3 modified. The MR consists of a Patriot missile mounted within a sealed aluminium canister that functions both as a shipping and storage container and as a launch tube. Canisters are either single or 4-packs and are mounted two by two on the launcher.
(5) The CRG provides a multi-routed, secure, two-way data relay capability between the ICC and its assigned fire units and adjacent units. The CRG also provides the capability for both data and voice exit and entry point communications with elements external to the Patriot ADA battalion.
(6) The AMG consists of four ultra high frequency (UHF) antennas used for communications between the ICC, CRG, ECS and adjacent units and or higher echelons. The AMG can be remotely controlled in azimuth from within the ECS.
(7) The EPP consists of two 150-kw generator sets, a power distribution unit (PDU), cables, and accessories mounted on a modified HEMTT. The PDU is stored between the generators and contains a parallel powerbus and power contractors to supply prime power to the ECS and RS.

Testing of Patriot's response to a unique, advanced electronic countermeasure (ECM) technique exposed an air defense system weakness and recommended corrective measurees. Over 155 Patriot surveillance investigations and 6 missile firings were completed in extensive ECM environments consisting of stand-off jamming, selfscreening jamming, and chaff.

In February 1995, the U.S. Army took delivery of the first PATRIOT Advanced Capability-2 (PAC-2) Guidance Enhanced Missile (GEM). The GEM incorporates improvements to the front end of the PAC-2 missile receiver to enhance its effectiveness and lethality against SCUD-class ballistic missiles. The U.S. Army will field about 350 PAC-2 GEM missiles.

MIM-115 Roland SAM

General Info:
Origin = Germany, France
Type = short-range surface-to-air missile
Manufacture = Aérospatiale, MBB
IOC = 1970
Guidance = semi-automatic line-of-sight radio command

Performance:
Power Plant = dual-thrust (boost/sustain) solid-fueled
Range = 8km
Speed = Mach 1.6
Ceiling = 18000ft

Dimensions:
Length = 7ft 10.5in
Wingspan = 20in
Diameter = 6.3in
Weight = 148lbs

Warhead:
14.3lbs pre-fragmented
Fuse = Contact and proximity

Description:

The Roland is a French/German mobile short-range surface-to-air missile system. The U.S. Army developed and evaluated an American version of the system, but in the end did not adopt it for large-scale operational service.

The development of the Roland began in 1964 as a joint project of Aérospatiale (France) and MBB (Germany), who later founded the Euromissile company for this and other missile programs. The first guided launch of a Roland prototype succeeded in June 1968. Although it had been orginally planned to field Roland by 1970, the test and evaluation phase of the system turned out to be much longer, especially for the all-weather variant. The clear-weather Roland I finally entered operational service with the French Army in 1977, while the all-weather Roland II was first fielded by the German Army in 1978.

The Roland is a very compact mobile short-range air-defense system, which combines all components on one dedicated vehicle. The missile is fired from tube-launchers and has a dual-thrust (boost/sustain) solid-fueled rocket motor. Immediately after the missile has left the tube, the four cruciform wings and small canards are extended. The wings and fins are fixed, and the Roland is steered in flight by jet vanes. A semi-automatic line-of-sight radio command guidance system directs the missile to its target, where the 6.5 kg (14.3 lb) pre-fragmented warhead is detonated by a combined proximity/impact fuze.

Originally there were two basic versions of the Roland system. In both versions, incoming targets are detected by a pulse-doppler surveillance radar at a range of 16 km (10 miles), and as soon as the target is determined to be a threat, the vehicle stops and the launch turret is turned in the target's direction. In the clear-weather Roland I, an operator now finds and tracks the target in an optical sight, and fires a missile as soon as the target is within the range of 8000 m (8750 yds) (minimum range is about 500 m (550 yds)). He then has to keep the sight pointed at the target, and the Roland system, which tracks the missile's tail-mounted flares with an infrared sensor, can send appropriate radio commands to keep the missile on the line of sight until warhead detonation. In the all-weather Roland II, no operator is needed to keep target direction data up-to-date, because this information is obtained from a special tracking radar. The system then steers the missile along the tracking radar's beam until impact. The Roland system can intercept targets at altitudes between 20 m (65 ft) and 5500 m (18000 ft).

The U.S. Army's Roland program began in 1974, when the Army issued a request for proposals for a new all-weather short-range air-defense system. The Roland II was eventually selected, and in January 1975, Hughes was awarded a development contract for an American version of the system, sometimes called US Roland. The missile was to be license-built by Boeing and Hughes and was designated XMIM-115A. Adapting the system to American standards took some time, and included the development of a new target tracking radar with longer range and better jamming resistance. The Army originally mounted the US Roland system on an M109 tracked chassis, but later adopted a modified M812A1 5-ton truck as the Roland vehicle. However, the European and U.S. Roland systems were kept compatible, so that U.S. missiles could be fired from European launch units and vice versa. The first launch of a U.S.-built XMIM-115A occurred in February 1978.

In 1979, low-rate initial production of the XMIM-115A was approved, so that operational evaluation could begin. However, in 1981 it was decided to terminate the US Roland program and limit procurement to a single Army National Guard battalion only. American production ended in 1985 after about 600 missiles had been built. The US Roland was never declared fully operational (and therefore the missile retained its "X" prefix), and the only battalion eventually deactivated all its Roland assets in September 1988.

The Roland was much more successful with European and other international customers, though. In the mid-1980s, an improved Roland III system was developed, which included an uprated missile with range, speed and warhead improvements a well as improved launchers and tracking systems. Roland is still in service with several countries, and more than 25000 missile rounds have been built.

Skyguard Aspide SAM

General Info:
Origin = Italy
Type = BVR Missile
Manufacture = Selenia
IOC = 1987
Guidance = Selenia monopulse semi-active radar homing
Intercept = Lead pursuit

Performance:
Power Plant = SNIA-Viscosa solid-propellant rocket motor
Range = 40nm
Speed = Mach 4
Ceiling = 24000ft
Single-shot hit probability (SSKP) = 80%

Dimensions:
Length = 12ft 1.67in
Diameter = 8in
Fin Span = 3ft 3.4in
Weight = 485lbs

Warhead:
72.75lbs blast/fragmentation
Fuse = doppler proximity- and direct action-fuzed

Description:

The Italian Aspide, basically a licensed version of the American Sparrow, is similarly employed as both an air-to-air and surface-to-air missile, and in the later role it is launched from both ships and ground platforms. The AIM-7E Sparrow entered service in 1962 and was widely used as a standard for other variants such as the Sky Flash (UK) and Aspide (Italy). Alenia Difesa offers a complete range of systems, including the air to air and surface to air systems based on Aspide missile (Spada, Skyguard, Albatros, ARAMIS).

The Chinese PL-11 medium-range AAM is based on the Aspide, which was acquired by China in the late 1980s for use in the air-to-air roles, and as with the American and Italian version, subsequently in the LY-60 system modified for both ground and naval air defence applications. In reaction to the Tiananmen Square massacre, the European Council--an EU decision-making body comprised of ministers from EU member countries--imposed several sanctions in June 1989, including "an embargo on trade in arms with China." The deliveries of Italian Aspide air-to-air missiles appear to have been made in connection with pre-embargo agreements. Although a contract for the Aspide system has been signed with Italian firm Alinea, the government in Rome had not given its permission to export the missiles to Cyprus, fearing the deployment would only fuel existing tensions.

Through Alenia Difesa, Finmeccanica offers a complete range of systems, including the surface to air systems based on the Aspide missile (Spada, Skyguard, Albatros, ARAMIS);

MM.38 Exocet

General Info:
Origin = France, U.K.
Type = Surface to Surface sea skimming anti-shipping missile
Manufacture = Aerospatiale, British Aerospace
IOC = 1975
Guidance = Midcourse INS, Terminal active radar
Intercept = Lead pursuit

Performance:
Range = 23nm
Speed = Mach 0.93

Dimensions:
Length = 205.1in
Diameter = 13.8in
Fin Span = 39.5in
Weight = 1477lbs

Warhead:
366lb Serat hexolite/steel block AP warhead
Fuse = Contact and proximity

Description:

The MM.38 Exocet is the Surface to surface version of the AM.39 air-launched Exocet brought to prominence in the Falklands conflict, where the air launched missiles caused significant damage to the UK taskforce. The missile is fired from deck mounted box-type launchers, and provides an all weather stand off anti-ship capability.
The missile is launched with approximate range and target bearing, and flys a sea-skimming trajectory to the target area, then switches on its active radar seeker, and autonomously locks onto its target, and dives towards its target.

MM.40 Exocet

General Info:
Origin = France, U.K.
Type = Sea to Surface, sea skimming
anti-shipping missile
Manufacture = Aerospatiale, British Aerospace
IOC = 1975
Guidance = "fire and forget": inertial navigation during
cruise phase active homing during terminal phase
Intercept = Lead pursuit

Performance:
Power Plant = 2 solid-propellant rockets (booster and sustainer)
Range = 40nm
Speed = Mach 0.9

Dimensions:
Length = 228in
Diameter = 13.8in
Fin Span = 44.5in
Weight = 1818lbs

Warhead:
341.7lbs HE
Fuse = Contact and proximity

Description:

Operational requirement
Engagement of high value naval targets at stand-off distance with a stealthy, easy to use " fire and forget " weapon with sea skimming flight.

The MBDA solution
The MM40 is the ship-launched long-range version of the EXOCET family of anti-ship missiles, with the same general characteristics and the same reliability.
The MM40 possesses the following characteristics:
a great enemy defence penetration capability and the fact that several missiles can be fired in a salvo while others are kept in reserve (due to the small-diameter cylindrical launcher-container).
An over-the-horizon capability, used if necessary, in conjunction with a discreet target indicating airborne relay, usually an helicopter with the system retaining its "fire and forget" characteristics throughout.
The range longer than 70 km is optimal for a high-subsonic, fire-and-forget missile.

Many possible combinations for MM40 launchers exist because of the munition's compactness. This makes them easily adaptable to all kinds of vessels, ensuring a maximum number of munitions is carried.
The advanced-technology firing unit is known by the French acronym ITL (Installation de Tir Légère).
Remarkably compact, it offers extensive possibilities. The ITL can be used to fire all of the ship-launched EXOCET (MM38, MM40 Block 1, MM40 Block 2).

Rapier

General Info:
Origin = U.K.
Type = Mobile surface to air Missile
Manufacture = BAE Matra Dynamics
IOC = 1967
Guidance (active) = active command to radar line of sight
Guidance (passive) = command to infra-red line of sight
Radar type = monopulse radar
Sensor Maximum detection range = 16km

Performance:
Power Plant = two stage enhanced solid-propellant rocket motor
Range = 4.3nm
Speed = Mach 2.5
Single shot kill probability = >90%

Dimensions:
Length = 88.2in
Diameter = 5.25in
Wing Span = 15.0in
Weight = 94.8lbs

Warhead:
9.9lbs fragmentation high explosive
Fuse = multi-mode laser proximity

Description:

The Rapier B1X air defence system introduces digital technology to the established and proven Rapier B1 capability. This gives the user greatly improved system performance plus increased reliability, availability and maintainability.
The benefits of digital technology, together with the new Rapier missile and Rapier B1's proven capability in the harshest battlefield conditions means that Rapier B1X provides the air defence commander with a cost-effective, high performance, low level air defence capability.
Rapier B1X is in service world-wide.

The Rapier B1X systems is available to:
Current Rapier users who wish to extend the capability of the Rapier B1 equipment as an upgrade
New customers who need the capability of a high performance low-level air defence system at minimal cost for procurement.
High ECM resistance through digital processing
Multi-target tracking leads to improved airspace management
Improved man-machine interface reduces crew workload, increases effectiveness and speed of deployment
Combination of accuracy and intelligent proximity fusing improves kill probability
Choice of soft skinned or armoured towing vehicles
Fast system reaction achieves rapid attrition of hostile targets
Networking options increase effectiveness and allow the system to work with other air defence equipment such as MSAMs, guns and radar systems.

Mistral 2

General Info:
Origin = France
Type = surface to air Missile (manpad)
Manufacture = BAE Matra Dynamics
IOC = 1989
Guidance = Passive IR homing guidance by highly sensitive cooled multicell seeker

Performance:
Power Plant = solid rocket booster with short combustion time
Range = 3.5nm
Speed = >Mach 2.7
Ceiling = 9800ft
Single shot kill probability = 93%

Dimensions:
Length = 6.1ft
Diameter = 35.4in
Weight = 41.1lbs

Warhead:
6.6lbs fragmentation high explosive
Fuse = laser proximity or impact triggered

Description:

The Mistral lightweight missile was developed to satisfy the requirements for ground-based and naval short-range air-defence as well as to provide helicopters with an air-to-air combat capability.
Mistral has a 93% proven success rate and higher reliability than any other existing low level air defence missile.
***MISTRAL 2** is a short range, Fire and Forget surface-to-air missile, which can be fired by various launching systems. It is fully autonomous after firing.*

***MISTRAL 2** is capable of engaging aerial targets with a low infrared signature, be they helicopters, UAVs or supersonic aircraft. The missile's maximum speed is Mach 2.5 and its maximum interception range is 6 000 metres.*
The key missions of MISTRAL systems are:

- *defence of sensitive points (air bases, ground forces, control centres, logistic depots, etc.),*
- *defence of surface ships (aircraft carriers, destroyers, logistic vessels, fast patrol boats, etc.),*
- *defence of areas (territorial defence, corridor penetration, deployment of military units)*
- *air-to-air engagement of helicopters*

FIM-92 Stinger

General Info:
Origin = U.S.A.
Type = surface to air Missile (manpad)
Manufacture = Raytheon, General Dynamics
IOC = 1981
Guidance = All aspect infra-red/UV

Performance:
Power Plant = Atlantic Research MK 27 dual-thrust solid-fueled rocket motor
Range = 4.3nm
Speed = Mach 2.2
Ceiling = 12500ft

Dimensions:
Length = 5ft
Diameter = 2.75in
Wingspan = 3.6in
Weight = 22.3lbs
Weight (complete system) = 34.7lbs

Warhead:
6.6lbs fragmentation high explosive
Fuse = proximity

Description:

*The **FIM-92** Stinger replaced the FIM-43 Redeye as the standard Western MANPADS (Man-Portable Air-Defense System), and is now very widely used in many countries of the world.*
*Development of the Stinger began in 1967 as a study for an improved FIM-43 Redeye, named Redeye II. The main improvement was to give the missile an all-aspect seeker capability. In 1971, the U.S. Army selected Redeye II for development as the future MANPADS, and assigned the designation **FIM-92**. In March 1972, the Redeye II was renamed as Stinger. Testing of guided **XFIM-92A** rounds began in November 1973, but was halted and restarted several times because of technical problems. By 1975, the most severe problems had been solved, and in July that year, the first shoulder launch of an XFIM-92A occurred. Finally, in April 1978, General Dynamics was awarded the first contract for mass production of the **FIM-92A** missile. Production Stinger missiles then replaced the old FIM-43 Redeye rounds on a one-to-one basis. IOC (Initial Operational Capability) was reached by the first Stinger units in 1981.*
The FIM-92A is fired by one man through a shoulder launcher. Once a target is located and identified as a threat, the operator has to activate the missile. This process takes about 6 seconds, and includes IR seeker cooling, gyro spin-up, and activation of the electronics. When the detector logic has locked on an IR source, a buzzer signal is sent to the operator, who may then pull the trigger. 1.7 seconds later, the FIM-92 missile is launched. After the Stinger has been ejected from the launcher by a very short duration boost motor, the forward control fins and fixed tailfins extend. After a short coasting period to take the missile to a safe distance from the operator, the two-stage (boost/sustain) solid-fueled main motor ignites. The initial boost phase accelerates the Stinger to Mach 2.2 within only 2 seconds, and top-speed at motor burnout can be as high as Mach 2.6 for certain trajactories. If no target is hit after about 17 (± 2) seconds, the missile self-destructs.
The Stinger has two major advantages over the older FIM-43 Redeye. The first is the second-generation cooled conical-scan IR seeker, which offers all-aspect detection and homing capability. Therefore, the Stinger can be used on approaching aircraft, before these had a chance to drop their short-range ordnance or begin ground-strafing. The second new feature of Stinger is its integrated AN/PPX-1 IFF system, which is an obvious advantage in a scenario where both friendly and enemy forces are operating aircraft. In flight, the missile's seeker head and guidance electronics can follow a target manoeuvering at more than 8g. In the immediate vicinity of the target, the guidance logic will be biased so that the missile homes on a particularly vulnerable part of the target (e.g. the cockpit of an aircraft, instead of the center of its IR signature, the jet exhaust). The 3 kg (6.6 lb) blast-fragmentation warhead is triggered by a proximity and time-delayed impact fuze. Minimum effective range is quoted as 200 m (660 ft).
*In 1977, General Dynamics had begun full-scale development of a next-generation Stinger, designated **XFIM-92B**. This missile, also known as Stinger-POST (Passive Optical Seeker Technique), has a new microprocessor-controlled two-band (IR/UV) seeker head. The POST seeker uses rosette-pattern image scanning techniques, which, together with new UV option, allows it to distinguish more efficiently between the real target and IR decoys or background clutter. The **FIM-92B** was placed in limited production in 1983, alongside the continuing production of the FIM-92A Basic Stinger. FIM-92A/B production finally ended in 1987 after more than 16000 rounds.*
*In 1984, development of the **FIM-92C** Stinger-RMP (Reprogrammable Microprocessor) began. The RMP upgrade allows reprogramming the on-board microprocessors' software to counter the latest threats. Stinger production switched to the FIM-92C in September 1987, and the first production Stinger-RMP missiles were delivered to operational U.S. Army units in July 1989. The designation **FIM-92D** applies to upgraded FIM-92Cs with improved countermeasures. In September 2002, the designation **FIM-92G** was allocated to an upgraded FIM-92D, but I have no details on the upgrade.*
*In April 1992, a contract was awarded to General Dynamics for the development of the **FIM-92E**, known as Stinger-RMP Block I. Later that year, GD's missile division was sold to Hughes, which therefore became prime contractor for the Stinger system. The FIM-92E is an improved FIM-92D, and adds a new roll sensor and improved software, which significantly enhances the missile's performance against low-signature targets and the latest countermeasures. The first production FIM-92E missiles were delivered in 1995. Many existing FIM-92 missiles will probably be upgraded to FIM-92E standard. The designation **FIM-92F** was allocated in 2001 to an upgraded FIM-92E, but I don't yet know specific details about the improvements. The designation **FIM-92H** refers to FIM-92D missiles, which have been upgraded to RMP Block I standard.*

RIM-7

General Info:
Origin = U.S.A.
Type = BVR Missile
Manufacture = Raytheon
IOC = 1958
Guidance = SARH
Sensor Type = Passive radar seeker
Field of View = 7.8º
Gimbal Limit = 60º
Intercept = Lead pursuit

Performance:
Range = 30nm
Speed = Mach 4
Max Target g = 7
Lethal Radius = 75ft

Dimensions:
Length = 12ft
Diameter = 8in
Fin Span = 40in
Weight = 510lbs

Warhead:
86lbs HE Fragmentation
Fuse = Contact and proximity

Description:

Originally developed in the 1950s as the harbinger of a new era in air-to-air combat in which fighter aircraft would use radar and missiles to destroy targets without ever getting close enough to see them, the AIM-7 Sparrow's performance in real combat was disappointing at best. The failure of Beyond Visual Range (BVR) combat in the Vietnam War sent both U.S. Air Force and Navy fliers back to the drawing boards in search of better tactics and better training. Even as late as 1989, the missile's performance has been underwhelming; out of eight missiles fired in various engagements during the 1980s, only two hit their targets. Modern versions of the missile share little more than the name and air frame with its Vietnam-era brethren, and performed somewhat better during Operation Desert Storm. Out of 88 Sparrow missiles fired in the Gulf War, 23 destroyed their targets, representing 70% of Coalition aerial victories. The reasons for the improved performance are thought to be better U.S. pilot training, new solid-state electronics and the abysmal performance of Iraqi pilots (the Sparrow has always done well against non-manoeuvring targets).

RIM-7 NATO Sea Sparrow
The RIM-7 is the naval variant of the AIM-7 Sparrow. It is used by many US and NATO ships as surface-to-air missile. There are various variants of the Sea Sparrow to accommodate for different launcher systems.

RIM-66A (SM-1MR)

General Info:
Type = medium and long range air defense missile
Origin = U.S.A.
Manufacture = Raytheon
IOC = 1967
Guidance = conscan radar seeker

Performance:
Power Plant = Aerojet MK 27 dual-thrust rocket moter
Ceiling = 65000ft
Range = 17nm
Speed = Mach 3.5

Dimensions:
Length = 176in
Diameter = 13.4in
Fin Span = 42.1in
Weight = 1091lbs

Warheads:
137lbs MK 51 continuous-rod warhead

Description:

The Standard missile program was initiated in 1963 to provide a replacement for the RIM-2 Terrier and RIM-24 Tartar missile systems. The Tartar replacement was designated RIM-66 Standard MR (Medium Range), while the longer-range Terrier replacement became the RIM-67 Standard ER (Extended Range). The Standard is still the U.S. Navy's main medium and long range air defense missile.
The Standard MR and ER both use the same basic missiles, to which a booster stage is added in the ER version. The basic missile is externally very similar to the later Terrier and Tartar models. The original Standard missiles are also generally known as SM-1 (Standard Missile 1). The main improvements of the Standard over the earlier missile are solid-state electronics and all-electric internal power (e.g. electrically instead of hydraulically operated control surfaces), which greatly improves missile realiability and significantly shortens reaction time. Standard also had a new MK 1 autopilot, which could adapt to changes in the missiles dynamic parameters (e.g. velocity and atmospheric pressure).
The YRIM-66A began flight tests in 1965, and the RIM-66A SM-1MR Block I entered service in 1967. It had the same MK 27 dual-thrust rocket moter as the RIM-24 Tartar, a 62 kg (137 lb) MK 51 continuous-rod warhead, and a conscan radar seeker. Slight improvements for the RIM-66A resulted in the Block II, Block III, and Block IV. Block IV was the main production variant of the RIM-66A, and featured ECCM improvements, reduced minimum range, and a shortened acquisition time for surface targets. It entered service in 1968, and many earlier Block III missiles were later converted to this standard.
The SM-1MR Block V was designated RIM-66B, because it introduced more significant changes. It had a new plane-scanning seeker, a faster-reacting autopilot, a new MK 90 blast-fragmentation warhead, and a new Aerojet MK 56 dual-thrust rocket motor. The latter increased missile length by 25 cm (10 in), and increased range and ceiling by about 45 percent and 25 percent, respectively.
The final SM-1MR version was the Block VI, designated RIM-66E (RIM-66C/D versions are SM-2, see below). The RIM-66E featured the monopulse seeker of the SM-2, and a new MK 45 MOD 4 proximity fuze (also known as TDD - Target Detection Device). Production began in 1980, and the RIM-66E entered service in 1983. It is still in production for export customers. The subvariants of Block VI include RIM-66E-1/3/7/8 (-3/8 have the MK 115 warhead of SM-2). Block VI A (RIM-66E-5) and Block VI B (RIM-66E-6) had later MODs (6 and 7, respectively) of the MK 45 fuze for improved performance against low-RCS targets, and both use the MK 115 warhead.

RIM-66C (SM-2MR)

General Info:
Type = medium and long range air defense missile
Origin = U.S.A.
Manufacture = Raytheon
IOC = 1978
Guidance = semi-active radar homing

Performance:
Power Plant = Aerojet MK 27 dual-thrust rocket moter
Ceiling = 80000ft
Range = 40nm
Speed = Mach 3.5

Dimensions:
Length = 176in
Diameter = 13.4in
Fin Span = 42.1in
Weight = 1369lbs

Warheads:
MK 115 blast-fragmentation

Description:

SM-2 (Standard Missile 2) was developed as the missile component of the U.S. Navy's Aegis fleet air defense system. The SM-2 missile uses semi-active radar homing only in the terminal intercept phase, and has a new inertial guidance unit and a new programmable MK 2 autopilot to guide it near the projected point of intercept. On Aegis ships, this autopilot is command-guided to the target by the launching ship, which can track multiple targets with the Aegis' powerful AN/SPY-1 radar (current version is AN/SPY-1D). When used on earlier Tartar ships, SM-2 uses pre-launch settings and its inertial guidance system to find its way to the target. Not needing SAR guidance through all its flight-path, effective intercept range of the SM-2MR is 60 percent greater than for the SM-1MR. The command guidance allows a more energy-efficient flight path, and the illuminator radar (e.g. AN/SPG-62) can provide effective illumination at almost doubled target ranges (because illumination immediately after launch is especially power-demanding, when the radar beam has to travel all the distance from ship to target and back). A further improvement in the SM-2 is the new monopulse seeker for terminal homing, which provides better ECM resistance.
The RIM-66C designation applied to SM-2MR Block I missiles for Aegis ships. It had a MK 115 blast-fragmentation warhead. RIM-66C entered service in 1978 and was produced until 1983. RIM-66D is the SM-2MR missile for Tartar ships.
All Standard missiles had inherent surface-to-surface capability. But there were also versions designed specifically as ship-to-ship weapons. The RGM-66D SSM-ARM (Surface-to-Surface Missile/Anti-Radiation Missile) was a relatively simple development of the RIM-66B SM-1MR Block V, which used an anti-radiation seeker to home on enemy ship radars. The designation RTM-66D was applied to a training version of the RGM-66D. The RGM-66E was a version of the SSM-ARM for use with the ASROC launcher. The RGM-66F was a projected active radar homing anti-ship missile. It was to have a monopulse doppler radar, which was briefly tested in 1973, but the RGM-66F was cancelled in 1975. SM-2MR Block II introduced an improved Thiokol MK 104 rocket motor, to deal with faster and more manoeuverable targets. The effective range is almost doubled, reaching the limits of illuminator power. Block II also has a new high-velocity fragmentation warhead. The RIM-66G is the Aegis version, RIM-66H is for vertical launch on Aegis ships with MK 41 VLS (Vertical Launch System), and RIM-66J is for Tartar ships. SM-2MR Block II entered service in 1983.

Chunma

General Info:
Type = anti aircraft SAM
Origin = South Korea
Manufacture = Doosan Infracore Samsung Techwin
IOC = 1999
Guidance = Command-to-line of sight (CLOS)
Sensor Type = Electro-optical

Performance
Range = 5nm (max. 8nm)
Speed = Mach 2.6
Ceiling = 10000ft
Max G = 30

Dimensions:
Length = 228.4in
Diameter = 13.2in
Wing span = 49in
Weight = 190lbs

Warheads:
26.5lbs HE fragmentation
Fuse = active laser

Description:

The Chunma (Pegasus), also known as K-SAM, is a short range air defense system designed to engage air threats flying at low altitudes. It is suitable for protection of industrial facilities, infrastructures, mobile military units, ports and airports.

The Chunma combines the proven Crotale NG search and track sensor and missile systems with a tracked armored chassis. The Republic of Korea launched the K-SAM program in 1989.

In 1999, the Korean Army ordered a first batch of 48 systems worth 330 million to be delivered between 1999 and 2005. In December 2003, a second batch worth 470 million consisting of 66 K-SAMs was ordered with deliveries slated to begin in 2003 and follow-on through 2009.

The South Korea Army is the sole operator of Chunma air defense system and the SAM system has been offered to international customers.

STORES

132 Imp Gal Tank

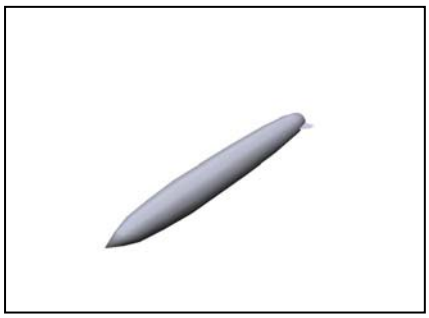
General Info:
Type = Fuel Tank

180 Imp Gal Tank

General Info:
Type = Fuel Tank

253 Imp Gal Tank

General Info:
Type = Fuel Tank
Origin = U.S.A.

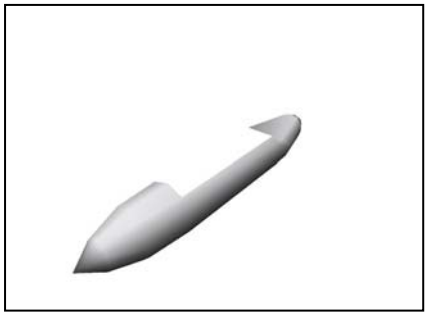


264 Imp Gal Tank

General Info:
Type = Fuel Tank

268 Imp Gal Tank

General Info:
Type = Fuel Tank
Origin = U.S.A.
Mounting = Centerline

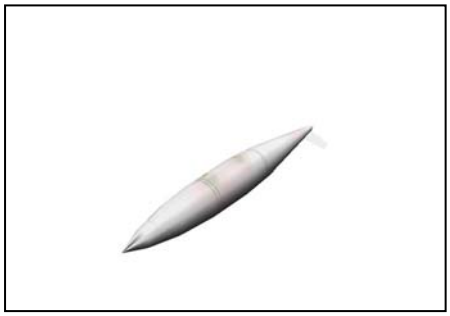


275 Imp Gal Tank

General Info:
Type = Fuel Tank
Origin = U.S.A.
Mounting = Wing and Centerline
Major Diameter = 24in

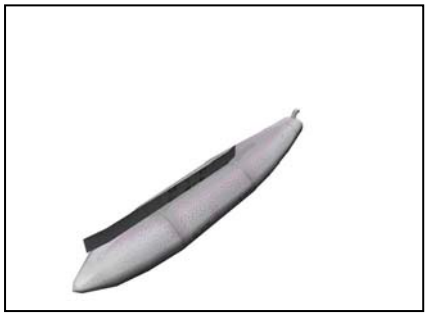
300 Imp Gal Tank AV-8/A-6, A7, A-7D, F-4C, F-111

General Info:
Type = Fuel Tank
Origin = U.S.A.
Mounting = Wing
Major Diameter = 26.5in



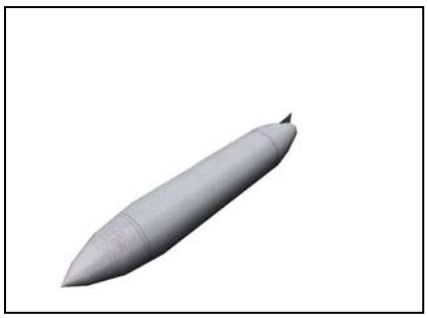
300 Imp Gal Tank F-16

General Info:
Type = Fuel Tank
Origin = U.S.A.
Mounting = Centerline



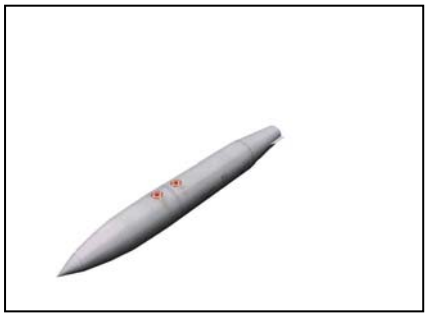
330 Imp Gal Tank F/A-18

General Info:
Type = Fuel Tank
Origin = U.S.A.
Mounting = Wing and Centerline
Major Diameter = 28.2in



370 Imp Gal Tank F-16, F-111

General Info:
Type = Fuel Tank
Origin = U.S.A.
Mounting = Wing
Major Diameter = 27in

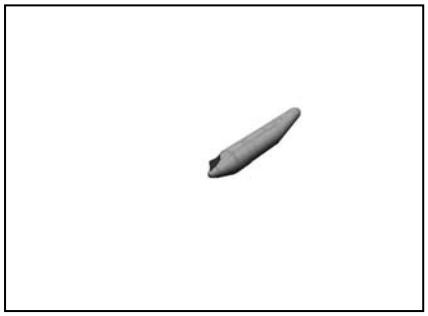


370 Imp Gal Tank F-4

General Info:
Type = Fuel Tank
Origin = U.S.A.
Mounting = Wing
Major Diameter = 26in

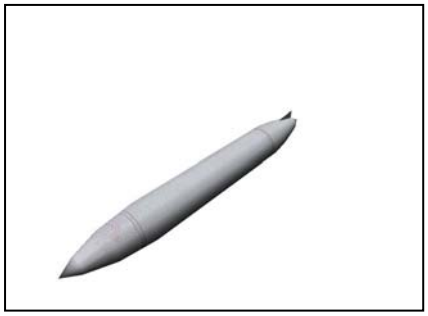
440 Imp Gal Tank F-105

General Info:
Type = Fuel Tank
Origin = U.S.A.



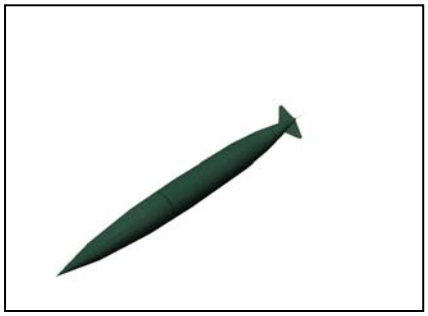
450 Gal USN Tank F-105

General Info:
Type = Fuel Tank
Origin = U.S.A.
Mounting = Wing
Major Diameter = 29in



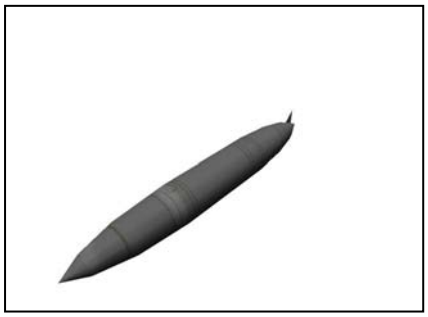
600 Gal Tank A-10

General Info:
Type = Fuel Tank
Origin = U.S.A.
Mounting = Wing and Centerline
Major Diameter = 32.6in



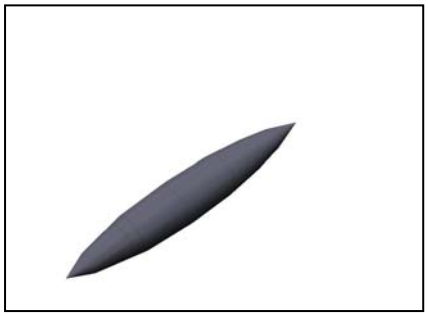
600 Gal Tank F-18

General Info:
Type = Fuel Tank
Origin = U.S.A.
Mounting = Wing and Centerline



600 Gal Tank F-4

General Info:
Type = Fuel Tank
Origin = U.S.A.
Mounting = Wing and Centerline

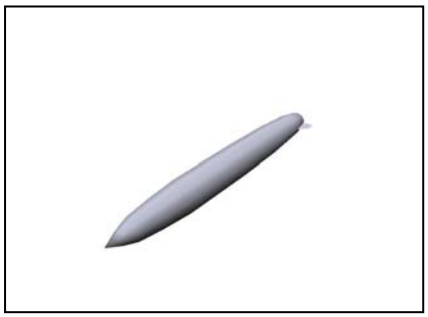


660 Imp Gal Tank

General Info:
Type = Fuel Tank

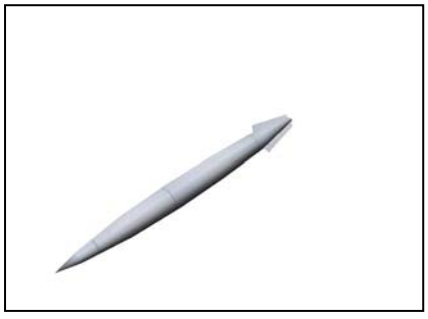
1000litre Tank

General Info:
Type = Fuel Tank
Origin = U.K.



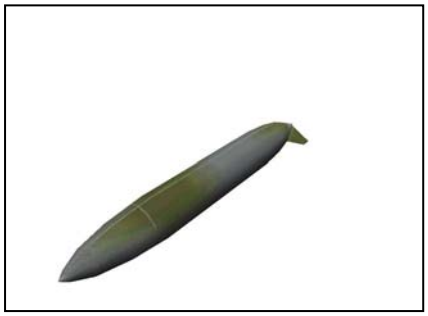
1300litre Tank

General Info:
Type = Fuel Tank



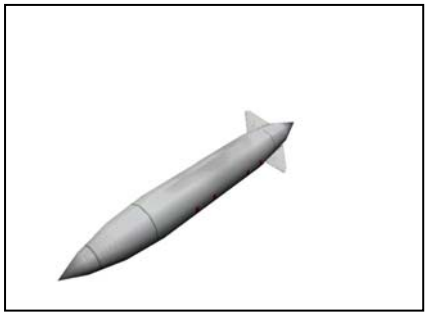
1500litre Tank Phantom

General Info:
Type = Fuel Tank
Origin = U.K.



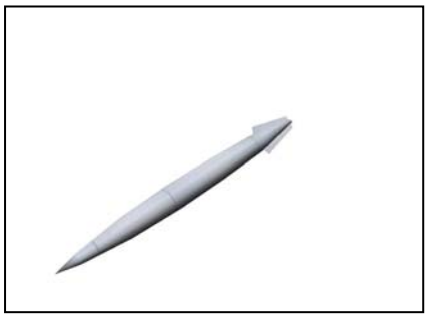
2250litre Tank

General Info:
Type = Fuel Tank



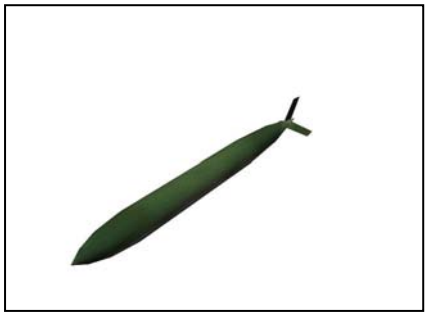
330 Imp Gal Tank Mig-29

General Info:
Type = Fuel Tank
Origin = Russia



330 Imp Gal Tank Mig-29

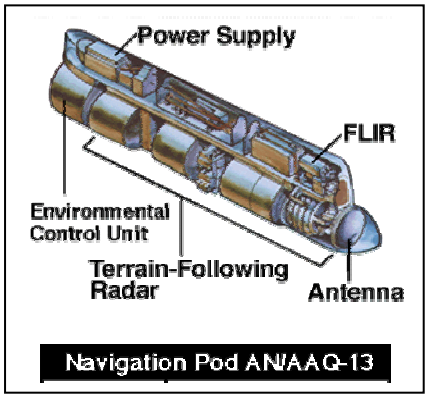
General Info:
Type = Fuel Tank
Origin = Russia



AN/AAQ-13 LANTIRN pod

General Info:
Type = Navigation system
Origin = U.S.A.
Manufacture = Lockheed Martin
IOC = 1987
Sensor Type = IR, TFR and Laser
Sensor Range = 15nm
Field of View = 30º

Dimensions
Length = 6.5ft
Diameter = 15in
Weight = 470lbs



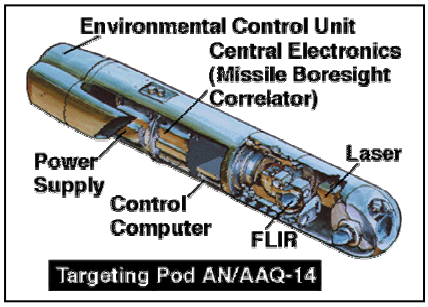
Navigation Pod AN/AAQ-13

Description:

The LANTIRN system consists of two externally mounted pods which provide a Forward-Looking Infrared (FLIR), terrain-following radar and a laser target designator. Targeting data from the system can be handed off to various weapons for attack. Only a few LANTIRN systems are in inventory, used primarily on the F-15E.

AN/AAQ-14

General Info:
Type = Targeting Pod
Origin = U.S.A.
Manufacture = Lockheed Martin
IOC = 1987
Sensor Type = Infrared laser designator and ranging
Sensor Range = 15nm
Field of View = 30º



Targeting Pod AN/AAQ-14

Dimensions
Length = 98.5in
Diameter = 15in
Weight = 524lbs

Description:

The AN/AAQ-14 targeting pod contains a high-resolution, forward-looking infrared sensor (which displays an infrared image of the target to the pilot), a laser designator-rangefinder for precise delivery of laser-guided munitions, a missile boresight correlator for automatic lock-on of AGM-65D imaging infrared Maverick missiles, and software for automatic target tracking. For a Maverick missile, the pod automatically hands the target off to the missile for launch with pilot consent. For a laser-guided bomb, the pilot aims the laser designator, and the bomb guides to the target. For a conventional bomb, the pilot can use the laser to determine range, then the pod feeds the range data to the aircraft's fire control system. The designator is a four-digit PRF-coded laser that can designate for its own weapons or for other acquisition devices or munitions. These features simplify the functions of target detection, recognition and attack and permit pilots of single-seat fighters to attack targets with precision-guided weapons on a single pass.

AN/ALQ-10

General Info:
Type = Advanced Miniature Jamming System
Origin = U.S.A.
Manufacture = Aeronutronic-Ford
Sensor Type = I-Band Deception
Platforms = Danish F-16

AN/ALQ-12 Pave Spike

General Info:
Type = electro-optical laser designator and ranging system
Origin = U.S.A.
Sensor Type = imaging infrared sensors and laser designator
Sensor Range = Stationary- Slant range/visibility dependent.
Platforms = F-4D, F-4E, Hawker Siddley Buccaneer

Description:

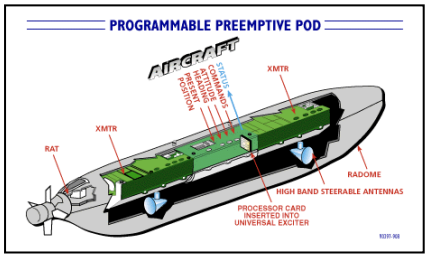
Pave Spike was an electro-optical target acquisition, laser designator, and weapon delivery system for the F-4D (EF-4D) and F-4E aircraft. It provided precision laser designation, ranging, and tracking of ground targets for attack with conventional ordnance or laser-guided weapons. It used a cockpit-selectable four-digit code and is PRF or PIM (pulse interval module) capable.

AN/ALQ-88

General Info:
Type = ECM Jammer
Origin = U.S.A.

AN/ALQ-99

General Info:
Type = Tactical Jamming System
Origin = U.S.A.
Manufacture = Raytheon
IOC = 1970s
Sensor Type = VHF/UHF
Sensor Range = 200km
Power Output = 2.5KW
Platforms = EA-6B Prowler, A/F-18G, EF-111



Description:

The AN/ALQ-99 Tactical Jamming System is the first fully integrated computer controlled support jamming system. The AN/ALQ-99 intercepts and automatically processes radar signals and power manages the system's transmitters to effectively jam large numbers of diverse radar threats with very high effective radiated power (ERP). Since the deployment in the early 1970's aboard US Marine Corps and US Navy carrier-based EA-6B Prowler aircraft, the system has undergone multiple upgrades. The EA-6B/ALQ-99 combination has become an indispensable fleet asset, fully integrated into all air wing combat missions.

The AN/ALQ-99 Tactical Jamming System (TJS) onboard system includes the receiver, processor, and aircrew interfaces. The TJS also includes a selection of mission-configured jammer pods carried as external stores. Each jammer pod contains a ram air turbine generator, two selectable transmitter modules with associated antennas, and a universal exciter which is interfaced with and controlled by the onboard system and aircrew. The modular open architecture of the jammer system, which facilitates optimizing transmitters and antennas for a given frequency range, also facilitates tailored mission configurations.

The AN/ALQ-99(V) Receiver Processor Group (RPG) system was developed for use in the severe interference environment of the EA-6B jamming aircraft. The RPG had completed Operational Assessment and obtained a recommendation for production before program cancellation in 1993. Six RPG EDM systems were delivered. The AN/ALQ-99 RPG provided precision direction finding, passive ranging, identification, and threat warning, and was intended for the Navy EA-6B ADVCAP aircraft in very dense environments and in the presence of onboard jamming. This system included look-through, look-above, and look-around techniques to control the interference, as well as processing algorithms to contend with the resulting fragmented pulse data. The RPG performed surveillance, radar warning, and countermeasures management in support of standoff and escort jamming missions. The system uses four quadrants of AZ/EL interferometer arrays for full azimuth coverage precision monopulse DF measurement. The receiver is a narrowband channelizer cued receiver architecture with a wide instantaneous bandwidth and multiple cued narrowband channels for simultaneous pulse measurement capability. The RPG performed real time lookthrough control of the ALQ-99 jammers to accomplish all required threat emitter detection and measurement functions without degrading jammer effectiveness. To achieve this, data processing algorithms were developed with lookthrough samples providing as little as 1% of an emitter's pulses.

AN/ALQ-119 Compass Tie

General Info:
Type = Jamming pod
Origin = U.S.A.
IOC = Late 1970s
Manufacture = Westinghouse
Length = 115in
Platforms = F-16, A-10, F-4

Description:

The Westinghouse AN/ALQ-119 jammer pod is currently carried on the F-16 and A-10, and previously carried on the F-4 prior to that aircraft's retirement. During the Vietnam War the ALQ-119 was carried on the F-4, typically frequently mounted on the inboard station, though subsequently it was frequently mounted on the Left Forward Aim-7 missile station. This noise/deception jammer covered three frequency bands. Current AN/ALQ-119 maintenance activities include programming of new threats and techniques to the system, system performance laboratory testing, threat and weapon systems analysis and technique development, and field support for various range testing of the system.

AN/ALQ-131 ECM pod

General Info:
Type = Self Protection Radar jamming pod
Origin = U.S.A.
Manufacture = Westinghouse
IOC = 1976
Sensor Type = five frequency bands
Platforms = F-16, F-111, A-10, F-4, F-15, F-5 and C-130

Dimensions
Length = 10ft
Diameter = 20in
Weight = 659lbs
Drag = 16

Description:

The AN/ALQ-131 Electronic Countermeasures Pod provides electronic countermeasures protection for USAF, ANG, AFRES, and FMS country aircraft. The AN/ALQ-131 is certified on the F-16, F-111, A-10, F-4, F-15, F-5 and C-130 aircraft. The ALQ-131 ECM Pod is modular in design containing various electronic receivers, antennas, and powerful transmitters designed to alter the flight path of an incoming enemy missile. This modular pod-mounted system can be configured to cope with a range of threats, spread over one to five frequency bands, by selecting individual modules for inclusion in the pod, the userthe pod to handle threats. Both noise and deception-jamming modes are available, and he pod can be reprogrammed to match the expected threat. The pod is controlled from the cockpit by both automatic and manual means. The cockpit control indicator is used to turn the system on, enable threat response actions, and display system status. ECM pods are pre-programmed on the ground for specific threats that may be encountered [...they also double as a pretty darn good microwave oven!].

The ALQ-131 pod contributes to full-dimensional protection by improving individual aircraft probability of survival. The ALQ-131 Block II is an upgraded version of a pod configured ECM system first fielded in the 1970s. The pod provides self protection jamming for USAF tactical fighter aircraft and is designed to operate in a dense, hostile environment of radar directed (RF) threats that require high duty cycle (pulse doppler) or CW jamming techniques. The ALQ-131 Block II is modularly constructed, providing a high degree of adaptability to various mission requirements. Basic hardware components include an Interface and control module, 2 or 3 Band modules that cover a portion of the pod's total frequency range, and the Receiver/Processor (R/P) module. The R/P module combines an accurate signal identification capability with power management. An important function of the R/P is the management of "look through" which permits periodic surveillance of the threat environment while jamming is in progress. This system is no longer in production for U.S. forces and is well past IOC. Operational Flight Program (OFP) Block software up-dates are expected about every two years, or as tactically required based on the continuum of threat evaluation to support theater tailored User Data Files (UDF), and jammer technique optimization.

AN/ALQ-167 Yellow Veil

General Info:
Type = countermeasures threat simulation pod
Origin = U.S.A.
Manufacture = Rodale
IOC = 1980s
Sensor Type = frequency range of 425 MHz to 18 GHz
Platforms = A-6E, EA-6A, EA-6B, EP-3J, F-14A/B, F/A-18A-D, EC-24A, and NKC-135

Dimensions
Length = 130in
Diameter = 10in
Suspension = 30in
Weight = 236lbs

Description:

The ALQ-167 is an electronic countermeasures threat simulation pod. It utilizes the ULQ-21 countermeasures set. There are many different ALQ-167 variants, each using different combinations of the ULQ-21 modules. These variants cover a frequency range of 425 MHz to 18 GHz and generate noise, deception/repeater, and combination ECM modes.
The AN/ALQ-167(V) (ALQ-167) Countermeasures Set is a noise and deception jamming system that is used to provide an electronic countermeasures (ECM) environment for testing and evaluating weapon systems and for training the weapon systems operators. The ALQ-167 provides ECM threat simulation for all microwave-oriented Navy weapon systems operating within the following radio frequency (RF) ranges: 425 to 445 MHz (B-Band), 902 to 928 MHz (C-band), 1 to 2 GHz (D-Band), 2 to 4 GHz (E- and F-Bands), 4 to 11 GHz (G- and I-Bands), and 12 to 18 GHz (J-Band). The ALQ-167 is designed to be effective against pulse Doppler and continuous wave (CW) weapon systems.

The ALQ-167 is comprised of a pod with ECM weapon replaceable assemblies (WRA) mounted internally on an equipment tray. Different pod configurations are used for specific purposes; these configurations are termed variants. Pod variants are numbered according to use.
The ALQ-167 pod mounts externally on aircraft. Cable assemblies unique to each aircraft type permit interface between the pod assembly and control indicator via aircraft wiring. Specific operating frequencies and parameters are preset prior to flight in accordance with mission objectives. One of several cockpit-mounted control indicators, including the UCB and mini UCB, is also used with the ALQ-167 depending on the pod variant. They provide remote selection of ECM operating modes.

The ECM WRAs mounted on the pod tray assembly are primarily from one of two CM sets: the AN/DLQ-3C(V) (DLQ-3) or the AN/ULQ-21(V) (ULQ-21). Additionally, the ALQ-167 can be fitted with the T-1487/ALT-41 (B-Band) and the T-1499/ALT-42 (C-Band) transmitters in three pod variants.

The ALQ-167 generates noise, deception/repeater, and combination ECM modes. The noise modes attempt to mask the illuminating radar's return signal with a larger power signal. These modes utilize an internal noise source to generate the RF signal. The deception/repeater modes attempt to provide false information to the weapon system (range, angle, velocity) and/or to break the weapon system track by applying various types of modulation to the received illumination signal. The resultant signal is then amplified to produce a larger signal at the radar than the actual radar return. The ALQ-167 produces combination modes by logically combining various noise and deception modes.

AN/ALQ-184 Electronic Attack Pod

General Info:
Type = self-protection jamming
Origin = U.S.A.
Manufacture = Raytheon
IOC = 1982
Platforms = F-16

Description:

The AN/ALQ-184 Electronic Attack Pod provides self-protection for the F-16 combat aircraft and crew in a complex radar guided threat environment. Built by Raytheon E-Systems for the Air Force, the AN/ALQ-184 protects aircraft against radio frequency threats by selectively directing high power jamming against multiple emitters. In 1995 Raytheon's Goleta, California, electronic warfare operation, which builds the AN-ALQ-184, was combined with the company's E-Systems division.

Between 1989 and 1996 Raytheon delivered more than 850 pods to the US Air Force, including a 1993 award for 78 pods. During 1996 the US Air Force awarded contracts totaling $28 million to upgrade and improve the AN/ALQ-184 electronic countermeasures pod, bringing total value of that program since its inception to more than $1.2 billion. In April 1996 the US Air Force awarded Raytheon E-Systems a $5.2 million contract for the ALQ-184(V)9 Pod Program, under which Raytheon will modify ten pods to incorporate two previously stand alone self- protection systems. This integrated system will be produced by installing the AN/ALE-50 Towed RF Decoy into the AN/ALQ-184 ECM Pod. Additional modifications will enhance the combined performance of the pod and decoy. The modification provides the US Air Force with the most capable full-band self-defense suite available today. The system can be installed on nearly all tactical aircraft, with no changes to the airplane and will add a measure of effectiveness not available elsewhere. The ALQ-184(V9) production program continues the integration of the ALE-50 towed decoy system in a 3-band ALQ-184(V9) ECM pod. The ALE-50 towed decoy system cannot be carried on F-16 Block 25/30 aircraft without this modification.

In May 1994 it was announced that Raytheon will upgrade Taiwan's of F-16s with AN/ALQ-184 ECM pods. The contract, worth nearly $106 million includes 82 pods and support equipment and spares, marked the first foreign sale of the AN/ALQ-184.

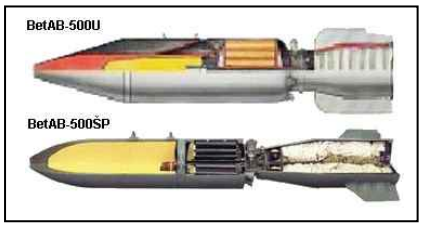
Marconi Sky-Shadow ECM

General Info:
Type = countermeasure
Origin = Europe
Manufacture = Marconi
IOC = 1980s
Sensor Type = frequency range H to J-Band
Platforms = Tornado

RUSSIAN MUNITIONS CHAPTER

FREE FALL BOMBS

BetAB 500ShP



General Info:
Origin = Russia
Type = Anti Runway, Armour Piercing
Guidance = Free Fall
Platforms = MiG-27

Performance:
Release speed = 0.46 – 0.92 mach
Release altitude = 490 – 1600ft
Performance = penetrates 21.6in of armour, leaves a 4.5-m crater

Dimensions:
Length = 82.7in
Diameter = 16.7in
Weight = 948lbs

Warhead:
837lbs HE

Description:

Russian BetAB class (concrete-piercing bomb). Low drag Free-fall Anti Runway "dumb" bomb (like BLU-107). It utilizes a parachute drogue and solid - propellant booster.

FAB-100/UKB

FAB-100 with a high drag UKB tail

FAB-250/UKB

FAB-250 with a high drag UKB tail

FAB-500/UKB

FAB-500 with a high drag UKB tail

FAB-750/UKB

FAB-750 with a high drag UKB tail

FAB-1000/UKB

FAB-1000 with a high drag UKB tail

FAB-1500/UKB

FAB-1500 with a high drag UKB tail

FAB-100

General Info:
Origin = Russia
Type = Aviation Bomb, low drag
Guidance = Free Fall
Platforms = Su-24, Su-25, Su-17/22, MiG-21

Performance:
Release speed = 0.42 – 0.84 mach
Release altitude = 980 – 16400ft

Dimensions:
Length = 58.66in
Diameter = 9in
Weight = 258lbs

Warhead:
86lbs Torpex
Fuse = Contact

Description:

Russian BetAB class (concrete-piercing bomb). Low drag Free-fall Anti Runway "dumb" bomb (like BLU-107). It utilizes a parachute drogue and solid - propellant booster.

FAB-250

General Info:
Origin = Russia
Type = Aviation Bomb, low drag
Guidance = Free Fall
Platforms = Su-24, Su-25, Su-37, Il-102, Tu-22, MiG-21

Performance:
Drag = 6
Lethal Radius = 750ft
Release speed = 0.42 – 0.84 mach
Release altitude = 980 – 16400ft
MSD, protected = 750ft
MSD, exposed = 1,650ft

Dimensions:
Length = 89in
Diameter = 11.5in
Weight = 551lbs

Warhead:
250lbs Torpex
Fuse = Contact

FAB-500

General Info:
Origin = Russia
Type = Aviation Bomb, low drag
Guidance = Free Fall
Platforms = Su-24

Performance:
Release speed = 0.42 – 0.84 mach
Release altitude = 980 – 16400ft

Dimensions:
Length = 95.7in
Diameter = 15.8in
Weight = 1095lbs

Warhead:
471lbs Torpex
Fuse = Contact

FAB-750

FAB-500 with chute for high-drag

FAB-1000

General Info:
Origin = Russia
Type = Aviation Bomb, low drag
Guidance = Free Fall
Platforms = Su-24, Tu-2,

Performance:
Release speed = 0.42 – 0.84 mach
Release altitude = 980 – 16400ft

Dimensions:
Length = 140in
Diameter = 19.6in
Weight = 2277lbs

Warhead:
1049lbs Torpex
Fuse = Contact

FAB-1500

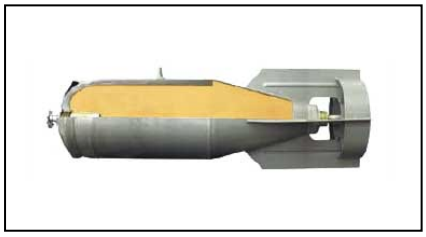
General Info:
Origin = Russia
Type = Aviation Bomb, low drag
Guidance = Free Fall
Platforms = MiG-27M, MIG-31BM/FE, Su-24, Tu-22M, Tu-95, Il-28

Performance:
Release speed = 0.46 – 0.92 mach
Release altitude = 980 – 16400ft

Dimensions:
Length = 118in
Diameter = 22.8in
Weight = 3417lbs

Warhead:
1488lbs Torpex
Fuse = Contact

OFAB-100



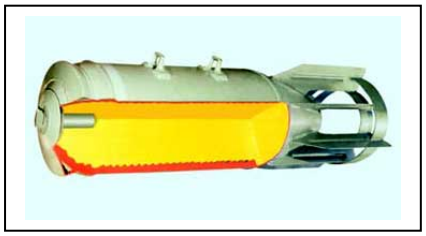
General Info:
Origin = Russia
Type = Demolition aviation bomb
Targets = engineering constructions, military – industrial objects, materials in the field, troops
Guidance = Free Fall

Performance:
Release speed = 0.42 – 0.84 mach
Release altitude = 980 – 16400ft

Dimensions:
Length = 42.1in
Diameter = 10.75in
Weight = 271lbs

Warhead:
101lbs HE
Fuse = Contact

OFAB-250



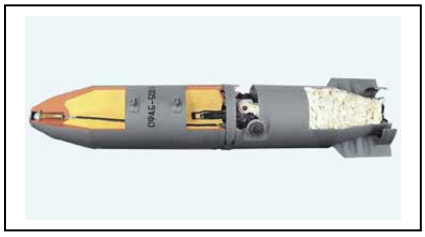
General Info:
Origin = Russia
Type = Demolition aviation bomb
Targets = engineering constructions, military – industrial objects, materials in the field, troops
Guidance = Free Fall

Performance:
Release speed = 0.42 – 1.26 mach
Release altitude = 980 – 20000ft

Dimensions:
Length = 57.5in
Diameter = 12.8in
Weight = 586lbs

Warhead:
207lbs HE
Fuse = Contact

OFAB-500



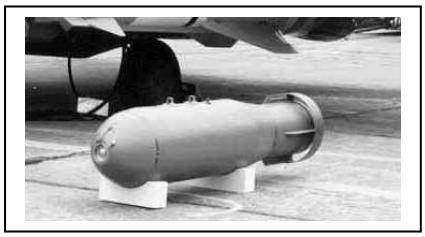
General Info:
Origin = Russia
Type = Demolition aviation bomb
Targets = engineering constructions, pillboxes, railway junctions, military – industrial objects, materials in the field, troops
Guidance = Free Fall

Performance:
Release altitude = 165 – 33000ft
Release speed = Mach 0.4 – 1

Dimensions:
Length = 90.5in
Diameter = 15.7in
Weight = 1135lbs

Warhead:
507lbs HE
Fuse = Contact

ODAB-500



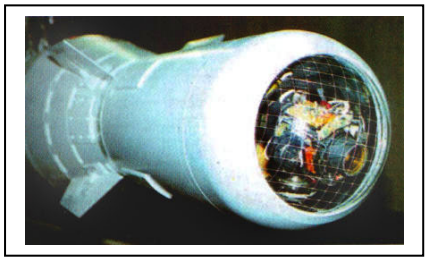
General Info:
Origin = Russia
Type = Fuel air explosive bomb
Targets = destroy troops, industrial constructions, parked aircrafts, engineering constructions, minefield clearance
Guidance = Free Fall
Platforms = MiG-21, MiG-27, MiG-29, Su-17, Su-22, Su-24, Su-25, Su-27

Performance:
Release altitude = 600 – 3200ft
Release speed = Mach 0.4 – 1

Dimensions:
Length = 90in
Diameter = 19.7in
Weight = 1146lbs

Warhead:
425lbs aerosol-gas mix

KAB-500Kr



General Info:
Origin = Russia
Type = guided Bomb
Guidance = TV/EO guided, lock before launch
Platforms = Su-33, Su-24, Su-25, MiG-27, Su-27, Su-30, Su-32, Su-35, MiG-29SMT

Performance:
Release speed = Mach 0.4 – 0.9
Release altitude = 1000 – 15000ft
angular angle of vision = 2 – 3 deg
Accuracy = 6 – 60ft

Dimensions:
Length = 120in
Diameter = 13.8in
Weight = 1234lbs

Warhead:
837lbs armour piercing
Fuse = Contact

KAB-500Kr/OD

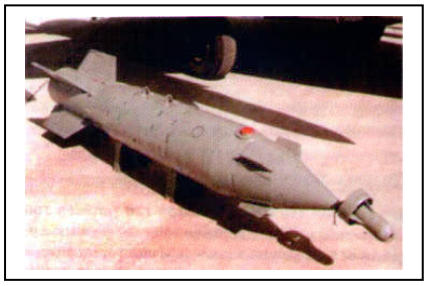
General Info:
Origin = Russia
Type = guided Bomb
Guidance = TV/EO guided, lock before launch
Platforms = Su-33, Su-24, Su-25, MiG-27, Su-27, Su-30, Su-32, Su-35, MiG-29SMT

Performance:
Release speed = Mach 0.4 – 0.9
Release altitude = 1000 – 15000ft
angular angle of vision = 2 - 3 deg
Accuracy = 6 – 60ft

Dimensions:
Length = 120in
Diameter = 13.8in
Weight = 1058lbs

Warhead:
551lbs armour piercing
Fuse = Contact

KAB-500L



General Info:
Origin = Russia
Type = guided Bomb
Guidance = Laser guided SAL
Platforms = Su-33, Su-24, Su-25, MiG-27, Su-27, Su-30, Su-32, Su-35, MiG-29SMT

Performance:
Release speed = Mach 0.4 – 0.9
Release altitude = 1000 – 15000ft
cover area = 1500sqm

Dimensions:
Length = 120in
Diameter = 15.8in
Weight = 1177lbs

Warhead:
881lbs
Fuse = Contact

KAB-1500Kr

General Info:
Origin = Russia
Type = guided Bomb
Purpose = PGM export weapon
Guidance = TV/EO guided, lock before launch
Platforms = MiG-27K, MiG-31BM/FE, Su-24/24M, Su-27, S-37, MiG-1.42

Performance:
Release speed = Mach 0.4 – 0.9
Release altitude = 1000 – 15000ft
Accuracy = 6 – 60ft

Dimensions:
Length = 120in
Weight = 3362lbs

Warhead:
2600lbs
Fuse = Contact

KAB-1500L/Pr

General Info:
Origin = Russia
Type = guided Bomb
Purpose = PGM export weapon, destruction of stationary ground targets like military/industrial bunkers and reinforced concrete
Guidance = Laser guided SAL
IOC = 1992
Platforms = MiG-27K, MiG-31BM/FE, Su-24/24M, Su-27, S-37, MiG-1.42

Performance:
Release speed = Mach 0.4 – 0.9
Release altitude = 3000 – 15000ft
Accuracy = 6 – 60ft

Dimensions:
Length = 181in
Diameter = 22.8in
Weight = 3306lbs

Warhead:
2425lbs Penetration
Fuse = Contact

KAB-1500L/F

General Info:
Origin = Russia
Type = guided Bomb
Guidance = Laser guided SAL
IOC = 1992
Platforms = MiG-27K, MiG-31BM/FE, Su-24/24M, Su-27, S-37, MiG-1.42

Performance:
Release speed = Mach 0.4 – 0.9
Release altitude = 3000 – 15000ft
Accuracy = 6 – 60ft

Dimensions:
Length = 181in
Diameter = 22.8in
Weight = 3439lbs

Warhead:
2600lbs Fragmentation/Blast
Fuse = Contact

Type 250-2

General Info:
Origin = China
Type = general purpose
Guidance = Free Fall
Platforms = J-6A, J-7E, J-8B, JH-7, J-10, Q-5M, Su-30MKK, H-5 and H-6A

Dimensions:
Weight = 551lbs

Warhead:
HE

Type 250-3

General Info:
Origin = China
Type = Cluster bomb
Guidance = Free Fall
Platforms = J-6A, J-7E, J-8B, JH-7, J-10, Q-5M, Su-30MKK, H-5 and H-6A

Dimensions:
Weight = 559lbs

Warhead:
Armor Penetration

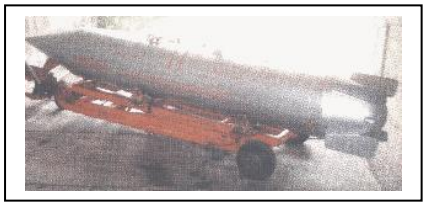
Type 500-2

General Info:
Origin = China
Type = general purpose
Guidance = Free Fall
Platforms = J-6A, J-7E, J-8B, JH-7, J-10, Q-5M, Su-30MKK, H-5 and H-6A

Dimensions:
Weight = 1102lbs

Warhead:
HE

KMGU-2



General Info:
Origin = Russia
Type = Cluster Bomb
Guidance = Free Fall
IOC = 70s
Platforms = SU-22, SU-24, SU-25, Mig-27, Mig-29

Performance:
Release altitude = 150 – 4800ft
Release speed = Mach 0.5 – 1

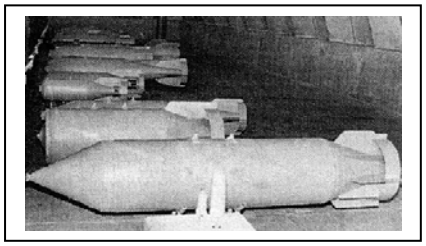
Dimensions:
Length = 145in
Diameter = 18.11in
Weight = 375lbs

Warhead:
Submunition = 12 PTAB-2,5 (Armour 4.7in, 6.2lbs), 12 AO-25RT (Armour 4.7in, 6.2lbs), 256 PTAB-1M (Armour 8.3in, 2.2lbs)
Fuse = Contact

Description:

The KMGU-2 dispenser was created in USSR in the 70s and 80s and was a response to the NATO MW-1 mine dispensers. It was designed to deploy lightweight bombs against large flat target such as runways, parking ramps, railway lines, roads, artillery positions and others. KMGU-2 has a cigar shaped fuselage with a hermetic compartment for packs of bombs in the center. In cruise flight the compartment is closed by movable flaps. Bombs are mounted in BKF blocks. In one dispenser there is room for 8 packs of 12 - 256 lightweight bombs. Bombs can be dropped at speeds between 700 and 1200km/h and at altitudes between 50 and 1500m. KMGU-2 dispensers were delivered with Su-22 (4xKMGU-2), Su-24, Su-25 (8xKMGU-2), MiG 27 (4xKMGU-2) and MiG 29 (4xKMGU-2). KMGU-2 dispensers are usually silver with red inscriptions..

RBK-250



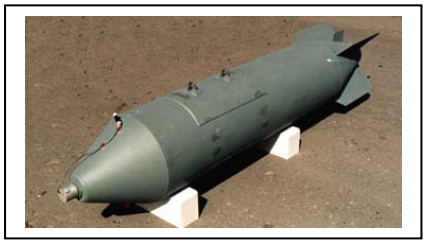
General Info:
Origin = Russia
Type = Cluster Bomb
Guidance = Free Fall
Platforms = SU-22, SU-24, SU-25, Mig-27, Mig-29

Performance:
Drag: 11

Dimensions:
Length = 86.6in
Diameter = 12.8in
Weight = 606lbs

Warhead:
RBK-250 = 48 ZAB 2.5 Incendiary
RBK 250-275 = 60 AO-2.5 APAM
RBK 250-275 = AO-2.5-2 APAM
RBK 250-275 = 150 AO-1SCh bomblet (4800sqm cover area)
RBK 250-275 = 30 PTAB 2.5M
Fuse = Contact

RBK-500 AO-25.RT



General Info:
Origin = Russia
Type = Cluster Bomb
Targets = anti-personnel/anti-material
Guidance = Free Fall

Performance:
Drag = 8

Dimensions:
Length = 98.4in
Diameter = 19.7in
Weight = 1111lbs

Warhead:
108 AO-2.5RTM
Fuse = Contact

RBK-500 ShOAB-0.5

General Info:
Origin = Russia
Type = Cluster Bomb
Targets = anti-personnel/anti-material
Guidance = Free Fall

Performance:
Drag = 8

Dimensions:
Length = 59in
Diameter = 17.7in
Weight = 736lbs

Warhead:
565 ShOAB-0.5 bomblet (12000sqm cover area)
Fuse = Contact

RBK-500 PTAB-1M

General Info:
Origin = Russia
Type = Cluster Bomb
Targets = Heat area effect
Guidance = Free Fall

Performance:
Drag = 8

Dimensions:
Length = 59in
Diameter = 17.7in
Weight = 736lbs

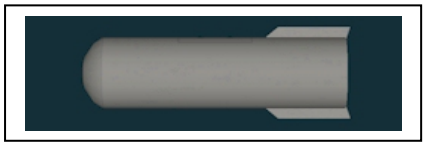
Warhead:
268 PTAB-1M (9.45in armour)
Fuse = Contact

RBK-500 U

General Info:
Origin = Russia
Type = Cluster Bomb
Guidance = Free Fall

Warhead:
10 OFAB-50 APAM
26 OFAB 2.5 APAM
10 BetAB (runway cratering bomblets)
15 SPBE-D
352 PTAB
Fuse = Contact

ZAB-250



General Info:
Origin = Russia
Type = incendiary bombs
Guidance = Free Fall

Dimensions:
Length = 39.4in
Diameter = 10.5in
Weight = 551lbs

Warhead:
441lbs

ZAB-500

General Info:
Origin = Russia
Type = incendiary bombs
Guidance = Free Fall
Platforms = Su-22, Su-24, Su-25, Su-27, Su-30,
Su-33, MiG-21, MiG-23, MiG-25, MiG-27, MiG-29, MiG-31

Dimensions:
Length = 84.3in
Diameter = 12.6in
Weight = 1102lbs

Warhead:
1058lbs

AIR TO GROUND MISSILES

AS-4 Kitchen (Kh-22 Burya)

General Info:
Origin = Russia
Type = Long Range Air-to-Surface Missile
IOC = 1964
Guidance = Inertia, active or passive radar, infrared
Platforms = Tu-22, Tu-95

Performance:
Range = 150 - 300 nm
Speed = Mach 4.0
Ceiling = 79000 ft

Dimensions:
Length = 444.88in
Diameter = 39.37in
Wingspan = 131.89in
Weight = 13000 lbs

Warhead:
350kT nuclear or 2200 lbs HE

Description:

The AS-4 comes in three variants:
1) The KH-22N, with a nuclear warhead and inertial guidance
2) The KH-22M, with a conventional warhead against ships and guidance by an active-radar during final phase of flight
3) The KH-22MP, for breaking through enemy air defenses.
Originally built for the Tu-22 and Tu-22M, the missile now also arms the modified Tu-95K-22 aircraft.

AS-6 Kingfish

General Info:
Origin = Russia
Type = Anti-ship
Manufacture = Raduga
IOC = 1971
Guidance = Inertial guidance midcourse; active radar Terminal (J-band radar)
Platforms = Tu-16

Performance:
Range = 400nm
Speed = Mach 3.0
MSD, protected = 800ft
MSD, exposed = 3250ft
Lethal Radius = 250ft
Frag Radius = 350ft

Dimensions:
Length = 34.5ft
Diameter = 35in
Fin Span = 100in
Weight = 12125lbs

Warhead:
2,205lbs High explosive (30mm Armour)
Fuse = Delayed

Description:

The AS-6 Kingfish is launched from the Tu-16 Badger. It is fielded in both active radar and passive radar homing versions. The missile can carry a conventional warhead or up to a 1 megaton nuclear charge.

AS-7 Kerry (Kh-66, Kh-23)

General Info:
Origin = Russia
Type = Ground attack
Manufacture = Zvezda
IOC = 1977
Guidance = Radio command
Platforms = Mig-19, Mig-21, Mig-23

Performance:
Range = 3nm
Speed = Mach 0.8
Drag = 6
Lethal Radius = 50ft
Frag Radius = 250ft

Dimensions:
Length = 11.5ft
Diameter = 11in
Fin Span = 55in
Weight = 628lbs

Warhead:
242lbs Hollow-charge high explosive (120mm Armour)
Fuse = Delayed
Concrete = 4ft

Description:

In April 1965, when work on the MiG-23 fighter aircraft began, the "Vympel" [Pennant] OKB-134 Special Design Bureau received an order for a Kh-23 tactical guided air-to-ground missile. The main incentive for developing it was intelligence received about the Bullpup missile, a highly effective American one of the same class built several years earlier. Right away the engineers faced an obstacle of technological nature: the Russians had never before built tactical guided missiles and had not acquired any experience with missile guidance systems. A particularly difficult problem was the stipulation by the Air Force that the missile guidance system fit already existing fighter aircraft and thus be small. Because the OKB-134 did not meet time schedules, the Air Force in early 1966 accepted the proposal from the "Zvezda" small Design Bureau at the Kalinin No 455 Series Production Plant near Moscow producing K-5, K-8, and other guided air-to-air missiles. They proposed to build the first tactical air-to-ground missile with ready-made components of air-to-air missiles.

What prompted the "Zvezda" OKB to submit its proposal was that it already had certain experience in using air-to-air missiles against ground targets. Such tests had been conducted during late nineteen fifties and early nineteen sixties with K-51 (RS-2US) missiles fired from MiG-19PM fighter aircraft. The main results of these tests indicated the feasibility of using these missiles against land and sea targets, though not very effectively because of the small warhead.

The first Soviet tactical air-to-ground missile was built in 1966 and, therefore, called the Kh-66 or Article 66. The key design requirement was that it be able to carry a warhead weighing 100 kg (for comparison, the warhead of the K-5 missile weighed 13 kg). For propulsion of the Kh-66 missile the propulsion system of the K-8 was used with only a small modification of the nozzle. The nozzle had to be split in two, because the K-51 (RS-2US) guidance system, also used by the Kh-66 missile, was located in the tail. Using the old guidance system had many drawbacks but also offered one great advantage, namely that it could be carried by every aircraft previously carrying a K-5 missile without modifications of the aircraft (except for a new attachment underneath the fuselage). The missile was produced within a few months and in September 1966 began to be tested with an MiG-21PFM aircraft. Then in 1968 the Kh-66 was officially certified as weapon of MiG-21 aircraft, supported on the center line beneath the fuselage.

The Kh-66 missile was a temporary solution and therefore, work on the Kh-23 missile was not discontinued but transferred from the "Vympel" OKB to the "Zvezda" OKB.

Many components of the Kh-66 missile were used for building the Kh-23 and only the tail carrying the Delta-R1M radio-command guidance system had to be altered. Furthermore, the propulsion fuel was replaced with one having a higher energy content. The first ten experimental Kh-23 units were tested in the beginning of 1968. Due to defects, factory testing continued till the end of 1969. The cause of perturbations in the missile guidance could not be determined for quite a long time. Eventually the cause was found to be the wrong location of the smoke tracker allowing it to interfere both thermally and mechanically with the antenna of the guidance system. This problem was solved by placing the tracker on the tail extension of the missile. The aircraft part of the Delta apparatus was installed either permanently on the aircraft (Delta N and Delta NM) or in containers (Delta NG or Delta NG2 systems). After completion of Government Qualification tests on MiG-23S and MiG-23B aircraft in autumn 1973, the Kh-23 missile was in 1974 officially certified as weapon with the Kh-23M (Article 68M) designation.

AS-10MR Karen (Kh-25)

General Info:
Origin = Russia
Type = Ground attack
Manufacture = Zvezda
IOC = 1978
Guidance = Radio command
Platforms = Su-17, Su-22, Su-24, Su-25, MiG-27

Performance:
Range = 4.3nm
Speed = Mach 1
Drag = 6
Lethal Radius = 100ft

Dimensions:
Length = 12.5ft
Diameter = 11in
Weight = 705lbs

Warhead:
310lbs High explosive
Fuse = Contact

Description:

The AS-10 Karen is a short-range ground attack missile which can be outfitted with a variety of seekers. These include radio command guidance via the launching platform fire control radar, laser homing, TV and anti-radiation. Su-17, Su-22, Su-24, Su-25 and MiG-27 aircraft are equipped to fire this missile.

AS-14L Kedge (Kh-29)

General Info:
Origin = Russia
Type = Ground attack
IOC = 1982
Guidance = semiactive laser
Platforms = Su-17M3, Su-25T, MiG-27M, Su-24M, Su-34, MiG-33, Su-35

Performance:
Range = 18.5nm
Speed = Mach 2.35
Launch Altitude = 600-15000ft

Dimensions:
Length = 12.79ft
Diameter = 15.75 in
Fin Span = 3.60 ft
Weight = 1455lbs (1520lbs Kh-29TE), (1500lbs Kh-29MP)

Warhead:
705lbs GP bomb as warhead
Fuse = Contact

Description:

This is the only missile of the air-to-ground class which has been designed by Matus Bisnovat's "Molniya" [Lightning] Design Bureau, which specializes in air-to-air missiles. It was developed in the middle nineteen seventies for MiG-27, Su-17, and Su-24 (Fencer) aircraft. It was later also installed on other aircraft. It is used chiefly against heavily reinforced targets (almost half its weight is the warhead). It is supported on AKU-58 launcher pylons, from which it is dropped down before its engine starts. The Kh-29L (Article 63) is an improved version of the Kh-29, with semiactive laser guidance. A target can be illuminated from the delivery aircraft or from another aircraft or from the ground. The Kh-29T (Article 64) has a television head with automatic optical homing to a distinguishable object indicated by the pilot in the cockpit. The Kh-29D version with a thermal- imaging head is also on the list of Russian export items.

AS-14T Kedge (Kh-29)

General Info:
Origin = Russia
Type = ASM/AGM
IOC = 1980
Guidance = TV or PIR
Platforms = Su-17M3, Su-25T, MiG-27M, Su-24M, Su-34, MiG-33, Su-35

Performance:
Range = 11nm
Speed = Mach 1
Drag = 10
Lethal Radius = 300ft
Frag Radius = 400ft
MSD, protected = 500ft
MSD, exposed = 2200ft

Dimensions:
Length = 12.5ft
Diameter = 12in
Fin Span = 54in
Weight = 1543lbs

Warhead:
705lbs High explosive
Fuse = Contact

Description:

The AS-14 Kedge missile can be guided by laser homing or by TV guidance. When fired by the MiG-27, the weapon can receive mid-course updates via a datalink pod. MiG-27, Su-24, MiG-29 and Su-25 aircraft can fire this missile.

AS-15 Kent (Kh-55, RKV-500, Kh-65)

General Info:
Origin = C.I.S.
Type = Air launched cruise missile
IOC = 1984
Guidance = Inertia with contour matching

Performance:
Range = 1700nm
Speed = Mach 0.8
Accuracy = 490 ft
Drag = 10
Lethal Radius = 300ft
Frag Radius = 400ft
MSD, protected = 500ft
MSD, exposed = 2200ft

Dimensions:
Length = 318 in
Diameter = 30.31in
Wingspan = 122in
Launch Weight = 3300 lbs

Warhead:
200 kT nuclear

Description:

The AS-15 Kent is a strategic cruise missile that carries a 200 kT nuclear warhead over a distance of up to 3000 km. It uses an inertial navigation system that updates its position by comparing contour features with stored image data.

AS-16 Kickback (Raduga Kh-15)

General Info:
Origin = C.I.S.
IOC = 1984
Guidance = Inertia with contour matching

Performance:
Range = 81nm
Speed = Mach 5
Launch Alt. = 130000ft

Dimensions:
Length = 188in
Diameter = 17.91in
Wingspan = 36.2in
Weight = 2645lbs

Warhead:
330lbs

Description:

The Kh-15 short-range attack missile is analogous to the the American AGM-69 SRAM. Its basic version is the Kh-15P (Article 115) antiradiation missile used for breaking through air defenses. Its Kh-15A anti-ship version (exhibited in Abu Dabi 1993 as the Kh-15S) has an inertial navigation system for the initial flight stage and a millimetric-wave active-radar self-homing system for the final flight stage. During its initial flight stage the Kh-15 missile, using a solid-fuel, rises to an altitude of about 40,000 m, whereupon the target seeking radar turns on. Having been zeroed in on the target, the missile dives while accelerating to a speed of Mach 5.

AS-17 Krypton A (Kh-31)

General Info:
Manufacture = Zvezda/ STRELA
Type = ASM
IOC = 1982
Guidance = inertial point active radar terminal seeker
Platforms = MiG-27, MiG-29/33, Su-30/33/34/35, Su-25, Su-24, Su-22

Performance:
Power Plant = integral rocket booster ramjet sustainer (12° AOA limit)
Range = 2.7-27nm (mod 1), 2.7-37nm (mod 2)
Profile = high cruise (40,000 ft. @ 5.0 Mach)
Launch Alt. = 165-49200ft
Speed = 2.9 Mach
Terminal impact speed = >1.0 Mach

Dimensions:
Length = 185in (mod 1), 206in (mod 2)
Fin Span = 45in
Diameter = 12.2in
Weight = 1322lbs

Warhead:
198lbs Blast Fragmentation

Description:

New air defense weapon systems of the American Patriot kind have raised the requirements which antiradar missiles must meet. These include first of all higher speed and longer range, then also high interference immunity and radar turn-off when attacked.
For the special purpose of meeting these requirements, the "Zvezda" group under the direction of V. Bugayskiy began in 1977 working on the Kh-31 missile (Article) 77P). The first launchings of this missile took place in 1982.
The most interesting component of the Kh-31P is its dual propulsion system designed by the "Soyuz" Design Bureau in Turayevo near Moscow (note: there are several "Soyuz" engineering groups in Russia). First the missile is accelerated by its solid-fuel rocket engine to a speed of Mach 1.8, then the engine is discarded and the interior of the missile is converted into the combustion chamber of the missile's jet engine. The latter accelerates the missile to a speed of almost Mach 4.5, while four air intake holes on the sides of the missile body open up. On the basis of the Kh-31P antiradar missile were developed the Kh-31A missile (Article 77A) with an active-radar guidance head and also an M-31 flying target for air defense training exercises. The Kh-31 was for the first time publicly displayed in November 1991, in Dubai (United Arab Emirates).
The State Scientific Production Center Zvezda-Strela has upgraded the air-to-surface supersonic ASM Kh-31A NATO: AS-17 Krypton). Recently a variant of the air-to-air class based on the Kh-31 was made available, equipped with a hybrid active-passive guidance head for use against nonmaneuvering airborne targets such as AWACS (passive guidance) from far distances. The range of this missile is 200 km. The unofficial designation of this missile is 'mini-Moskit'. The Kh-31A missile has been developed from the technologies of the 1970-80s.

AS-18 Kazoo (Kh-59M Ovod-M)

General Info:
Origin = Russia
Type = Long Range Air-to-Surface Missile
IOC = 1982
Guidance = Command updated inertia,TV command
Platforms = Su-24M, Su-34

Performance:
Power Plant = Turbojet
Range = 115km
Speed = Mach 1
Accuracy = 6.5-10ft

Dimensions:
Length = 224in
Diameter = 15in
Wingspan = 51.2in
Weight = 2028lbs

Warhead:
705lbs HE(penetrating) or 617lbs cluster warhead

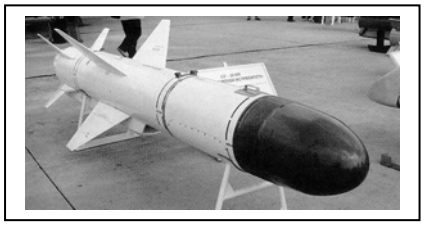
Description:

The Kh-59 missile (Article D9) was for the first time publicly displayed in November 1991, in Dubai (United Arab Emirates). This missile is guided by television and propelled by a powder-fuel engine, with a powder- fuel accelerator in the tail. Its folding stabilizers are located at the front, while its cantilever wings with rudders are located in the rear.

The Kh-59M missile differs from the original model by having a twice as large warhead and by another propulsion system. Under the missile body has been suspended a small turbojet engine, the RDK-300 designed by the "Soyuz" [Union] OKB. The missile is brought up to speed by a powder-fuel accelerator located in the tail section and then continues flying propelled by that turbojet engine. Equipped with such a propulsion system, the missile has a three times longer range than the Kh-59.

Because television guidance has the drawback that the target must be "seen" by the missile, which limits the missile's range of action, the Kh-59M has a dual guidance system. After having been fired, the missile is guided by an inertial navigation system into the vicinity of the target and then the television camera is turned on for transmission of images to the receiver on board the missile's carrier aircraft. The transmitter of flight-correcting radio commands (APK-8 for MiG-27K aircraft or APK-9 for Su-24M/30M and newer aircraft) is mounted in a container which hangs under the aircraft. The armament consisting of a Kh-59M missile with such guidance is called Owad [Insect]-M.

AS-20 Kayak (Kh-35 S-20/SS-N-25 HARPOONSKI)



General Info:
Origin = Russia
Type = low altitude subsonic cruise,
anti-ship standoff missile
Manufacture = East Germany & Zvezda OKB
IOC = 1988
Guidance = inertial (1st leg), active radar and
IR/thermal imaging (terminal)
Platforms = MiG-29M/K, Su-27/30/33/34, Su-24, Su-25KT

Performance:
Power Plant = air-breathing turbofan (rocket boosted launch)
Cruise height = 2.7nm-5.4nm
Speed = Mach 0.95 -1.05
Range = 2.7nm (Min), 70nm (Max)
Launch altitude = 650ft (Min), 6,400ft (Max)

Dimensions:
Length = 12.29ft
Diameter = 16.50in
Fin Span = 4.27ft
Weight = 1060lbs

Warhead:
320lbs HE Blast

Description:

In 1972 the Zvezda-Strela State Scientific-Industrial Center (GNPTs) group began working on the Uran (Western SS-N-25) anti-ship missile system - also commonly called Kharpunskiy because of its similarity to the American Harpoon - for ships of various classes. The Kh-35 antiship cruise missile can be used by surface ships and motor boats, coastal reconnaissance/strike systems, naval helicopters and also by Air Force planes.
The Uran missile systems comprise 16 Kh-35 missiles - 4x4 launchers with pressurised transport-launching containers. The Uran system now serves as armament of Project 1149.8 missile equipped gun boats and other vessels. A coastal defense variant and, more recently, an antiaircraft variant were later developed on the basis of this missile.
The Kh-35 missile has a normal aerodynamic design and an aluminium-alloy airframe. The missile's power plant consists of a solid-fuel booster and a turbojet powerplant. The missile's take-off weight is 750 kilograms, the warhead weighs 150 kilograms with a range of up to 130 kilometres. The Kh-35U anti-ship aircraft missile (Article 78U), propelled by a turbojet engine, flies toward its target at a speed of about the 300 m/s at an extremely low altitude. Owing to its high-precision radio-altimeter, the missile can skim the sea waves at an altitude of 3-5 metres at the terminal phase of trajectory. Its guidance system combines inertial guidance for during the initial flight stage and active-radar guidance during the remaining flight stage. The missile has a folding wing and a folding tail fin.
For use by coastal or shipborne launchers the missile is equipped with a rocket starter-accelerator, a container-type launcher having room for four missiles.
The air-launched AS-20 Kayak version was scheduled to become part of ordnance in 1994. The Kh-35U is intended to serve as weapon of practically all tactical naval aircraft, also of ZOP on the Tu-142 long-range aircraft (eight missiles on two positions, four per position, under the wings) and carrier-based Ka-27 helicopters (four missiles).

SS/N-22 Sunburn (3M80/Kh-41 Moskit)

General Info:
Origin = Russia
Manufacturer = Raduga
Type = Anti Ship
IOC = 1993
Guidance = Active radardhoming
Platforms = Su-27, Su-30

Performance:
Range = 135nm
Speed = Mach >2.5
Power Plant = turbojet

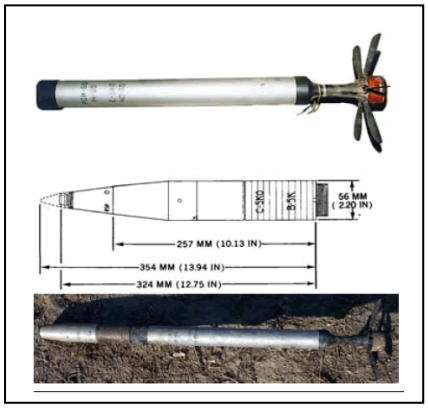
Dimensions:
Length = 383.9in
Weight = 9920lbs
Diameter = 30in

Warhead:
705lbs HE
Fuse = Contact

Description:

The enormous Kh-41 "Moskit" (Mosquito) missile is an air-launched version of the SS-N-22 "Sunburn" Surface Missile intended for use against large sea vessels. The Kh-41 (designated 3M80 by the manufacturer) is carried by the Su-32, which is the only aircraft able to field this large missile that weighs in excess of 9,000 pounds.
A Su-33 was recently displayed with a Kh-41 loaded on the centerline but the Su-33 is considered impractical as a platform to accomodate this missile in an operational loadout and was most likely shown only for display purposes.

S-5



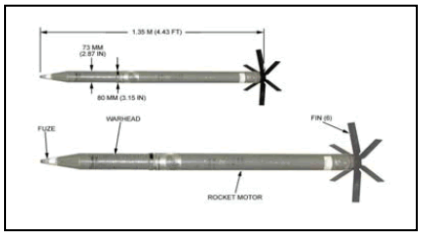
General Info:
Origin = Russia
IOC = 1950s
Manufacture = Ametech
Type = Folding Fin Aerial (anti-infantry) Rocket
Guidance = Ballistic
Platforms = 8-tube, 16-tube, or 32-tube launchers

Performance:
Power Plant = solid propellant
Accuracy = 0.3% of launch range

Dimensions:
Length = 39.4in
Diameter = 2.24in

Warhead:
10-15.5lbs 9 warhead options
Fuse = Contact

S-8



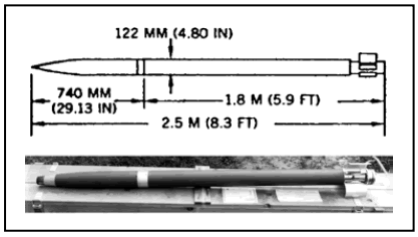
General Info:
Origin = Russia
IOC = late 1970s
Manufacture = Ametech
Type = Folding Fin Aerial Rocket
Guidance = Ballistic
Platforms = carried in 20-canister B-8 rocket pod

Performance:
Power Plant = solid propellant
Accuracy = 0.3% of launch range
Range = 1.1nm (Max)

Dimensions:
Length = 53.15in
Diameter = 3.15in

Warhead:
10-15.5lbs SCF, BF, AP (penetrate up to 32in of reinforced concrete)
Fuse = Contact

S-13



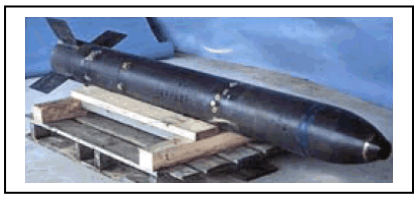
General Info:
Origin = Russia
IOC = late 1970s
Manufacture = Ametech
Type = Folding Fin Aerial Rocket
Guidance = Ballistic
Platforms = carried in 5 - round B-13 rocket pod

Performance:
Power Plant = solid propellant
Accuracy = 0.3% of launch range
Range = 1.62nm (Max)

Dimensions:
Length = 90.5-118.5in
Diameter = 4.8in

Warhead:
10-15.5lbs CP, SCF, BF, AP (penetrate up to 118in of reinforced concrete)
Fuse = Contact

S-24 Rocket



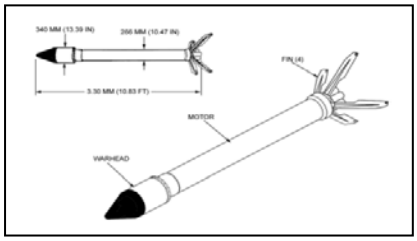
General Info:
Origin = Russia
IOC = 1980s
Targets = soft-skinnned vehicles, small buildings
Guidance = Ballistic
Platforms = MiG-27, MiG-29, Su-24, Su-25

Performance:
Power Plant = solid
Accuracy = 0.3% of launch range

Dimensions:
Length = 82.7in
Diameter = 9.45in

Warhead:
270lbs BF, HE
Fuse = Delayed

S-25 Rocket



General Info:
Origin = Russia
IOC = 1980s
Targets = soft-skinnned vehicles, small buildings
Guidance = Ballistic
Platforms = MiG-27, MiG-29, Su-24, Su-25

Performance:
Power Plant = solid
Accuracy = 0.3% of launch range
Range = 1.1nm (Max)

Dimensions:
Length = 130in
Diameter = 13.4in

Warhead:
420lbs BF, HE

ANTI RADIATION MISSILES

AS-11 Kilter (Kh-58)

General Info:
Origin = Russia
IOC = 1978
Type = Medium Range Anti-Radar missile
Guidance = Inertia, millimetre wave active radar (58A)
Platforms = Su-24M, MiG-25BM and others

Performance:
Power Plant = solid fuel
Range = 65nm
Speed = Mach 3.6
Single-shot probability = 80%

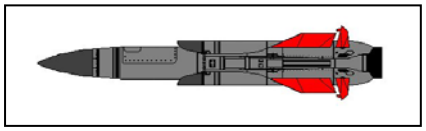
Dimensions:
Length = 189in (58U), 197in (58A)
Diameter = 15in
Wingspan = 57in (58U), 46in (58A)
Weight = 1410lbs (58U), 1433lbs (58A)

Warhead:
353lbs HE fragmentation effect or nuclear(unconfirmed)(58U),
330-440lbs SAP warhead(58A)

Description:

AS-11 Kilter anti-radar missile replaces the outdated AS-9 Kyle. The on-board "Fantazmagoria" (Phantasmagoria) of the SU-24M provides target indication and guidance programming prior to launch of the missile. This can also be done by the external "Vyyuga" (Snowstorm) system which is suspended in a container.
The probability of hit within a 20 m radius is 80%. The A model is equipped with an active radar to help homing in on the target.

AS-12 Kegler (Kh-25MP/Kh-27PS)



General Info:
Origin = Russia
Manufacture = Zvezda
IOC = 1988
Type = Anti-Radar missile
Guidance = Passive radar-homing
Platforms = Su-25T, MiG-29, Su-24M, Su-30, Su-33, Su-34, Su-35, Su-39, MiG-33, Yak-141

Performance:
Range = 2.7-37.8nm
Speed = Mach 3.6

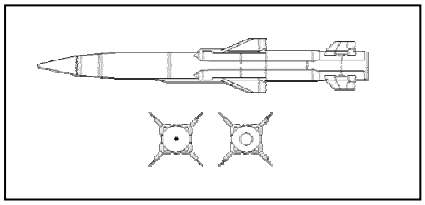
Dimensions:
Length = 205in
Weight = 1323lbs

Warhead:
198lbs HE

Description:

Work began on the Kh-27PS (also known as the Kh-25MP) in 1972. It was intended for use specifically against Hawk and Nike radars. The AS-12 has a two-stage rocket motor to allow it to operate outside a 60km range. It can be carried by the Su-17 family, Su-24, and the Mig-27.

AS-17P Krypton



General Info:
Origin = Russia
Manufacture = Zvezda
IOC = 1978
Type = Anti-Radar missile
Guidance = Fire and forget Passive radar-homing

Performance:
Range = 43nm
Speed = Mach 3
Lethal Radius = 75ft
Frag Radius = 250ft
MSD, protected = 475ft
MSD, exposed = 1,650ft

Dimensions:
Length = 19.75ft
Diameter = 19in
Fin Span = 71in
Weight = 1654lbs

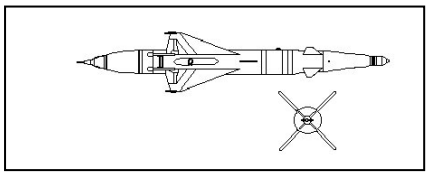
Warhead:
330lbs High explosive
Fuse = Proximity

Description:

New air defense weapon systems of the American Patriot kind have raised the requirements which antiradar missiles must meet. These include first of all higher speed and longer range, then also high interference immunity and radar turn-off when attacked.
For the special purpose of meeting these requirements, the "Zvezda" group under the direction of V. Bugayskiy began in 1977 working on the Kh-31 missile (Article) 77P). The first launchings of this missile took place in 1982.
The most interesting component of the Kh-31P is its dual propulsion system designed by the "Soyuz" Design Bureau in Turayevo near Moscow (note: there are several "Soyuz" engineering groups in Russia). First the missile is accelerated by its solid-fuel rocket engine to a speed of Mach 1.8, then the engine is discarded and the interior of the missile is converted into the combustion chamber of the missile's jet engine. The latter accelerates the missile to a speed of almost Mach 4.5, while four air intake holes on the sides of the missile body open up. On the basis of the Kh-31P antiradar missile were developed the Kh-31A missile (Article 77A) with an active-radar guidance head and also an M-31 flying target for air defense training exercises. The Kh-31 was for the first time publicly displayed in November 1991, in Dubai (United Arab Emirates).
The State Scientific Production Center Zvezda-Strela has upgraded the air-to-surface supersonic ASM Kh-31A NATO: AS-17 Krypton). Recently a variant of the air-to-air class based on the Kh-31 was made available, equipped with a hybrid active-passive guidance head for use against nonmaneuvering airborne targets such as AWACS (passive guidance) from far distances. The range of this missile is 200 km. The unofficial designation of this missile is 'mini-Moskit'. The Kh-31A missile has been developed from the technologies of the 1970-80s.

AIR TO AIR MISSILES

AA-1 Alkali



General Info:
Origin = Russia
Type = Early Radar missile
Manufacture = Kaliningrad Production
IOC = 1957
Guidance = Radio controlled
Platforms = MiG17PFU, MiG19P, MiG21F, Yak25, Yak28

Performance:
Range = 3nm (Max)
Speed = Mach 2.5
Max Target g = 3

Dimensions:
Length = 111.4in
Weight = 183.4lbs

Description:

AA-1 ALKALI
K-5 (RS-1U / RS-2)
PL-1
In 1955 the Kaliningrad (Moscow Oblast) Series Production Plant, which was producing gun turrets for M-4 bomber aircraft and similar equipment, began series production of the first K-5 and K-8 guided air-to-air missiles.
The R-55 (K-55, Object 67), a modification of the K-5 missile, was series-produced throughout the 1967-77 period and quite widely used. By then the Almaz team had given up work air-to-air missiles, and the development of the K-55 missile was assigned to the engineering office at the Kaliningrad (Moscow Oblast) Series Production Plant. This plant was producing aircraft weapons (artillery turrets for M-4 bomber aircraft, sights, etc.), then in 1955 began series production of the first K-5 and K-8 guided air-to-air missiles. Developing the K-55 missile was the first task ever assigned to this team alone (and the only one concerning air-to-air missiles in the history of this team). Currently this engineering office in Kaliningrad, under the name Zvezda, is the leading Russian creator of strategic guided air-to-ground missiles.
During the 1966-168 period the two teams working on air-to-air missiles were renamed -- Bisnovat's OKB-4 team was renamed Molniya and Andrey Lyapin's (who replaced Ivan Toropov in 1961) team was designated Vympel. During later part of the 1960s the Vympel team began working on modifications to the R-55 which resulted in the R-55M missile, with a cooled homing head, a radio rather than optical closing-in igniter, and a more potent warhead. The PL-1 [Pili = Thunderbolt, or Pen Lung = Air Dragon] medium range air-to-air missile was a Chinese copy of the AA-1.

AA-2-2 Atoll-C (R-13R)

General Info:
Origin = Russia
Type = Rear-aspect SAR missile
IOC = 1960
Guidance = Various
Sensor Type = SARH (AA-2-2)
Sensor Range = 5nm
Field of View = 20º
Tracking Rate = 11sec
Gimbal Limit = 25º
Platforms = Mig-19PF, Mig-21, Mig-23M, Mig-27, Su-17

Performance:
Range = 8nm
Speed = Mach 2.5
Max Target g = 3
Drag = 4
Lethal Radius = 6ft

Dimensions:
Length = 9.5ft
Diameter = 5in
Weight = 167lbs

Warhead:
24.3lbs HE

Description:

The 24 September 1958 Chinese acquisition of an American AIM-9B Sidewinder missile marked the beginning of a breakthrough in the development of Soviet air-to-air missiles. The missile, fired from a Taiwanese F-86 Sabre aircraft, lodged without exploding in a Chinese MiG-17. The missile was sent to Toropov's engineering office to be copied, and the product the K-13, long the most popular Soviet air-to-air missile. The Sidewinder had a number of valuable features, not least of which was the modular construction that facilitated ease in production and operation. The simplicity of the AIM-9 was in marked contrast to the complexity of contemporary Soviet missiles. The Sidewinder's infrared-guided homing head contained a free-running gyroscope and was much smaller than Soviet counterparts, and the steering and in-flight stabilization system were equally superior. Gennadiy Sokolovskiy, later chief engineer at the Vympel team, said that "the Sidewinder missile was to us a university offering a course in missile construction technology which has upgraded our engineering education and updated our approach to production of future missiles."
During late 1960s the Vympel team began working on the K-13M (R-13M, Object 380) modification of the K-13 missile, which in 1973 was certified as an operational weapon. It has a cooled homing head, a radio rather than optical closing-in igniter, and a more potent warhead. Analogous modifications of the R-55 resulted in the R-55M missile. The last version of the K-13 is the R-13M1 with a mofified steering apparatus.

AA-2-2 Atoll-D (R-13M)

General Info:
Origin = Russia
Type = Rear-aspect IR missile
IOC = 1960
Guidance = Various
Intercept = Pure pursuit
Sensor Type= Uncooled IR
Sensor Range: 4nm
Field of View: 20º
Tracking Rate: 11sec
Gimbal Limit: 25º
Platforms = Mig-19PF, Mig-21F, Mig-21, Mig-23M, Mig-27, Su-17

Performance:
Range = 4nm
Speed = Mach 2.5
Max Target g = 3
Drag = 4
Lethal Radius = 6ft

Dimensions:
Length = 9.5ft
Diameter = 5in
Weight = 167lbs

Warhead:
24.3lbs HE

Description:

The Atoll is a direct copy of the AIM-9B. How the Soviets obtained a Sidewinder has been the subject of speculation ranging from intrigue and espionage to a story about a Chinese jet carrying home a dud round embedded in its fuselage. The Atoll also shares the limitations of the AIM-9B. It uses an uncooled detector, limiting it to tail-aspect shots and making it unable to track against the sun, warm ground and making it highly susceptible to flares. The missile must be launched within a 30-degree cone off the target's tail and within a range of 2.5nm. Even then, its small seeker FOV and slow tracking rate mean that even a half-hearted maneuver by the target will trash the missile.

AA-6 Acrid (R-40TD)

General Info:
Origin = Russia
Type = Long Range IR missile
IOC = 1970
Intercept = Pure pursuit
Guidance = Command, Inertial and IR (AA-6)
Platforms = Mig-25,

Performance:
Range = 16nm
Speed = Mach 4.5
Max Target g = 3.5
Drag = 4

Dimensions:
Length = 20.3ft
Diameter = 14in
Weight = 1047lbs

Warhead:
154.5lbs HE

Description:

In early 1962 the Bisnovat design team began working on the R-40 (K-40)or AA-6, a new long-range missile intended for use with the the MiG-25-40 high- altitude interception system, consisting of the MiG-25 aircraft with Smerch-A radar set and the R-40 missile. Though only slightly larger than the predecessor R-4, the range of the R-40 is over three times greater. This missile was produced in two variants: R-40R (Object RD46 with PARG-12 head) and R-40T (Object TG-46).
After the defection of a MiG-25P to Japan on 06 September 1976, an extensive redesign of the aircraft was undertaken, resulting in the MiG-25PD interception system. Instead of the Smerch-A, a Sapfir-25 radar was installed. The new missile R-40D and its R-40D1 update ("dorabotanaya" [more elaborate]) were produced in two variants R-40RD and R-40TD, both featuring improved countermeasures resistance and a more sensitive homing head to improve performance against low-flying targets. The R-40D1 missile was developed by the Vympel team, the Molniya team having by that time withdraw from development of aircraft missiles. The R-40 is still included among the weapons of MiG-25 and MiG-31 aircraft, although production was discontinued in 1991.

AA-6R Acrid (R-40RD)

General Info:
Origin = Russia
Type = Long Range SAR missile
IOC = 1970
Guidance = Command, Inertial and Semi-Active Radar
Intercept = Pure pursuit
Platforms = Su-15, Mig-25, Mig-31

Performance:
Range = 32nm
Speed = Mach 4.5
Max Target g = 3.5
Drag = 4

Dimensions:
Length = 20.3ft
Diameter = 14in
Weight = 1047lbs

Warhead:
154.5lbs HE

Description:

In early 1962 the Bisnovat design team began working on the R-40 (K-40)or AA-6, a new long-range missile intended for use with the the MiG-25-40 high- altitude interception system, consisting of the MiG-25 aircraft with Smerch-A radar set and the R-40 missile. Though only slightly larger than the predecessor R-4, the range of the R-40 is over three times greater. This missile was produced in two variants: R-40R (Object RD46 with PARG-12 head) and R-40T (Object TG-46).
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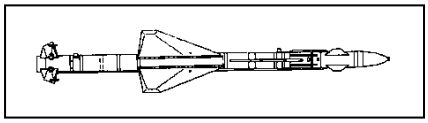
AA-7 Apex (R-24T)



General Info:
Origin = Russia
Type = Medium Range Missile
Manufacture = Vympel
IOC = 1975
Guidance = Semi Active Radar
Sensor Type = IR
Sensor Range = 10nm
Field of View = 2.5º
Tracking Rate = 10sec
Gimbal Limit = 20º
Intercept = Lead pursuit
Platforms = Mig-25, Mig-23

Performance:
Range = 11nm
Speed = Mach 3
Max Target g = 7
Drag = 4
Lethal Radius = 50ft

Dimensions:
Length = 13.5ft
Diameter = 8in
Fin Span = 42in
Weight = 551lbs

Warhead:
66lbs HE

Description:

In the mid-1960s the Vympel design bureau developed the K-23 intermediate-range missile for MiG-23 fighter jet aircraft. While the first units of the K-23 missile were tested with the prototypes the MiG-23 aircraft, the missile was certified as a weapon for the MiG-23M in 1973. The R-23 comes in two variants: R-23R (Object 340) with radar guidance and R-23T (Object 360) with infrared guidance. There is also the training version R-23UT.
The later MiG-23ML and MiG-23MLD aircraft carry the R-24 missile, a modification of the R-23 with various improved characteristics, most importantly a 50 km rather than 35 km range. In its external appearance this missile is similar to the predecessor R-23. For actual use it is available in two variants: R-24R (Object 140) and R-24T (Object 160).
The R-23 is produced in Romania under license as the A-911.
In 1968 the Soviets acquired an American AIM-7M Sparrow, which was similar to the R-23 class of missiles the under development, and the Vympel team copyied the Sparrow under the designation K-25. Several of these missiles were tested, but Soviet R-23 missile was sent to production, and work on the K-25 ended in 1971. The R-23 and R-24 missiles were superior to the K-25 Sparrow-ski in versatility and range, as well as interference immunity, signal processing logic, and other characteristics. Nevertheless, analysis of the Sparrow missile design were helpful in later work on the the R-27 missile: on its hydraulically driven closed-loop servomechanisms and aerodynamic system with movable wings.

AA-7R Apex (R-24R)

General Info:
Origin = Russia
Type = Medium Range Missile
Manufacture = Vympel
IOC = 1975
Guidance = Command and Semi-Active Radar Homing
Sensor Type = SARH
Sensor Range = 8nm
Field of View = 2.5º
Tracking Rate = 10sec
Gimbal Limit = 20º
Intercept = Lead pursuit
Platforms = Mig-25, Mig-23

Performance:
Range = 19nm
Speed = Mach 3
Max Target g = 7
Drag = 4
Lethal Radius = 50ft

Dimensions:
Length = 13.5ft
Diameter = 8in
Fin Span = 42in
Weight = 551lbs

Warhead:
66lbs HE

Description:

The SARH AA-7 version is roughly equivalent to the AIM-7 Sparrow in range and capability. The Apex also comes in an all-aspect infrared version. Russian tactical doctrine calls for ripple firing two of these missiles to increase the probability of a kill. Often both an infrared and a radar version are launched within a three second interval.

The AA-7 has not demonstrated strong combat performance. Syrian MiGs firing AA-7s failed to score against the Israeli Air Force during the 1982 invasion of Lebanon. The missile's sole victim is a South African Mirage F1 when fired by an Angolan MiG-23.

Evasion
The AA-7 can be defeated at long range by notching to the beam, with or without ECM and chaff. At closer range, ECM, chaff, flares and a break inside the missile's turn radius might be necessary.

AA-8 Aphid (R-60)

General Info:
Origin = Russia
Type = Dogfight Missile
Manufacture = Vympel
IOC = 1975
Guidance = Fire and forget
Sensor Type = Nominally all-aspect IR
Sensor Range = 5nm
Field of View = 2.5º
Tracking Rate = 8sec
Gimbal Limit = 20º
Intercept = Lead pursuit
Platforms = Mig-21Mbis, Mig-23MS, Mig-25, Mig-29A, Mig-29G, Mig-29M/-33, Mig-29S, Mig-31, SU-17, SU-24M, SU-25, SU-27, SU-27UB, SU-30M, SU-30MKK, SU-32, SU-33, SU-39

Performance:
Range = 2.7nm
Speed = Mach 2.5
Max Target g = 12
Drag = 2
TOF = 23sec
Lethal Radius = 4ft

Dimensions:
Length = 6.75ft
Diameter = 5in
Fin Span = 17in
Weight = 143lbs

Warhead:
13lbs HE

Description:

The AA-8 Aphid was the first Russian missile designed specifically for dogfighting. The missile uses a peltier-cooled IR detector for all-aspect capability and a high tracking rate to follow targets maneuvering at up to 12G. The seeker also has ±20° gimbal limits allowing shots farther off boresight than earlier missiles. The missile can be launched from a fighter maneuvering at up to 8G. To achieve this maneuverability, the missile's designers traded range and size. As a result, the Aphid must get within a few feet of its target to have a good chance of causing serious damage.

The AA-8 has not demonstrated strong combat performance. Syrian MiGs firing AA-8s failed to score against the Israeli Air Force during the 1982 invasion of Lebanon.

AA-9 Amos (R-33)

General Info:
Origin = Russia
Type = Intercept Missile
Manufacture = Vympel
IOC = 1981
Guidance = SARH
Intercept = Lead pursuit

Performance:
Range = 65nm
Speed = Mach 3.5
Max Target g = 4
Drag = 11
Ceiling = 92000ft
Lethal Radius = 100ft

Dimensions:
Length = 13.5ft
Diameter = 15in
Fin Span = 36in
Weight = 1080lbs

Warhead:
220lbs HE
Fuse = Proximity

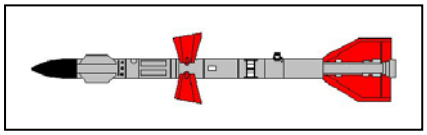
Description:

The AA-9 is a long-range Semi-Active Radar-Homing (SARH) missile closely integrated with the MiG-31 fire control radar. Similar in concept to the F-14/Phoenix weapon system, the MiG-31 can engage and launch on four independent targets. The missile is primarily designed to attack bombers and cruise missiles and is incapable of maneuvering with most modern fighters. (This doesn't mean the threat can be ignored, however, since it carries a large enough warhead that even a near-miss can be fatal).

The missile has never been used in combat, but test firings from above 20,000ft have successfully intercepted high speed targets flying at 200ft.

Evasion
The usual techniques of putting the radar illuminator on the beam, ECM and chaff followed by a hard break into the missile should work.

AA-10A Alamo (R-27R)



General Info:
Origin = Russia
Type = Medium Range SAR Missile
Manufacture = Vympel
IOC = 1985
Guidance = Inertia, Command and SAR
Sensor Type = SARH
Sensor Range = 70nm
Max Data Link Range = 54nm
Intercept = Pure pursuit
Platforms = Mig-29A, Mig-29G, Mig-29M/-33, Mig-29S, Su-27, Su-27UB, Su-30M, Su-30MKK, Su-32, Su-33, Jaguar

Performance:
Range = 27nm
Speed = Mach 4
Lethal Radius = 38ft

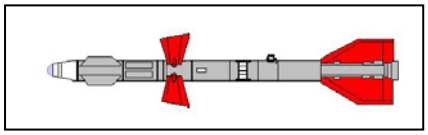
Dimensions:
Length = 13.1ft
Diameter = 9in
Weight = 558lbs

Warhead:
80lbs Expanding Rod

Description:

The R-27R (AA-10A) is the semi active radar homing version of the AA10A. The main radar missile of the MiG29, it can be counted as a serious threat if ignored. Its range is up to 60km under perfectF-pole firing conditions. (approx. 26nm)

AA-10B Alamo (R-27T)



General Info:
Origin = Russia
Type = Medium Range IR Missile
Manufacture = Vympel
IOC = 1985
Guidance = Inertia, Command and IR
Sensor Type = All-aspect IR (AA-10B)
Sensor Range = 8nm
Field of View = 2.5º
Tracking Rate = 16sec
Gimbal Limit = 20º
Intercept = Lead pursuit
Platforms = Mig-29A, Mig-29G, Mig-29M/-33, Mig-29S, Su-27, Su-27UB, Su-30M, Su-30MKK, Su-32, Su-33, Jaguar

Performance:
Range = 22-37nm
Speed = Mach 4
Max Target g = 8
Lethal Radius = 38ft

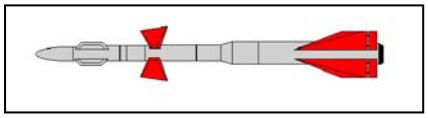
Dimensions:
Length = 12.1ft
Diameter = 9in
Weight = 560lbs

Warhead:
80lbs Expanding Rod

Description:

The R-27 Izdieliye 470 entered production phase in 1986 and is now Russia's primary intermediate-range missile in air-to-air missile category. The first service versions of the missile were semi-active radar homing missile R-27R (Alamo-B) and infrared missile R-27T (Alamo-A). Both versions use inertial guidance with data link commands from the launching aircraft in the first phase of the flight. The third version, R-27P (Pasivnaya), is equipped with a passive homing head. It can be used against targets transmitting radar emissions, such as AWACS planes. The developed version R-27E (Energitisheskaya) is fitted with a more powerful rocket engine, which lengthens the missile by about 17 percent. The semi-active radar homing missile and infrared missile are R-27ER (Alamo-C) and R-27ET (Alamo-D), respectively. In 1992 Russia announced that it has two new air-to-air missile versions. The R-27EA is equipped with an active radar homing head and the R-27EM is semi-active radar homing missile designed specifically for the Su-35 fighter (47).

AA-10C Alamo (R-27ER)



General Info:
Origin = Russia
Type = Long Range SAR Missile
Manufacture = Vympel
IOC = 1985
Guidance = Inertia, Command and SAR
Sensor Type = CW SARH (AA-10C)
Field of View = 5º
Gimbal Limit = 55º
Intercept = Pure pursuit
Platforms = Mig-29M/-33, Mig-31, Su-27, Su-27UB, Su-30M, Su-30MKK, Su-32, Su-33, Jaguar

Performance:
Range = 37nm
Speed = Mach 4
Lethal Radius = 38ft

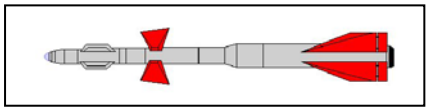
Dimensions:
Length = 15.5ft
Diameter = 10in
Weight = 771.5lbs

Warhead:
80lbs Expanding Rod

Description:

The R-27ER (AA-10C) is the improved AA-10A, with better range and tracking ability. A flight of SU27's armed with the AA-10C should be considered a serious threat to even amraam armed fighters, as the AA-10C can be launched further out. The missile must still be supported by the launching craft's radar until impact, but the potency of a Flanker-AA-10C threat cannot be taken lightly. The reported range is up to 130km under optimum condtions. (59nm approx)

AA-10D Alamo (R-27ET)



General Info:
Origin = Russia
Type = Long Range IR Missile
Manufacture = Vympel
IOC = 1985
Guidance = Inertia, Command and IR
Sensor Type = All-aspect IR (AA-10D)
Sensor Range = 8nm
Field of View = 2.5º
Tracking Rate = 16sec
Gimbal Limit = 20º
Intercept = Pure pursuit
Platforms = Mig-29M/-33, Su-27, Su-27UB, Su-30M, Su-30MKK, Su-32, Su-33

Performance:
Range = 41nm
Speed = Mach 4
Lethal Radius = 38ft

Dimensions:
Length = 14.7ft
Diameter = 10in
Weight = 756lbs

Warhead:
80lbs Expanding Rod

Description:

The R-27ET (AA-10D) is the AA-10C fitted with an IR seeker. Although this tracking system will reduce the aquisition range of the missile for launch, the AA-10D has extremely long legs for an IR missile.

AA-11 Archer (R-73)

General Info:
Origin = Russia
Type = Dogfight Missile
Manufacture = Vympel
IOC = 1992
Sensor Type = All-aspect IR
Sensor Range = 16nm
Field of View = 2.5º
Tracking Rate = 45sec
Gimbal Limit = 60º
Intercept = Lead pursuit

Performance:
Range = 16nm
Max g = 45
Max Target g = 12
Ceiling = 65600ft
TOF = 23sec
Lethal Radius = 16ft
Drag = 5

Dimensions:
Length = 9.5ft
Diameter = 7in
Fin Span = 20in
Weight = 276lbs

Warhead:
16lbs HE Fragmentation
Fuse = Radar proximity and Contact

Description:

The AA-11 Archer combines unprecedented maneuvering ability with equally unprecedented seeker agility. This allows an attacking fighter to acquire, fire upon and kill a target at a much larger angle off the missile boresight than a fighter armed with any other missile, including the AIM-9M Sidewinder. The missile gets its maneuverability from a complex system of aerodynamic control surfaces and thrust vectoring. A powerful motor and sensitive seeker extend the range of the missile to 20nm for head-on shots. To fully utilize its off-boresight capability, the Archer is normally integrated with a helmet-mounted sight.
Evasion
The Archer is less susceptible to flares and violent maneuvers than are other heat seeking missiles. In a head-on engagement, the AA-11 outranges the Sidewinder and can get in the first shot. In a neutral turning fight, the HMS/Archer combination gives its pilot an earlier shot advantage. One-on-one, a superior pilot should be able to negate these advantages, particularly if he picks his entry into the fight carefully. In a multiple-fighter furball, or when the fight is forced, the Archer might just provide the enemy with a decisive advantage.

AA-12 Adder (R-77)

General Info:
Origin = Russia
Type = Medium Range Missile
Manufacture = Spetztekhnika Vympel NPO
Guidance = Inertial command, Active Radar Homing
Platforms = SU33, SU27, SU35, Su37

Performance:
Range = 48.6-54nm
Speed = Mach 4

Dimensions:
Length = 141.7in
Diameter = 7.87in
Fin span = 13.8in
Weight = 385lbs

Description:

The most recent medium range air to air missile developed in Russia is the R-77 (AA-12 Amraamski). It is similar and in some respects equal to the American Aim120 Amraam. Some analysts believe that is is superior in some respects. The AA-12 has more kinetic energy due to its aerodynamic airframe and "trellis" rear control assembly. This gives a maneuvering advantage over the aim120. It also has a slight advantage in range.
This may be negated by the fact that the aim120 has better ECCM characteristics and tracking radar. The AA-12 has yet to prove this operationally.

PL-7 Thunderbolt

General Info:
Origin = China
Type = WVR IR Missile
Guidance = Rear-aspect IR
IOC = 1980s

Performance:
Range = 3.7nm
Speed = Mach 2.5

Dimensions:
Length = 107.9in
Diameter = 6.5in
Fin Span = 26in
Weight = 196lbs

Warhead:
27.6lbs High explosive

Description:

The PL-7 is a rear-aspect IR missile. ItÂ´s probably a PRC clone of the French Magic-I by Matra. The seeker characteristics are similar to that of the AIM-9PÂ´ seeker. Therefore, like the AIM-9P , the PL-7 is very susceptible against flares. The tracking rate, however, is superior to the AIM-9P. Likewise, manouverability is higher than the AIM-9p, but not as high as for the AIM-9M. Overall, the PL-7Â´s performance must be rated as midway between the two AIM-9 variants.

When defending against the PL-7, flare should usually work. However, when out of flares, the missile is difficult to evade because of the good manouverability. Creating tracking problems for the incomming missile is the way to go.

The shooting pilot should strive to pull less than 5g when launching the missile to minimize initial tracking problems.

PL-8 Thunderbolt

General Info:
Origin = China
Type = Dogfighting missile
Guidance = Rear-aspect IR
Sensor Type = All-aspect IR
Sensor Range = 3nm head-on
IOC = 1980s

Performance:
Range = 2-2.5nm tail-on
Speed = Mach 2.5

Dimensions:
Length = 107.9in
Diameter = 6.5in
Fin Span = 26in
Weight = 196lbs

Warhead:
27.6lbs High explosive

Description:

The PL-8 is probably based on the Israeli Python-3 design. Developed in the 1980´s, it is carried by the Chinese J-7III. There are also two naval version, the PL-8N and PL-8H.

The agile missile is powered by a high-impulse rocket motor. It´s manourability comes close to that of the AIM-9M, although it bleeds more speed at high g-maneuvres. The highly sensitive seeker has only limited ICCM and is susceptible against flares and ground-clutter. Seeker tracking rate is very high, comparable to the AIM-9M.

To spoof the missile force it to bleed energy by high-g turns and use flares. Due to the high speed of the PL-8 the target must react very quickly. When out of flares, the PL-8 can become quite dangerous. Generally, it is a good idea to handle every MiG-21 like a potential J-7III.

Except for the limited ground clutter rejection and and sun reflections, the PL-8 can be shot much like the AIM-9M

SURFACE MISSILES

AT-3 Sagger

General Info:
Type = ATGM
Origin = Russia
Manufacture = Nepobidmy
IOC = 1961
Guidance = MCLOS

Performance:
Effective Range = 3281yrds
Velocity = 394ft/sec
TOF = 27sec

Dimensions:
Length = 2.75ft
Diameter = 5in
Fin Span = 19in
Weight = 24lbs

Warheads:
6lbs HEAT
Fuzing = Contact
Armor = 16in

Description:

The AT-3 Sagger is a wire-guided ATGM equipped with a HEAT warhead. Early variants of the missile were guided by manual command (MCLOS), later variants by semi-automated-command-to-line-of-sight (SACLOS) In both cases, missile guidance commands are sent via a thin wire trailing behind the missile. Wire guidance makes the weapon extremely resistant to electronic countermeasures, although smoke can still obscure the gunner's view. The operator must give away his position away with the Sagger's bright flash and tell-tale smoke trail, and then must survive to guide the missile all the way to its target. This can be a problem, since gun rounds fired in return travel much faster than the Sagger does. The AT-3 can be fired by ground troops or mounted on a helicopter.

AT-4 Spigot

General Info:
Type = ATGM
Origin = Russia
IOC = 1975
Guidance = SACLOS

Performance:
Range = 2,187nm
Velocity = 600ft/sec
TOF = 11sec

Dimensions:
Length = 3.5ft
Diameter = 5in
Weight = 39lbs

Warheads:
5.5lbs HEAT
Fuse = Contact
Armor = 21.7in

Description:

The AT-4 Spigot is a lightweight, tube-launched, wire-guided ATGM equipped with a HEAT warhead. The missile uses semi-automated-command-to-line-of-sight (SACLOS) guidance over a trailing wire. The weapon was designed for use by dismounted infantry, but has been mounted on APCs as well.

AT-5 Spandrel

General Info:
Type = ATGM
Origin = Russia
Manufacture = KBP Design Bureau
IOC = 1977
Sensor Type = Optical sight
Guidance = SACLOS

Performance
Effective Range = 4374yrds
Velocity = 700ft/sec
TOF = 18sec

Dimensions:
Length = 4.5ft
Diameter = 7in
Weight = 53lbs

Warheads
6.6lbs HEAT
Fuzie = Contact
Armor = 19.7in

Description:

The AT-5 is a heavyweight version of the AT-4 designed for mounting and firing from armored personnel carriers. The increased weight allows for longer range and a heavier warhead.

AT-6 Spiral

General Info:
Type = ATGM
Origin = Russia
Manufacture = Nepobidmy
IOC = 1982
Guidance = SACLOS

Dimensions:
Length = 6ft
Diameter = 5in
Weight = 103lbs

Performance:
Effective Range = 5470yrds
Velocity = 1312ft/sec
TOF = 15sec

Warheads:
5lbs HEAT
Fuse = Contact
Armor = 9in

Description:

The AT-6 Spiral was primarily designed as a helicopter-launched weapon, but has been mounted on ground vehicles as well. The missile uses semi-automated-command-to-line-of-sight (SACLOS) guidance via a radio command link. Several warhead variants exist including a enhanced blast "bunker-buster" and an anti-reactive armor warhead.

AT-9, AT-16 Vikhr

General Info:
Origin = Russia
Type = ATGM
Guidance = Laser homing
Platforms = Su-25, KA-50

Performance:
Range = 4nm
Velocity = 500ft/sec

Dimensions:
Length = 2ft
Diameter = 5in
Fin Span = 12in
Weight = 37lbs

Warhead:
7lbs HEAT (Armour 250mm)
Fuse = Contact

Description:

The latest aircraft antiarmor missile is the 9A4172 of the Vikhr (AT-9) family for Ka-50 helicopters and Su-25T aircraft. It was built in Tula by A. Shipunov's group (Priborostroyeniye Design Bureau), builder of aircraft guns. The missile is fired from launchers containing a 6-8 pack. Its guidance system combines radio-command guidance during the initial flight stage followed by laser-beam guidance afterwards. The missile is a supersonic one with a 8-10 km range, its caliber is 125 mm, and its weight together with the launcher is 60 kg. The two-stage shaped-charge warhead is capable of piercing armor of equivalent to 900 mm thickness. With the switch set in the appropriate position on the pilot's panel in the cockpit, the Vikhr operates as an air-to-air missile with a radar turn-on for approach navigation. It is effective against airborne targets flying at speeds up to 800 km/h (600 km/h during rendezvous tacks).
Also available is an IC-35 flying target simulator for training a ship's air defense team in destroying missiles of this class. The "Zvezda" product line includes a variant of the Kh-35 missile which operates with thermal-imaging rather than radar guidance during the final flight stage.

AT-10 AT-2 Swatter

General Info:
Type = ATGM
Origin = Russia
IOC = 1960
Guidance = MCLOS

Performance
Effective Range = 2734yrds
Velocity = 492ft/sec
TOF = 17sec

Dimensions:
Length = 3.75ft
Diameter = 6in
Fin Span = 28in
Weight = 60lbs

Warheads:
12lbs HEAT
Armor = 19.7in

Description:

The AT-2 Swatter is a radio guided Anti-Tank Guided Missile (ATGM) equipped with a HEAT warhead. Early versions of the missile use manual command-to-line-of-sight (MCLOS) guidance, which requires the operator to manually control the missile's flight. Later versions use semi-automated-command-to-line-of-sight (SACLOS), which only requires that the operator keep the target in the launcher sights. An IR sensor tracks a flare on the missile tail and sends guidance commands to keep the flight path along the weapon's line of sight.

AT-16 VIKhR 9M120

General Info:
Type = Anti- Tank
Origin = Russia
Manufacture = NPO Mashinostroyenie
IOC = 1990
Guidance = Laser Beam Rider SACLOS

Performance
Range = 0.27-3.24nm
Speed = 164ft/sec

Dimensions:
Lenght = 94.5in
Diameter = 4.92in
Weight = 88.2lbs

Warheads:
12lbs HEAT
Armor = 39.4in

Description:

A modification of the Shturm-V family is the Ataka-V family of missiles used on Mi-28 helicopters and on the latest Ka-50 helicopter. The Vikhr antitank missile is also the main weapon of the Su-39. The aircraft is armed with 16 such missiles The Ataka-V family includes several versions, the basic one being the 9M120 with a shaped-charge warhead against armored targets and its improved version being the 9M220. Addition of a second warhead, a demolition warhead, has created the Fugasnaya [High-Explosive] 9M120F. Another version used against airborne targets is the 9A2200 with a rod warhead. All these missiles of the Ataka-V family have semiautomatic radio command guidance and a 6000 m range, the producer quoting a 0.95 probability of a hit. Missiles of the Malutka-Falanga-Shturm-Ataka families were built by the "Mashinostroyenie" Design Bureau in Izhevsk, which had been established by Boris Shavyrin and is now directed by Sergey Niepobiedimyy.

SA-2 GUIDELINE

General Info:
Type = SAM
Origin = Russia
Manufacture = Lavochkin/Grushin
IOC = 1959
Guidance = Command Fire Control & Tracking by a FAN SONG

Performance
Range = 19-27nm
Power Plant = solid booster and liquid sustainer
Speed = max Mach 4.5
Ceiling = 130000ft
Engagement Range = 3.8nm
Lethal Radius = 210ft

Dimensions:
Length = 34.77ft
Diameter = 27.56in
Weight = 5060lbs

Warheads:
440-650lbs HE, possible nuclear
Fuse = contact and proximity fuzes

Description:

The V-75 (SA-2) surface-to-air missile system was designed for the defense of both fixed targets and field forces. The V-75 was designed to cope with the threat posed by small groups of aircraft rather than massed raids. Flexibility and mobility are its chief advantages over the SA-1. In contrast to the massive SA-1 sites, each of which is capable of defending only a limited sector around the target area, each SA-2 site is capable of 360° coverage. This flexibility is obtained at the expense of target handling capacity and rate of fire relative to the SA-1.

Although there are a variety of arrangement patterns, all sites consist of six launching positions -- usually revetted - deployed around a guidance radar and linked by service roads to facilitate loading. While the sites were permanent installations, all operating components of the system are mounted on wheeled vehicles and are capable of movement by road or raiL

The V-75 was the basic missile defense system for critical urban-industrial areas in the USSR, other than Moscow. The V-75 deployment began on a wide scale since early 1958, with sites located throughout the western part of the Soviet Union and Warsaw Pact countries. Deployment patterns and levels of concentration varied according to the geography, size, and shape of the target area, and the Soviet estimate of the worth of individual targets. Between mid-1958 and 1964 more than 600 SA-2 sites were identified by US intelligence in the USSR, mostly in defense of population centers, industrial complexes, and government control centers.
Most SA-2 sites defended major centers of population and industry. SA-2 defenses were also deployed for the special protection of nuclear materials production and storage facilities. In addition, some key Soviet field forces and long range bomber bases were included in the SA-2 deployment pattern. The construction of sites and the training and activation of firing units was seasonal, with activity at a minimum during the winter months.
The sites in the Moscow area, located within the inner ring of SA-1 sites, were intended to supplement the existing defenses. Deployment of SA-2 installations around Moscow included seven sites as of 1964 as part of a program to supplement the SA-1 system.

Missile defenses were provided for most of the Soviet cities with populations greater than 200,000. SA-2 sites were emplaced at some smaller urban areas which contained government control centers or other installations of critical importance. They were also deployed for defense of naval and port facilities, nuclear production and weapon storage Installations, missile test ranges, and Industrial facilities. Other major military installations, such as long-range missile sites and alrfields of the long-range air force, are also defended by SA-2. A number of sites in border areas, which were unrelated to specific targets, were part of the deployment of peripheral defenses which eventually extended from the Kola Peninsula along the western and southern borders of the USSR into central Asia. Deployment in the Baltic coastal area was particularly dense. In mid-1962 about 750 sites were operational in defense of more than 200 target areas in the USSR. The Soviets eventually deployed roughly a thousand SA-2 sites in the USSR, with the major portion of the deployment completed by the mid-1960s.

Some SA-2 units were deployed in support of Soviet field forces in East Germany and in the USSR. Although SA-2 units assigned to Soviet field forces were normally emplaced at fixed installations, the system is transportable by road and SA-2 units were observed in field exercises. However, SA-2 units have a limited ability to follow a fast moving front because of the requirement for good roads and the time required to displace to new positions. SA-2 missile defenses for field forces were primarily assigned to such targets as major headquarters, logistic centers, and airfields.

Deployment of SA-2 sites for defense of Warsaw Pact targets began in 1960. The heaviest deployment has occurred in East Germany. About half of the sites were manned by East German troops, and the remainder by units of the Soviet field forces. The East German sites were located in the vicinity of Berlin and in the northern portion of East Germany. The Soviet sites were deployed to defend important Soviet military installations such as major headquarters and airfields.

SA-3 GOA

General Info:
Type = SAM
Origin = Russia
IOC = 1961
Guidance = Command (IR terminal homing)

Performance
Power Plant = two stage solid
Range = 3-15nm
Speed = >Mach 3
Ceiling = 84000ft
Lethal Radius = 41ft

Dimensions:
Length = 30ft
Diameter = 23.6in
Weight = 880lbs

Warheads:
132lbs HE

Description:

The S-125 SA-3 GOA medium altitude surface-to-air missile system uses a two-stage, solid-fuel missile built by the Isayev OKB. The S-125 missile includes a large 2.6 second burn-time solid propellant booster with rectangular fins that rotate through 90º at launch. The smaller main stage has an 18.7 second burn-time solid propellant sustainer motor, and has four aft fixed fins and four forward movable control. Following booster jettison the missile is tracked by the system's radar with guidance signals sent to an antenna on the rear fins.

US intelligence imagery at Kapustin Yar in late 1959 revealed two probable R&D sites, each of which consisted of four launch pads. A possible launcher on one of the pads held two missile-like objects about 20 feet long. US intelligence subsequntly identified more than 35 sites of this type in the USSR between late 1961 and 1964, usually near SA-1 or SA-2 sites. The initial SA-3A GOA Mod 0, deployed in 1961, includes command guidance throughout the missile's flight. The subsequent SA-3B GOA Mod 1, first deployed in 1964, incorporated an improved guidance system. The missile's ability to dive allows it to be used against surface targets and naval vessels.

Long-range surveillance and target acquisition is handled by the van-mounted P-15 FLAT FACE) radar. The P-15 radar has been replaced in many S-125 units by the P-15M SQUAT EYE radar, which has the antenna mounted on a 20-30 m mast for improved low altitude coverage. The accompanying PRV-11 SIDE NET E-band height-finding radar has a range of 180 km covering targets at altitudes of up to 32000 meters.

SA-4 GANEF

General Info:
Type = SAM
Origin = Russia
Manufacture = Antey Scientific Industrial Organization
IOC = 1967
Guidance = Command (SARH)

Performance
Power Plant = Ramjet sustainer, 4 solid rocket boosters
Range = 22nm
Speed = Mach 4
Ceiling = 80000ft

Dimensions:
Length = 28.9ft
Diameter = 33.8in
Weight = 5500lbs

Warheads:
300lbs HE

Description:

SA-4 GANEF is a medium to high altitude surface-to-air missile system. Over the years at least four variants of the missile have been produced, designated 9M8, 9M8M, 9M8M1 and 9M8M2, though external differences are minimal. The 9M8M1 and 9M8M2 variants are the primary types in service. The 9M8M1, introduced in 1967, is a 8.8 meter long-nosed version (the SA-4a) with effective range limits of 8 to 55 km and effective altitude limits of 100 to 27000 m. The 9M8M2, introduced in 1973, is the short-nosed 8.3 m version (SA-4b or GANEF Mod 1). It has improved close-range performance to reduce the dead zone above the TEL at the expense of losing some 3000 m in altitude and 5-10 km in maximum range capabilities. Both versions have a fuselage diameter of 0.86 m, a wing span of 2.3 m and a tail span of 2.73 m. The HE warhead weighs 135 kg and is detonated by a proximity fuse.
The missile is launched by four solid booster rockets mounted externally on the body. The missile is armed 300 meters from the launcher. After launch the boosters burn for about 15 seconds and then fall away when the fueled ramjet kerosene sustainer motor ignition speed of over Mach 1 is attained at about 9 km from the TEL. The four fins are fixed and the four wings, in two pairs, are hydraulically operated.
A battery typically has one TEL fitted with the 9M8M2 and two TELs with the 9M8M1 missile, although some TELs may carry one missile of each type. An electro-optical fire control system is fitted for use in a heavy ECM environment. Targets are initially detected by the long range LONG TRACK early warning E-band radar, which has a 150 km range and 30 km maximum altitude coverage. LONG TRACK is mounted on a lengthened version of the AT-T heavy artillery tractor with a large van body added, and is also used for the SA-6 SAM.
This system passes data to the SA-4 GANEF battery where the H-band PAT HAND continuous wave fire control and command guidance radar takes over. The PAT HAND radar is mounted on the same chassis as the GANEF launcher, with the whole assembly collapsed flat and a grill raised in front of the radar for road transit. This radar acquires the target at about 120-130 km and when it is within the 80-90 km tracking range a single missile is launched and guided to the target by the guidance beam with a semi-active terminal homing phase for the final stage. The missile is tracked in flight by a continuous wave radar transponder beacon attached to one of the tail fins. If required the PAT HAND can handle two missiles per target in order to increase the kill probability.

SA-5 GAMMON

General Info:
Type = SAM
Origin = Russia
Manufacture = Fakel/Almaz
IOC = 1967
Guidance = Command (SARH)
Radar Range = 6nm
Sweep rate = 11°/sec
Beam width = 4°
Max scan angle = 39°
Pulse radar

Performance
Power Plant = 4 solid propellant boosters, solid dual thrust sustainer rocket motor
Range = 16.5nm
Speed = Mach 4
Ceiling = 80000ft

Dimensions:
Length = 35.2ft
Diameter = 33.5in
Weight = 5500lbs

Warheads:
473lbs HE Proximity and command

Description:

The S-200 SA-5 GAMMON is a medium to high -altitude surface-to-air missile system. The single-stage missile has four jettisonable, wraparound solid propellant boosters, each of which is is 4.9 m long and 0.48 m in diameter with a single fin spanning 0.35 m from the booster body. The missile is 10.72 m long overall with a wing span of 2.85 m. The main body is 0.85 m in diameter and has a solid fuel dual thrust sustainer rocket motor.
Each missile battalion has one 320 km range P-35M BARLOCK-B E/F-band target search and acquisition radar with an integral D-band IFF system, one 270 km range SQUARE PAIR H-band missile guidance radar, and six trainable semi-fixed single rail launchers.
The missile's minimum range of 60 km is due to the booster burn time and jettison requirements, limiting the system to engagements against relatively large unmaneuverable targets at ranges up to 250 km. Guidance beyond the 60 km booster jettison point is by course correction command signals from the SQUARE PAIR radar with the S-200's own active radar terminal homing seeker head activated near the projected intercept point for final guidance.
The large HE warhead is detonated either by a command signal or the onboard proximity fusing system. When fitted with a nuclear warhead only the command detonation option is used.

SA-6 GAINFUL (SA-N-3)

General Info:
Type = SAM
Origin = Russia
Manufacture = Vympel
IOC = 1970
Guidance = radio command
Sensor Type = semi-active radar terminal

Performance
Power Plant = two stage, solid-fuel
Range = 15nm
Speed = Mach 2.8
Ceiling = 40000ft

Dimensions:
Length = 228.4in
Diameter = 13.2in
Wing span = 49in
Weight = 1320lbs

Warheads:
130lbs HE fragmentation
Fuse = contact and proximity fuzes

Description:

The SA-6 GAINFUL is a two stage, solid-fuel, low-altitude SAM. It has radio command guidance with semi-active radar terminal homing. The 3M9 KUB self-propelled surface-to-air tactical low-altitude anti-aircraft missile system is intended for destruction of aircraft, missiles, cruise missiles and assault helicopters at low to medium altitudes. The system was developed by the Russian TOROPOV OKB-134 company and produced by Vympel MKB and NIIP. It first entered operational service in 1970. The system is characterised by a very good mobility even in demanding cross-country conditions, and by a high speed of its anti-aircraft missiles achieving up to M =2.8, which permits to destroy even highly manoeuvring air targets. Each battery has its own STRAIGHT FLUSH (IS-91) fire control radar, four launchers on an armoured carrier chassis, and four transport and support vehicles. The system can carry out combat activities in a totally independent manner - it can search, automatically track and recognise air targets, illuminate them and provide anti-aircraft missiles homing. The system can guide three missiles to one target at any given time. It can automatically track up to 6 air targets and control 2 missiles at the same time. Reloading of the missiles from transport vehicle to launcher takes about 10 minutes. A built-in TV camera with the range of 25 km range increases the resistance of the system against EW. The last SA-6B Gainful Mod 1 version with increased EW resistance was produced till 1992.

Development of the 3M9 antiaircraft missile for the Kub [Cube] system ended the career of Ivan Ivanovich Toporov, founder of the OKB-134 Special Engineering Office. The missile designed had not been experimentally verified, and it became necessary not only to build the missile but also to simultaneouly conduct basic research. During the initial test launch in 1961, the 3M9 missiles disintegrated in the air. The associated aerodynamic, engine, and guidance problems compelled Toporov to ask the Ministry of Armaments to extend the deadline for submitting the 3M9 to governmental tests. Toporov was removed from his post of chief engineer at the end of August 1961, becoming department chairman at the Moscow Institute of Aviation, and replaced by Andrey Lyapinov as director of the team. This did not accelerate the work on the 3M9.

Finally in 1966 the missile together with all the Kub equipment was certified as an operational weapon, and it turned out to be one of the most successful Russian antiaircraft missiles. Although it is frequently reported that a naval version of the missile is the SA-N-3 GOBLET, this is evdiently not the case.

The SA-6a missile has a length of 5.7 meters, body diameter of 0.335 meters, a wing span of 1.245 meters, a tail span of 1.524 meters and has a launch weight of 599 kilograms with a 56 kilogram HE-fragmentation warhead. The proximity and contact fuses are armed after some 50 meters of flight. The basic SA-6a has a maximum effective range of 24,000m and has a minimum effective range of 3,000m, the minimum engagement height is 100m when using the fire control (STRAIGHT FLUSH) radar and 80m when in the optical tracking mode, the maximum effective altitude is about 11,000m.

A battery is able to relocate to an alternate firing position in approximately 15 minutes from systems being shutdown. In 1977, a new version - the SA-6b Gainful, was mounted on an SPU medium-tracked transporter. The SPU carried three SA-6b missiles and also an associated FIRE DOME H/I-band missile guidance illuminator radar is fitted on the front end of the launcher assembly. Reload missiles are carried on modified 6x6 trucks and are loaded manually onto the launcher by a crane carried on the rear of the loader vehicle. Reloading an TEL takes approximately 10 minutes.

The STRAIGHT FLUSH fire control radar has a maximum range of 55 - 75km and a 10,000m altitude capability depending upon the conditions and target size, and performs limited search, low altitude detection and/or acquisition, pulse Doppler IFF interrogation, target tracking & illumination, missile radar command guidance and secondary radar missile tracking functions. Some modified fire control (STRAIGHT FLUSH) radars use a TV camera with a 30km range to enable the battery to remain in action even if the vehicle's radar is jammed or forced to shut down due to threats from anti-radiation missiles. This radar can also be linked to the launch vehicles by either a radio data link or a 10m long cable for direct data input to the launcher's systems. The data link antenna is carried on the right forward hull corner of the TEL. It also carries the fire control computers for the SA-6 Gainful missile battery.

The foldable 28km range dish antenna is of the conical scanning type and is used for low altitude H-band sector search scans, target tracking and target illumination. The lower parabolic antenna is the G-band medium altitude target acquisition and early warning radar with a 55-75km range, with the lower feed for medium to high altitude coverage and the upper feed for low altitude coverage.

The STRAIGHT FLUSH fire control radar can begin target acquisition at its maximum range of 75km, and begin tracking & illumination at 28km. The STRAIGHT FLUSH radar can only illuminate a single target and control three missiles at any one time so normal practice when a target track has been initiated is to normally order the launch of two and sometimes three weapons from one or more TELs.

SA-7 GRAIL (HN-5A)

General Info:
Type = SAM manpad
Origin = Russia
Manufacture = Strela
IOC = 1968
Guidance = Rear-aspect IR
Sensor Type = semi-active radar terminal

Performance
Range = 3nm
Speed = Mach 1.7
Ceiling = 15000ft
Min. Eng. Alt = 700ft
Max. Eng. Alt = 7000ft (SA-7), 7500ft (HN-5A)
Engagement Range = 0.2nm

Dimensions:
Length = 4.6ft
Diameter = 2.8in
Weight = 22lbs

Warheads:
2.5lbs HE
Fuse = contact and proximity fuzes

Description:

The HN-5A is a Chinese variant of the SA-7 with improved capabilities. It's performance places the HN-5A mid-way between the SA-7 and the SA-14.
Any pilot unfortunate enough to encounter a squad of ground troops armed with this weapon is in for an unpleasant surprise. These shoulder-launched SAMs have IR guidance and home in on exhaust pipes. Fortunately, this also proves to be a weakness. The SA-7 must be fired directly at the rear of an aircraft in order to get a lock, and it is exceptionally vulnerable to flare countermeasures. Even if one of these missiles hits a plane, there's no guarantee that the aircraft will be taken out. As a result, the Grail is primarily a defensive weapon.
The HN-5A is a Chinese variant of the SA-7 with improved capabilities. It's performance places the HN-5A mid-way between the SA-7 and the SA-14.

SA-8 GECKO

General Info:
Type = SAM
Origin = Russia
Manufacture = Antey OKB
IOC = 1980
Guidance = Command, RF CLOS

Performance
Range = 9nm
Speed = Mach 2.5
Ceiling = 40000ft

Dimensions:
Length = 10.35ft
Diameter = 8.2in
Weight = 374lbs

Warheads:
88lbs HE contact and proximity fuzes

Description:

The SA-8 GECKO is a single-stage, solid-fuel, short-range, low-altitude, all-weather SAM system. The first production version of this system was identified as SA-8a, which only had 4 launcher rails and exposed missiles. The SA-8b typically has two BAZ-5937 resupply/transloader vehicles, carrying 18 missiles each (boxed in sets of three) that supports a battery of four TELARs. A target can be brought under fire both with one missile as well as a volley of two missiles. This system is also air transportable. The SA-8a (GECKO Mod 0) high acceleration missile (Factory Index number 9M33) has a launch weight of about 130 kg. Maximum speed is Mach 2.4, minimum altitude is 25 meters, maximum effective altitude 5000 meters. The minimum range is 1500 meters and the maximum range 12000 meters. The SA-8b or GECKO Mod 1, introduced in 1980, is mounted in a rectangular launch box and incorporates improved guidance and higher speed providing an increased maximum range of 15000 meters. The warhead of both missiles is fitted with proximity and contact fuses, and the 19 kilogram warhead's lethal radius at low altitude is about 5 meters. The system reload time is five minutes, and combat deployment time is four minutes with system reaction 26 seconds. The LAND ROLL conical-scan fire control radar operates in the H-band with a 360º travers, with a maximum range of 35 kilometers and an effective range of around 30 kilometers against a typical target. LAND ROLL also has a short-range target acquisition capability. The radar, at the rear of a one-man gunner-radar operator position, folds back 90º to reduce the overall height of the vehicle for air transport and high speed road travel. The pulsed-mode tracking radar operates in the J band with a range of 20 to 25 kilometers. The two I-band guidance radars make it possible to launch two missiles at the same target, each one responding to a different frequency to frustrate ECM. Mounted on top of each missile guidance radar is an low light level TV optical assist system for target tracking in low visibility and heavy ECM.
The SA-8 transporter erector launcher and radar (TELAR) vehicle is a six-wheeled design designated BAZ-5937. Four command-guided missiles are carried ready to launch, two either side. The driver's compartment at the front of the vehicle has accommodation for two, the driver and commander, with access via a hatch in the roof. The engine is at the very rear, and the vehicle is fully amphibious, being propelled in the water by two water jets at the rear of the hull. The vehicle is fitted with an air filtration and overpressure NBC system together with IR systems for the commander and driver.

SA-9 GASKIN

General Info:
Type = SAM
Origin = Russia
Guidance = 1-3 m waveband uncooled PbS
passive IR homing seeker

Performance
Speed = Mach 1.8
Power Plant = single-stage solid propellant rocket motor
Max. Altitude = 12000ft
Range = 4.3nm
Lethal Radius = 16ft

Dimensions:
Length = 5.9ft
Diameter = 4.7in
Weight = 70.4lbs

Warheads:
5.7lbs HE contact and proximity fuzes

Description:

The SA-9 GASKIN is a short-range, low-altitude self-propelled SAM-carrying system based on the BRDM-2 chassis. The vehicle carries quadruple SA-9 SAM launchers on a revolving mount in place of the KPV/PK machine gun turret. The missiles are usually fired in pairs against each target to increase the kill probability, with an interval between rounds of about five seconds. Reloading is performed manually and takes about five minutes.
The 30 kilogram Mach 1.5 Strela-1 missile is 1.8 meters long and 0.12 meters in diameter with a wing span of 0.375 meters. It carries an HE-fragmentation warhead and proximity fuse with a lethal radius of 5 meters and damage radius of 7.6 meters. The original version of the Strela-1 was known as the 9M31 (SA-9A GASKIN Mod 0) and used an uncooled first-generation lead sulfide (PbS) infra-red (IR) seeker operating. This was supplemented by the 9M31M variant (SA-9B GASKIN Mod 1) which has an improved seeker providing greater target sensitivity and lock on ability. The minimum range of the 9M31 is 800 m and the maximum range 6500 m within altitude limits of 15 to 5200 m. The minimum range of the 9M31M is 560 meters and the maximum range 8000 meters (increasing to a possible 11000 meters when used in a tail-chase engagement) within altitude limits of 10 to 6100 meters. When engaging a head-on target the system has a considerably reduced range.
One SA-9 TEL (SA-9 Mod A, BRDM-2A1 or SA-9A TEL) in each battery is fitted with FLAT BOX A passive radar detection antenna, one either side of the hull above the front wheel housings, one under the left launch canisters pointing forward and one mounted on a small frame above the rear engine deck plate pointing rearwards to give 360º coverage. The TEL without the FLAT BOX A system is known as the SA-9 Mod-B, BRDM-2A2 or SA-9B.
The BRDM-2 transporter erector launcher (TEL) has the chain-driven belly wheels removed and the normal turret replaced by one with four ready to launch SA-9 container-launcher boxes. These are normally lowered to the horizontal when traveling to reduce the overall height of the vehicle. The vehicle crew of three consists of the commander, driver and gunner. An air-filtration and overpressure NBC system are standard.

SA-10 GRUMBLE (SA-N-6)

General Info:
Type = SAM
Origin = Russia
Manufacture = Almaz Scientific-Production Association
IOC = 1980
Guidance = radio command

Performance
Power Plant = single-stage solid propellant rocket motor
Range = >50nm
Speed = 0.92nm/sec
Ceiling = 100000ft

Dimensions:
Length = 275in
Diameter = 17.7in
Weight = 3263lbs

Warheads:
220lbs HE-fragmentation
Fuse = proximity

Description:

The S-300PMU [SA-10 land-based, SA-N-6 naval version] surface-to-air missile system is able to engage a number of targets simultaneously, countering intensive aircraft raids at low-to-high altitude. The SA-10 offers significant advantages over older strategic surface-to-air missile systems, including multitarget handling and engagement characteristics, a capability against low altitude targets with small radar cross-sections such as cruise missiles, a capability against tactical ballistic missiles, and possibly a potential to intercept some types of strategic ballistic missiles.
The first SA-10 site became operational in 1980. Over 80 sites were operational by 1987, when work was progressing on at least another 20 sites. Nearly half of these sites were located near Moscow. This emphasis on Moscow as well as the deployment patterns noted for the other SA-10 sites suggested a first priority on terminal defense of command-and-control, military, and key industrial complexes. A program to replace all of the older strategic SAM systems with the SA-10, well under way by 1996, has been considered by experts to be one of the most successful reequipment programs of the post-Soviet armed forces.
This vertically launched missile uses a single-stage solid propellant rocket motor. It is normally armed with a 100 kg HE-fragmentation warhead with a proximity fuse, though a low yield tactical nuclear type is believed to be an alternative warhead option. The missile's vertical launch trajectory provides fastest available reaction time capability to counter targets approaching from any azimuth. Missile engagement altitude extend from 25 m up to about 30,000 m. The maximum engagement range is stated as at least 90000 m, though in practice it is probably greater.
The SA-10A launch complex consists of a missile battery which includes a battery command post and engagement control center, the large CLAM SHELL 3D continuous wave pulse Doppler target acquisition radar, the FLAP LID A I-band multi-function phased-array trailer-mounted engagement radar with digital beam steering in hardened sites, and up to 12 semi-trailer erector-launchers which mount four tubular missile container-launchers. The towing unit for the semi-trailer erector-launcher is the KrAZ-260V (6 x 6) tractor truck. The launchers are usually positioned on concrete pads with the trailers being leveled by the use of four hydraulic jacks. An S-300PMU Regiment comprises three such batteries and employs the BIG BIRD 4 meter tall F-band long-range, 3D surveillance and tracking radar at the Regimental command post for initial target detection.

SA-11 GADFLY (SA-N-7)

General Info:
Type = medium-range SAM
Origin = Russia
Manufacture = Dolgoprudny
IOC = 1979
Guidance = semi-active
(for dense ECM environment)
Sensor Range = 85km
Single-shot kill probability = 30-70%

Performance
Power Plant = solid-rocket
Speed = Mach 3.5
Range = 1.6-15nm
Ceiling = 45000ft
Lethal Radius = 55ft

Dimensions:
Length = 224in
Diameter = 5.1in
Weight = 1521lbs

Warheads:
155lbs HE-fragmentation

Description:

The SA-11 GADFLY is a medium-range, semi-active, radar-guided missile using solid-rocket propulsion that provides defense against high-performance aircraft and cruise missiles. The SA-N-7 GADFLY is the naval Version of the SA-11.
The SA-11 represents a considerable improvement over the earlier SA-6 GAINFUL system, and can engage six separate targets simultaneously, rather than the single target capability of the SA-6. Single-shot kill probability are claimed to be 60-90% against aircraft, 30-70% against helicopters, and 40% against cruise missiles, a significant improvement over the SA-6. The system is more mobile, taking only about 5 minutes to move from road march to engagement. The new system also offers significantly greater resistance to ECM than previous systems. The SA-11 system is comprised of the TELAR (9A310M1), Loader/Launcher (9A39M1), SNOW DRIFT Surveillance Radar (9S18M1), and Command and Control vehicle (9S470M1).
The Mach 3 semi-active homing 9M28M1 missile has a maximum slant range of 28 km and a minimum range of 3 km. It is capable of engaging targets between altitudes of 30 and 14000 m and can sustain 23 g maneuvers. The solid fuel missile is 5.6 meters long with a diameter is 0.4 m and a wing span is 1.2 m. The launch weight is 650 kg, which includes a 70 kg HE warhead with a 17 meter lethal radius.
The SNOW DRIFT warning and acquisition radar provides target height, bearing and range data. The SNOW DRIFT has a detection range of 85 km against high-flying targets, 35 km against targets at an altitude of 100 meters, and 23 km against targets flying nap-of-the-earth (NOE). The radar's tracking range extending from 70 km for high-flying targets to 20 km for NOE targets. Tracking of helicopters hovering at 30 m can be made as far as 10 km. Once a target is identified it is turned over to an TELAR via a data link for tracking and attack. The SNOW DRIFT receives early warning from brigade-level surveillance radars such as the SPOON REST.
The H/I-band FIRE DOME monopulse guidance and tracking engagement radar has an effective guidance range of 3-32 km and an altitude envelope 15 meters to 22 km, and can engage approaching targets moving at a maximum of 3000 km/h (1860 mph). The radar guides as many as three missiles against a single target.

SA-12 GLADIATOR/GIANT

General Info:
Type = low-to-high Altitude, tactical SAM
Origin = Russia
Manufacture = JSC "Kalinin Machine Plant Ekaterinburg"
IOC = 1986
Guidance = Command and Inertia, Semiactive radar

Performance
Power Plant = Solid
Range = 3.2-40nm
Speed = 0.9nm/s (? Can't believe)
Ceiling = 13.5nm

Dimensions:
Lenght = 295in
Weight = 3880lbs

Warheads:
330lbs Nuclear or HE

Description:

The S-300V (SA-12) low-to-high Altitude, tactical surface to air missile system also has anti-ballistic missile capabilities. The HQ-18 reportedly the designation of a Chinese copy of the Russian S300V, though the details of this program remain rather conjectural. In early 1996 Russia astounded the United States Army by marketing the Russian SA-12 surface-to-air missile system in the UAE in direct competition with the United States Army's Patriot system. Rosvooruzheniye offered the UAE the highest-quality Russian strategic air defense system, the SA-12 Gladiator, as an alternative to the Patriot at half the cost. The offer also included forgiveness of some of Russia's debt to the UAE.

The 9M83 SA-12a GLADIATOR is a dual-role anti-missile and anti-aircraft missile with a maximum range between 75 and 90 km.
The 9M82 SA-12b GIANT missile, configured primarily for the ATBM role, is a longer range system [maximum range between 100 and 200 km] with a longer fuselage with larger solid-fuel motor.
The 9A82 SA-12b GIANT and 9A93 SA-12a GLADIATOR TELAR vehicles are similar, though the 9A83-1 carries four 9M83 SA-12a GLADIATOR missiles, whereas the 9A82 carries only two 9M82 SA-12b GIANT missiles. The configuration of the vehicles command radar is also different. On the 9A83-1 the radar is mounted on a folding mast providing 360º coverage in azimuth and full hemispheric coverage in elevation. The radar on the 9M82 TELAR is mounted in a semi-fixed position over the cab, providing 90º coverage on either side in azimuth and 110º in elevation. The TELARs are not capable of autonomous engagements, requiring the support of the GRILL PAN radar.
The 9S457-1 Command Post Vehicle is the command and control vehicle for the SA-12 system, which is supported by the BILL BOARD A surveillance radar and the HIGH SCREEN sector radar. The CPV and its associated radars can detect up to 200 targets, track as many as 70 targets and designate 24 of the targets to the brigade's four GRILL PAN radar systems for engagement by the SA-12a and SA-12b TELARs.
The BILL BOARD A radar provides general surveillance, with the antenna rotating every 6-12 seconds. The radar, which can detect up to 200 targets, provides target coverage of 0-55º in elevation and 10-250 km in range with an accuracy is 30-35 min of arc in azimuth and 250 m in range. and.
The HIGH SCREEN sector radar supporst the ATBM role, providing surveillance of anticipated azimuths of threat missiles. The radar is switches to a tracking mode when high speed targets are detected, automatically transmiting the trajectory parameters to the Command Post Vehicle. The CPV prioritizes the threat and instructs the HIGH SCREEN radar to track specific missiles, with the maximum being 16 simultaneous targets.

The GRILL PAN radar system controls the battery's launcher vehicles (TELARs and LLVs). It can simultaneously track up to 12 targets and control up to six missiles against these targets The radar can acquire targets with a radar cross-section of 2m2 at a range of 150 km in manual mode and 140 km in automatic mode. The GRILL PAN tracks targets assigned to it by the CP while simultaneously maintaining a horizon search for new targets.

The LLVs (9A85 GLADIATOR and 9A83 GLADIATOR) resemble normal TELARs, but with a loading crane rather than command radars. While the primary role of the LLV is to replenish the TELARs, they can also erecting and launch missiles if needed, though they are dependent on the use of command radars from neighboring TELARs.

SA-13 GOPHER

General Info:
Type = SAM
Origin = Russia
IOC = 1981
Guidance = passive lead sulfide all-aspect infra-red or cryogenically cooled passive all-aspect infra-red
Sensor Range = 6nm
Field of View = 2º
Gimbal Limit = 30º
Tracking Rate = 12º/sec

Performance
Speed = Mach 2
Range = 0.3-2.7nm
Ceiling = 11000ft

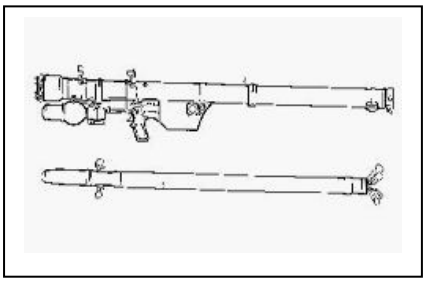
Dimensions:
Length = 86.6in
Diameter = 4.7in
Fin Span = 15.75in
Weight = 92.6lbs

Warheads:
11lbs HE

Description:

The 9K35M STRELA-10M (S-10M) surface-to-air missile system is intended to defend troops from enemy air attacks in all sorts of combat activities. Its NATO code name is SA-13 GOPHER.
The combat assets of the system consist of the 9A34 and 9A35 combat vehicles and 9M37 anti-aircraft missiles. Technological assets include a test station, technological maintenance equipment, operator´s simulator, a dummy missile (a weight equivalent of the real missile), a training missile, and an operator´s checking device. The MT-LB light armoured tracked vehicle provides the entire system with excellent cross-country capabilities. The combat vehicles have been gradually modernised; the upgrade consists in installation of a new command workplace (PVK-10M). The PVK-10M provides for reception and processing of data files and information on air situation. It enables turning of the launcher against the selected target according to data sent from a command post or directly from the radar. The PVK-10M software also provides for the control of individual devices of the combat vehicle; moreover, it enables to use the system in a simulator regime and it provides for the operation of the 9F75 control device which, as a result, doesn´t have to be awkwardly connected to the vehicle during combat fire. To ensure a credible identification of air targets, the original transponder system KREMNYJ-2 used in S-10M vehicles is being substituted by the MARK XII. The 9M37 missile with an infrared guidance unit and a solid propellant engine enables maximum speed of Mach 2 and it is capable of hitting a target flying at up to Mach 1.25. The missile uses a 6 kg HE-fragmentation core warhead. A container is used for safe storage and transportation of the missile, its connection to the launcher, aiming and launching. Some combat vehicles are fitted with a 9S16 radio direction finder for air target acquisition. The range of detection provides for a sufficient set-up time for turning the combat vehicle´s turret and launcher towards the target. The SA-13 GOPHER [ZRK-BD Strela-10] is a short-range, low altitude SAM system. The SA-13 missile (9M37) is 2.2 m long, 0.12 m in diameter with a 0.4 m wingspan and has a maximum speed of Mach 2. It carries a 5 kg HE warhead and is fitted with either an improved passive lead sulfide all-aspect infra-red seeker unit, or a cryogenically cooled passive all-aspect infra-red seeker unit. The estimated minimum range of the SA-13 is 500 meters and the maximum effective range of 5000 meters with altitude engagement limits of 10 to 3500 meters.

SA-14 GREMLIN



General Info:
Type = SAM (manpad)
Origin = Russia
IOC = 1978
Guidance = passive IR homing

Performance
Speed = Mach 2
Range = 0.32-3.2nm
Ceiling = 19700ft

Dimensions:
Length = 4.6ft
Diameter = 3in
Weight = 6.5lbs

Warheads:
2.2lbs HE
Fuse = Contact/grazing

Description:

SA-14 GREMLIN (Strela-3 9K34) man-portable SAM is the successor to the SA-7/SA-7b (Strela-2 9K32 and Strela-2M 9K32M). The system consists of the 9P59 gripstock, 9P51 thermal battery/gas reservoir, and 9M36-1 missile. The external appearance of the SA-14 is very similar to the SA-7, and the gripstock, launch canister and aft missile body are almost identical. The most significant differences are the new seeker system and the substitution of a ball-shaped 9P51 thermal battery and gas reservoir for the SA-7's canister shaped battery. The SA-14's new nitrogen-cooled lead sulfide seeker allows it to home in on the exhaust plume of jet engines, turboprop and helicopter gas turbine engines. The enhanced seeker allowed the SA-14 to be fired against targets from much broader angles, as well as defeating countermeasures such as exhaust shrouds. Optical filtration was added to the seeker to reduce vulnerability to typical IRCM flares. The warhead of the SA-14 was nearly doubled in weight over the small warhead of the SA-7. The guidance electronics were reduced in weight and a new solid-propellant motor was introduced, compensating for the heavier warhead and improving aerodynamic performance. The SA-14 has a maximum range of 4500 meters, and a maximum altitude of 3000 meters.

SA-15 GAUNTLET (SA-N-9)

General Info:
Type = SAM
Origin = Russia
IOC = 1988
Guidance = Command Radar
Sensor Type = K-band Doppler, Phased Array
Sensor Range = 10.8nm

Performance
Speed = Mach 3
Range = 0.05-6.5nm
Ceiling = 20000ft

Dimensions:
Length = 114.2in
Diameter = 9.25in
Weight = 368lbs

Warheads:
33lbs HE
Fuse = RF Proximity

Description:

The Tor-M1 is the successor to the Osa (NATO: SA-8 Gecko) surface-to-air missile (SAM) system. The 9K331 Tor [SA-15 GAUNTLET land-based, SA-N-9 naval version] low-to-medium altitude SAM system is capable of engaging not only aircraft and helicopters but also RPVs, precision-guided weapons and various types of guided missiles.
The principal advantages of Tor-M1 is its ability to simultaneously destroy two targets in any weather or at any time of day and night; the use of both the powerful and jamming-resistant radar with electronic beam control and vertically launched missiles able to maintain high speed and manoeuvrability inside an entire engagement envelope; the high degree of automation of combat operation provided by the electronic equipment suite. Tor detects targets at a distance of 25 kilometers and kills them at a distance of 12 kilometers. In combating manned aviation, Tor is thrice and 1.5 times more efficient than foreign systems of the same class - France's Crotale and Britain's Rapier, respectively.
The HQ-17 is a copy of Tor-M1, that China will use it to replace the aging HQ-61 SAMs, will enter service around the year 2005.
Although it is an autonomous system it can be interfaced into an integrated air defense network. SA-15b is designed to be a completely autonomous air defense system (at division level), capable of surveillance, command and control, missile launch and guidance functions from a single vehicle. The basic combat formation is the firing battery consisting of four TLARs and the Rangir battery command post. The TLAR carries eight ready missiles stored in two containers holding four missiles each. The SA-15b has the capability to automatically track and destroy 2 targets simultaneously in any weather and at any time of the day.
The single stage solid propellant missile has a maximum speed of 850 m/s and is fitted with a 15 kg HE-fragmentation warhead detonated by a proximity fusing system. The missile is approximately 3.5 meters long with a diameter of 0.735 meters and a launch weight 170 kilograms. The cold launch ejection system propels the missile upwards to a height of 18-20 meters, whereupon thruster jets ignite and turn the weapon to the target bearing. The main sustainer rocket motor then ignites and the missile is command guided to the intercept point where the proximity fuse is triggered.
Effective range limits are from 1500 to 12000 m with target altitude limits being between 10 and 6000 m. The maximum manoeuvring load factor limit on the weapon is 30 g.

SA-16 GIMLET

General Info:
Type = SAM (manpad)
Origin = Russia
Manufacture = Nepobidimy OKB
IOC = 1986
Guidance = passive 2-color IR and UV homing

Performance
Speed = >Mach 2
Range = 0.27-2.7nm
Ceiling = 11500ft

Warheads:
4.4lbs HE
Fuse = Contact/grazing

Description:

SA-16 GIMLET (Igla-1 9K310) man-portable surface-to-air missile system, a further development from the SA-7 & SA-14 series, is an improved version of the SA-18 GROUSE, which was introduced in 1983, three years before the SA-16. The SA-16 feattures a new seeker and modified launcher nose cover. Whereas the the SA-18 9M39 missile is fitted with an aerodynamic spike on the nose, the 9M310 missile of the SA-16 has the spike replaced with an aerodynamic cone held in place with a wire tripod. On the SA-18 the protective cover of the seeker is conical, on the SA-16 it is tubular with a prominent lip at the forward edge. The 9M313 missile of the SA-16 employs an IR guidance system using proportional convergence logic, and an improved two-color seeker, presumably IR and UV). The seeker is sensitive enough to home in on airframe radiation, and the two-color sensitivity is designed to minimize vulnerability to flares. The SA-16 has a maximum range of 5000 meters and a maximum altitude of 3500 meters.

SA-17 GRIZZLY (SA-N-12)

General Info:
Type = SAM
Origin = Russia
Manufacture = Almaz / Fakel
IOC = 1995
Guidance = SARH

Performance
Speed = Mach 3.1
Range = 24.3nm
Ceiling = 45000ft
Lethal Radius = 56ft

Dimensions:
Length = 224.4in
Diameter = 15.75in
Fin Span = 33.9in
Weight = 1550lbs

Warheads:
155lbs HE
Fuse = Proximity

Description:

SA-17 GRIZZLY is a new mobile SAM system to augment and eventually replace the SA-11 GADFLY. The new system uses the same launch vehicle chassis, and overall has a similar configuration to the SA-11 GADFLY. The SNOW DRIFT surveillance radar is also carried on the modified GM-569 tracked vehicle chassis. Russia is upgrading the Belorussian Buk (NATO: SA-11 Gadfly) air defence missile system at the Uliyanovsk Mechanical Plant. The new Buk-M1-2 (SA-17 Grizzly) system has increased fire power, and guarantees hits against six targets flying simultaneously from different directions and at different altitudes.

The Yezh naval version [SA-N-12] of the SA-17 is visually Identical to SA-N-7.

The HQ-16 is a joint development project between China and Russia that apparently represents a further evolution of the Russian Grizzly. The system would represent a significant overall improvement in Chinese air defense capabilities. The HQ-16 will reportedly have a range of 50 miles and the ability to hit both high and low flying targets.

SA-19 GRISOM

General Info:
Type = SAM
Origin = Russia
Manufacture = KBP Instrument Design Bureau
IOC = 1986
Guidance = radio commands with IR or radio direction finding

Performance
Speed = Mach 3.5
Range = 10nm
Ceiling = 11500ft
Single shot kill probability = 65%

Dimensions:
Length = 10.5ft
Diameter = 6.7in
Weight = 143lbs

Warheads:
35.2lbs HE fragmentation rod
Fuse = Proximity

Description:

The SA-19 GRISOM (9M111) is a radar command guided, two-stage surface to air missile mounted on the 2S6 Integrated Air Defense System. The 2S6 vehicle is fitted with two banks of four missiles in blocks of two, which can be elevated vertically independent of each other. The SA-19 can engage aerial targets moving at a maximum speed of 500 meters/second at altitudes ranging from 15 to 3,500 meters, and at slant ranges from 2400 to 8000 meters. The missile's high-explosive fragmentation warhead is actuated by a proximity fuse if the missile passes within 5 meters of the target. The SA-19 is claimed to have a kill probability of 0.65.
The SA-19 missile is a two-stage command-guided missile. The missile system is composed of the fire control unit, launcher, missile tracker, and the canistered missile, and is supported by the direct-view optics (DVO) and the HOT SHOT target tracking and acquisition radars onboard the 2S6M. Typical reaction time is 8-12 seconds.
During a missile action the radar first locks on the target, as in the case of gun employment, and then lays the slaved optical sight on the target. Subsequently the gunner assumes target tracking functions through his optical sight, and the radar is used for relaying the trajectory correction commands to the missile in flight. Immediately prior to the launch, the turret is turned slightly off-axis, so that the smoke caused by the launch will not obstruct the sight on the target.
The 2S6M must be stationary during the launch sequence, in order to avoid damage to the missile while it leaves the launch tube. Immediately after launch, the weapon system is lowered again into the lock position (-60) in order to keep the line of sight free and because the turret is not moved during the target tracking.
The missile is accelerated to around 900m/s (Mach 3) by a rocket booster. After the booster is jettisoned, a pulsed light source in the missile's tail is activated, allowing automatic tracking of the missile in flight by the optical sight. During the entire flight time of the missile, the gunner must constantly maintain the crosshair of the optical sight on the target; the deviation of the missile's flight path form the line-of-sight is automatically computed and used to generate course correction signals. These are then transmitted to the missile in flight through the tracking radar, which during a missile engagement sequence doubles as fire-control radar. Missile employment is only possible in daylight and fair visibility conditions, because the target needs to be tracking with the optical sight for the entire duration of the engagement sequence.

The radar and fire-control system of the 2S6M can be employed in five different operating modes:

- *Mode 1: Automated radar tracking. This is the main operating mode.*
- *Mode 2: Manual electro-optical angle track with range data from either radar.*
- *Mode 3: Inertial tracking.*
- *Mode 4: Radar on manual electro-optic angle track with range estimation.*
- *Mode 5: Ground target engagement.*

In the main operating mode, after the tracking radar has locked-on to a target, tracking is automatic and most data are relayed directly to the computer. The optical sight can either be slaved to the line-of-sight to the target (in preparation for the missile launch) or used independently for further target acquisition. The weapons are laid automatically and the crew's tasks are limited to selecting the weapons and pressing the fire key; when the missiles are used, as previously indicated the gunner must keep his sight on the target for the entire duration of the engagement sequence. The remaining three operation modes are intended for degraded conditions, bypassing a failed subsystem or replacing it with an alternate working mode. However, these modes produce lower accuracy and/or slower operation and the vehicle must be stationary. The fifth mode is applied during the engagement of ground targets. The radar system is shut off, and a reticle is inserted into the optical sight; the lead angle is automatically computed according to bearing and distance, and the laying speed is then proportional to the movements of the gunner's control stick.

SS-1B SCUD-A (R-11)

General Info:
Type = tactical ballistic surface-to-surface
Origin = Russia
Manufacture = Makeyev OKB
IOC = 1957
Guidance = gyroscopes guided

Performance
Power Plant = single-stage (Liquid Storable: Kerosene and nitric acid)
Accuracy = about 13000ft
Range = 70nm

Dimensions:
Length = 403.5in
Diameter = 34.7in
Weight = 13670lbs

Warheads:
1700-2100lbs HE, chemical, or nuclear (5-80 kiloton)
Fuse = Impact

Description:

The Scud is a mobile, Russian-made, short-range, tactical ballistic surface-to-surface (hence the nomenclature abbreviation SS) missile system. The SCUD-series guided missiles are single-stage, short-range ballistic missiles using storable liquid propellants. The Scud is derived from the World War II-era German V-2 rocket. Unlike the FROG series of unguided missiles, the SCUDs have movable fins. Warheads can be HE, chemical, or nuclear, and the missile, launched vertically from a small platform, has a range of 300 km. Unsophisticated gyroscopes guided the missile only during powered flight - which lasts about 80 seconds. Once the rocket motor shut down, the entire missile with the warhead attached coasted unguided to the target area. Consequently, Scuds had notoriously poor accuracy, and the farther they flew, the more inaccurate they became. SCUD missiles are found in SSM (SCUD) brigades at front/army level. The SCUD series of missiles gave the Soviet front and army commanders an integral nuclear weapons capability. Non-nuclear variants of the SCUD missiles have been exported to both Warsaw Pact and non-Warsaw Pact nations.

The SCUD-A is also known as SS-1b. The SCUD-B replaced the JS-3-mounted SCUD-A, which had been in service since the mid-1950s.
The longer range SCUD B, also known as SS-1c, can be distinguished by the one meter greater length of the missile and the presence of two air bottles on the side of the superstructure in place of the single bottle used for the "SCUD A" missile. The SCUD B used unsymmetrical dimethylhydrazine (UDMH), a more powerful (and toxic) fuel than the kerosene used on the SCUD A, which required an engine redesign. They were transported originally on a heavy-tracked vehicle based on the JS heavy-tank chassis. This vehicle serves also as an erector and launcher for the missiles. The SCUD-B was introduced on the JS-3 tracked chassis in 1961 and appeared on the MAZ-543 wheeled chassis in 1965. The "SCUD B" missile has appeared on a new transporter-erector-launcher based on the MAZ-543 (8x8) truck. The introduction of this new powerful cross-country wheeled vehicle gave this missile system greater road mobility, reduces the number of support vehicles required, and still preserves a great choice in selecting off-road firing positions. The same basic chassis also has been used for the transporter-erector-launcher for the "SCALEBOARD" surface-to-surface guided missile. In the early 1980s, the SCUD-B was replaced by the SS-23, which has greatly improved range (500 km), increased accuracy, and reduced reaction and refire times.
The SCUD-C SS-1d achieved an initial operational capability with Soviet forces around 1965. It had a longer range, though lower accuracy, than the SCUD B, and was deployed in smaller numbers. As of the late 1990s some remained in service in Russian ground forces.
The SCUD-D SS-1e featured an improved guidance system, possibly incorporating active radar terminal homing, and a wider choice of warheads than its predecessors. This missile has a range of about 700 km. Initially operational in the 1980s, it may not have been deployed by former Soviet ground forces.
At launch, a basic Scud contains about 3,500 kilograms (7,700 pounds) of IRFNA and about 1,000 kilograms (2,200 pounds) of fuel. Most of the IRFNA and fuel is used within the first 80 seconds of flight when the missile is gaining enough speed to reach its target. When this speed is reached, the Scud is designed to shut off its engine by shutting off the propellant tanks (a fuel tank and an oxidizer tank). The unused propellants—roughly 150 kilograms (330 pounds) of RFNA and 50 kilograms (110 pounds) of fuel—remain on board for the remainder of the flight.

In the early 1970s, the Soviet Army sought a replacement for the 9K72 Elbrus (SS-1C `Scud B') system, which had a very slow reaction time [around 90 minutes to prepare and fire] and its poor accuracy when using conventional warheads. The replacement system, codename 9K714 Oka [SS-23 Spider], was developed by KB Mashinostroyenia (Machine Industry Design Bureau) in Kolomna. This system was phased out in compliance with the INF Treaty in the late 1980s. Russia's TBM inventory is limited to thousands of SS-1c/Scud B and SS-21/Scarab SRBMs as a result of the Intermediate Nuclear Force (INF) Treaty, which required the elimination of the FSU's extensive stocks of MRBMs.

A second SCUD-followon effort began in the form of the SS-26, which apparently entered service by 1999. The SS-26 SRBM is expected to be both a replacement for the SS-1c/Scud B and an export. By the early 1990s, the `Scud' system was unquestionably obsolete and many of the 9P117 launcher vehicles were retired due to age.

SS-N-2A STYX

General Info:
Type = medium-range anti-ship cruise
Origin = Russia
Manufacture = Raduga
IOC = 1954
Guidance = Autopilot with active radar

Performance
Power Plant = liquid propellant rocket engine and the powder starting
Range = 3-24nm
Speed = Mach 0.9

Dimensions:
Length = 228.4in
Diameter = 30in
Fin Span = 94.5in
Weight = 5070lbs

Warheads:
1000lbs HE

Description:

The SS-N-2 STYX is a ship launched medium-range anti-ship missile.
P-15 - antiship cruise missile of sea basing with the liquid propellant rocket engine and the powder starting (SPRD-E0), with the autonomous system for administration + OF TGSN or ARLGSN.
Glider - all-metal monocoque, midwing monoplane with wing and tail assembly of small lengthening. The wing spread in flight was for the first time designed and mastered by production.
Wing in two versions: riveted and cast (prepared with new progressive method - the method of the squeezing of thin-walled panels). Fairing from the radio-transparent fiberglass laminate ASTT and the polystyrene PS -1. Tank cut off welded construction, the made from the material D -20, insertable oxidant tank - from AMG-E. Basic materials used: D -16T, D -20, AMG-', Ei-'shchya, E0KHGSA, AMG-E.
By special novelty in the technology of production is wing rocket it appeared the method of the squeezing of thin-walled panels. Idea and primary developments of this method belong to E. To s. stebakov (NIAT), who, after becoming acquainted with the construction of article P -15, proposed to pour off wings by this method. With great difficulty the chief metallurgist of plant A. S. zvyagin E. S. stebakov they convinced chief engineer yu. i. shuksta of the expediency of preparing the cast wing instead of the riveted and in the need continuation of these experimental works. Very for long scrupulously was mastered the folding "book" - installation for the squeezing. With the introduction of this method there were many difficulties: first crack, then uzhimy, underfillings and the like for long searched for composition for working of the folds of "book" before the filling - they found. Castings began to be obtained, but with their heat working strongly it warped - was lost outline and basic dimensions. Large it is working it was worthwhile to develop the one-piece steel rigging, in which the cut castings loaded into the heat treating furnace. The castings, which do not require mechanical processing on the theoretical contour, began to be obtained after this, and articles became to complete wings in the cast version. This became possible because of the risk and daring decision of chief engineer shukst Yuri Ivanovich, who at the critical moment, even with the not worked out to the end version of casting, forbade to make wings P -15 in the riveted version. This accelerated the process of the mastery of cast version, although the situation with the planned deliveries was critical at that time. During the subsequent years the aircraft plant in g. to arsen'eve, where we communicated technical documentation on the series deliveries P -15, manufactured articles only with the cast wings.

In 1960 the production of aggregates by the method of squeezing was exposed at VDNKH - EXHIBITION OF ACHIEVEMENTS OF THE NATIONAL ECONOMY OF THE USSR, where to the author- developers there was prisuzhdena silver medal, and to the executors of this method were entrusted prizes and rewards (V. d. chekushenkov, Yu. i. shukst, A. To s. zvyagin). It was rewarded with medal OF VDNKH - EXHIBITION OF ACHIEVEMENTS OF THE NATIONAL ECONOMY OF THE USSR and with A. 4. birch grove, which much made for the success of this work.

During the mid-1970s efficient infra-red seekers were developed and used in the P-22 missiles (SS-N-2d) supplementing the P-21 as the prime anti-ship weapon of the Project 1241 and Project 206 Missile Cutters ('Tarantul' class corvettes and 'Matka' class FACs which entered service in 1978. They were also used for coast defense purposes and received the NATO designation SSC-3 'Styx'.

It is the only ship-launched missile to have sunk large warships in action. On 21 October 1967 the Israeli destroyer Eilat was hit and sunk off Port Said by three missiles. Subsequently in the Holy Day War of 1973 the missile proved less effective with some 52 being fired without effect by Egyptian and Syrian naval units. One missile was destroyed in the air by a 76 mm gun.

The versions of the 'Styx' missile are as follows:
P-15M Termit is an improved P-15 with folding wings and modified guidance system.
P-20 Rubezh is a redesigned P-15 with improved range, due to the use of new fuels. There is also some improvement to the radar range and to its lock-on capability, while the autopilots are further modified. It is possible that the guidance system in this version received an Indian-developed jamming system as an ECCM measure.
P-20M Rubezh is a P-20 with the MS-2A seeker. This has a solid-state radar with improved range, bearing accuracy, low-level detection capability and clutter suppression. The radar has six preset frequencies and several can be selected for use during the flight with the receiver opening for selected pulses. The radar has improved ECCM capabilities including the ability to home-on-jam.
P-21 Rubezh is a P-15 with infra-red seeker.
P-22 Rubezh is a P-20M with infra-red seeker. The infra-red seeker, whose sensor head projects from just below the nose, is used as a backup to the radar seeker if the latter is jammed. The sensor is reported to be extremely sensitive but no further details are available.
P-27 Rubezh is a P-20M with L-band seeker. In larger ships such as the 'Tarantul' class corvettes the 'Square Tie' radar is replaced by one with the NATO designation 'Plank Shave'. This is another I-band system which is reported to have the Russian name Garpun.

The 'Styx' missiles have been subject to extensive in-service modification, indeed Indian sources would suggest that each of the former Soviet Navy fleets may have adapted their missiles to meet anticipated local tactical conditions. It is reported that MS-2A and IR. sensors have been retrofitted into earlier missiles together with ECCM hardware. Indian sources suggest that improvements in seeker technology developed by the Defense Research and Development Laboratories in Hyderabad and the Naval Chemical and Metallurgical Laboratories in Vishakhapatnam were adopted into the missiles of the Soviet Navy.

The P-15 is manufactured in China, North Korea and India. It would appear that production of' Styx' has ceased in Russia but it may continue in India, North Korea and possibly Egypt.

User countries include Algeria, Angola, Bulgaria, Croatia, Cuba, Egypt, Ethiopia, Finland, India, Iraq, North Korea, Libya, Poland, Romania, Russia, Syria, Vietnam, Yemen, and Yugoslavia.

FROG 7

General Info:
Type = Free Rocket Over Ground
Origin = Russia
IOC = 1965
Guidance = unguided, spin-stabilized,

Performance
Range = 38nm
CEP = 1640 – 2300ft

Warheads:
1210lbs HE, nuclear, or chemical

Description:

The FROG-7 is the latest addition to the "Free Rocket Over Ground" family of unguided, spin-stabilized, short-range (battlefield support) artillery rockets. The rocket is of conventional single-stage design, with a cylindrical warhead of the same diameter as the rocket body, giving it a cleaner, more modern appearance than its predecessors. The FROG-7 has a range of 70 km and a 550 kg warhead, and an impact area of approximately 2.8 km long by 1.8 km wide. The FROG-7 is capable of delivering HE, nuclear, or chemical warheads. The FROG-7 gave the Soviet division commander a deep interdiction/penetration nuclear threat.
The FROG-7A was first introduced in 1965 as a replacement for earlier FROG variants, some of which had been in service since the mid-1950s. The FROG-1 and -2 are obsolete. The FROG-3, -4, and -5 variants, mounted on a non-amphibious version of the PT-76 light tank chassis, are obsolete in the USSR, but were still found in other Warsaw Pact armies at the end of the Cold War. The FROG-5 is still used as a training rocket, and the FROG-6 is a dummy rocket used for training purposes only. The FROG-7B, introduced in 1968, is essentially the same rocket as the FROG-7A but with a longer warhead section.
The FROG-7 was replaced by the SS-21 tactical ballistic missile which has greater range (120 km) as well as probable improvements in reaction time, missile reliability, accuracy, and handling characteristics. Since the SS-21 is mounted on a six-wheeled TEL similar to the SA-8/GECKO SAM system, it has improved cross-country capability and is probably amphibious. Like the SA-8, it probably has an air filtration and overpressure system for-collective chemical and biological protection. The SS-21 was first deployed in 1976 in the USSR and was reported in GSFG in 1981.
During the Cold War the most prominent short-range nuclear force [SNF] system at at the division level was the unguided free-rocket-over-ground (FROG), which in the Soviet Army was deployed in a battalion of four launchers. As of 1987 the Soviets were replacing FROGs with the more accurate, longer range SS-21s in some divisions opposite NATO. About 500 FROG and SS-21 launchers were opposite NATO. Another 215 FROG launchers were opposite China and in the Far East; some 100 were opposite Southwest Asia and eastern Turkey; and about 75 were in strategic reserve. Non-nuclear versions of the FROG-7 have been exported to both Warsaw Pact and some non-Warsaw Pact nations. The FROG-7 is deployed by Cuba, Egypt, Iraq, Kuwait, Libya, North Korea, Syria, and Yemen. Laith, an Iraqi improved version of the FROG-7, has a 90 km range.
The FROG-7 (9K52 Luna), the final version of the FROG family, is an unguided, spin-stabilized, short-range, battlefield support artillery rocket. The range of the FROG-7A rocket is 70 km with a CEP of 500 to 700 meters. It is fitted with either a 450 kg HE, 450 kg nuclear, or 36 kg chemical warheads. The improved FROG-7B carries a cargo warhead for delivering bomblets or mines.

GLOSSARY

RECALCULATIONS

Here are some recalculations for all of you who have no experiences with the metric system. The metric system is the standard in Europe and in the eastern hemisphere.

1km (kilometer) = 1000m (meter) = 0.54nm (nautical miles)
1m (meter) = 100cm (centimeter) = 1000mm (millimeter)
1m (meter) = 3.28ft (feet) = 39.37in (inches)

1t (ton) = 1000kg (kilograms) = 2204.6lbs (pounds) = 137.8oz (ounces)
1kg (kilograms) = 1000g (grams)

EXPLOSIVES

Preface

Because this treatise is written for the TacRef Munitions handbook, here I will treat principally conventional explosives, thus no Thermonukleare reactions, as for example in the atom bomb or H-bomb, because these, fortunately, in the today's conflicts are not used and only as a deterrent weapon is required.

General

The history of the explosives already began approx. 3000 years ago in China. The Chinese discovered a mixture of coal, Salpeter and sulphur which they used to the production of fireworks bodies to expel bad minds.

Only in the 14th century the bull's-eye powder found move in Europe. Here it was used for the war, as a propellant for floors in cannons and Musketen. The mixture from 15% of coal, 75% of potassium nitrate and 10% of sulphur of the Franciscan's monk Berthold Schwarz from Freiburg received the name of "bull's-eye powders". Today bull's-eye powder is hardly used militarily, because it is very unreliable, especially if it becomes moist, and because it came over and over again to deadly accidents. Earlier it was used a lot in mines to the spraying by rocks. Indeed, today it has been expelled by save explosives from most areas. One of the operational areas for bull's-eye powder is, like 3000 years ago, the pyrotechnics, because it is required here only in small quantities.

If one moves oxidisers (e.g., NO3, KMnO4) with metal powder so one receives flash sentences, or flash bang sentences. These release a relatively high light amount, which is why they are used mainly in the pyrotechnics. Militarily such mixtures are used, e.g., in Flashgranades. An advantage of these explosive materials is that they can explode without insulation suddenly what depends on the composition of the mixture.

In 1846 professor Schönbein discovered a new kind of the explosives as he let effected nitric acid on some construction woolen cotton. There originated the first organic nitrobody which was used as an explosive – shooting cotton. All explosive materials related today are as a rule organic nitrobodies, as for example Semtex, TNT, dynamite and Hexogen. These are more effective around something and more reliable and these materials offer very much a big advantage: Oxidation means (oxygen) and the reducing material (carbon) are already bound in one molecule. That is the fact that also the energy to be released is already bound in a molecule. However, this molecule is more or less unsteady. Nitroglycerin is so unsteady, for instance that it can already disintegrate with vibrations. Silbersulfinat (use in firecrackers) is unsteady so that already the weight of own crystals leads to a decomposition.

The chemical energy, is released as a rule, by an initial ignition and therefore by the effect of warmth and pressure. This crosses the so-called stability threshold which causes a chain reaction. Whether an initial succeed depends on several factors, how the loading density and the physical state. A loose, porous construction by small particle size offers good conditions (black powder). A homogeneous material with high density and small surface complicates rather an initial (TNT). Among the rest, as an initial load a mixture of Bleiazid and Bleinitroresorcinat is used.

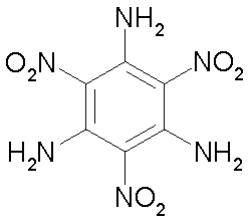
All explosives have in common, they release a large amount of energy in few fractions of one second. This happens in the form of warmth, light and pressure. The chain reaction takes place with most explosives with supersonic speed. This reaches 10^3 to 10^4 m/s and temperatures of 2500 to 6000°C. The nascent warmth cannot be delivered fast enough to the surroundings by which the temperature rises in the system quickly. The chemical conversion is thereby accelerated what leads to an increased warm emission. The gases originating with this reaction cannot escape at first from the system. It comes to an increase of pressure which leads again to a temperature rise which accelerates the whole chemical conversion further. There originates a circulation of temperature rise and increase of pressure and an acceleration of the reaction. This signifies, the single dimensions increase mutually, until it comes to an explosive development of this energy which has disastrous consequences. The nascent pressure might play, on this occasion, the biggest role. The originating gas takes substantially more space one than the more or less steady explosive. Thus originates with the conversion of 1 kilo of black powder 270 liters of gas, shooting cotton moves itself to 849 liters.

An other important size of explosives is the detonation speed which gives how fast itself the material can move and delivers therefore his energy to the surroundings. Black powder has, e.g., a detonation speed of about 400 m/s. The material developed according to theoretical calculations Tetranitroglykoluryl (“Sorguyl”) has a detonation speed of 9300 m/s what explains nowadays at the highest detonation speed. Indeed, this does not become, from 8 C atoms and 8 NO3 groups an existing, cubically built up material yet industrially made.
These both dimensions and of course the production ability and shelf life (stability) brag as a rule where the explosive is used. Thus TNT (Trinitotoluol) is very easy to produce (easy methods and for a good price), well to camp down (not hygroscopic and solidly) and very explosive. It is used since, therefore, already for over hundred years of bombs and is still a very popular explosive for bombs. However, dynamite is substantially more use-unsafe. The mixture of nitroglycerin and Kieselgur which was invented at the end of 19-th century by Alfred Nobel was used mainly for sprayings in mines where by whirled up coal dust many disasters occurred.

To form explosives by own wishes, to unite different qualities, to extend the application spectrum or to raise the achievement, mixtures from are also used and the dynamite is the best known one. Plastic explosive is such a mixture of different materials which is used today mainly for special applications. The plastic explosive was discovered in 1887 likewise by Alfred Nobel. It was a mixture of Kollodiumwolle (as shooting cotton) and nitroglycerin what combined to a galleria mass. In runs of the years this explosive gel was further improved and found, among the rest, in cartridge fillings use. Modern plastic explosives use no more nitroglycerin, how the very much known C4 which is based, for instance, on Hexogen.

Triaminotrinitrobenzene (1,3,5-Triamino-2,4,6-trinitrobenzene; TATB)

Structure



$C_6H_6N_6O_6$

Qualities

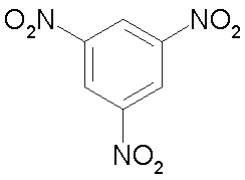
Molecular weight = 258.15g/mol
Melting point = >350°C
Colour = yellow, triclinic crystals
Density = 1.94g/cm^3
Detonation velocity = ~ 8000m/s

Areas of application

TATB becomes despite its high manufacturing costs (100.- €/kg) assigned, if highest insensitivity, stability and security are particularly important, like in atom bombs ("nuclear warheads") or in ammunition for ships and submarines.

Trinitrobenzene (1,3,5-trinitrobenzene; TNB)

Structure



$C_6H_3N_3O_6$

Qualities

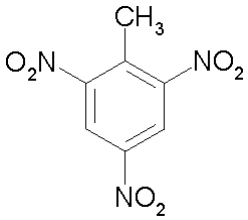
Molecular weight = 213.11g/mol
Melting point = 122.5 – 123.2°C
Boiling point = 315°C
Colour = yellow, monoclinic crystals
Density = 1.6g/cm^3

Areas of application

TNB is one of the most important explosives for pouring and press charges. It finds use both in the military and in the commercial range as safety explosive. It stands back however behind the TNT.

Trinitrotoluene (2,4,6-trinitromethylbenzene; TNT; Trotyl)

Structure



$C_7H_5N_3O_6$

Qualities

Molecular weight = 227.1g/mol
Melting point = 80.35°C
Density = 1.65g/cm^3
Colour = yellow, spicular crystals
Cloud volume = 730L/kg
Oxygen balance = -73.9%
Detonation velocity = 6900m/s

Areas of application

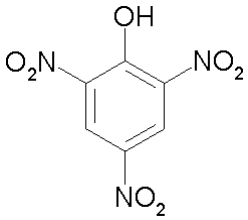
TNT was first made in 1863 by a German chemist Joseph Wilbrand, but its potential was not seen for several years, mainly because it was so hard to detonate and because it was less powerful than other explosives. Amongst its advantages, however, are that it can be safely melted using steam or hot water and so poured molten into shell cases. It is also so insensitive that, for example, in 1910 it was exempted from the British 1875 Explosives Act from actually being considered as an explosive for the purposes of manufacture and storage.

The German armed forces adopted it as an artillery shell filling in 1902, and the British gradually started using it as replacement for lyddite in 1907. A particular advantage that it gave the German Navy in the First World War was that their TNT-filled armour piercing shells would detonate after they had penetrated the armour of British capital ships, whereas the British lyddite filled shells tended to explode as soon as they struck the German armour and thus expend their energy outside of the ship.

Because of the insatiable demand for it during the war, it was frequently mixed with 40-80% ammonium nitrate, producing an explosive called amatol. This was nearly as powerful as TNT, but suffered from the slight disadvantage that ammonium nitrate is hygroscopic.

Picric acid (2,4,6-trinitrophenol; TNP)

Structure



$C_6H_3N_3O_7$

Qualities

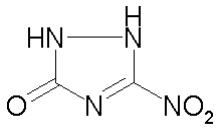
Molecular weight = 229.1g/mol
Melting point = 122°C
Boiling point = Decomposes over 300°C
Density = 1.76g/cm^3
Colour = yellow crystals
Cloud volume = 800L/kg
Oxygen balance = -45.4%
Detonation velocity = 7350m/s
Detonation heat = 4520kJ/kg

Areas of application

By far the largest use has been in munitions and explosives; it was known in World War I as Lyddite (from Lydd, Kent, where UK work was carried out) or Melinite.
The use of Picric acid as a filling material for shells (how in the First World War) or in general as an explosive material was put because of the uncontrolled education by highly explosive heavy metal spades rates, the Picric acid was substituted here with TNT. Picric acid was, so for example, for the catastrophic Halifax explosion (engl). in 1917 responsibly.

Nitrotriazolon (3-Nitro-1,2,4-triazol-5-on; NTO)

Structure



$C_2H_2N_4O_3$

Qualities

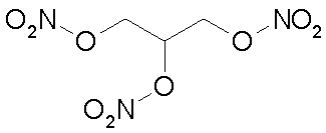
Molecular weight = 130.06g/mol
Melting point = > 280°C
Density = 1.92g/cm^3
Colour = colourless crystals
Detonation velocity = max. 8560m/s

Areas of application

NTO results in pour able mixtures, which are clearly more insensitive than comparable RDX TNT mixtures with TNT. In the mixture with thermoplastic binder NTO is used in press charges for insensitive ammunition. With NTO pour able plastic explosives with favour able safety characteristics and good power ratings can be manufactured.

Nitro-glycerine (1,2,3-Tris-nitro-oxy-propane; trinitroglycerin)

Structure



$C_3H_4N_3O_9$

$4\ C_3H_5(ONO_2)_3 \rightarrow 12\ CO_2 + 10\ H_2O + O_2 + 6\ N_2$

Qualities

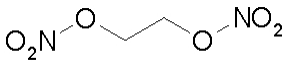
Molecular weight = 227.1g/mol
Melting point = 13.2°C
Boiling point = Decomposes at 50-60 °C
Density = 1.13g/cm^3
Colour = Yellow but colourless when pure
Cloud volume = 780L/kg
Oxygen balance = +3.5%
Detonation velocity = 7700m/s
Detonation heat = 6770kJ/kg

Areas of application

Glycerintrinitrat is used as an explosive. However, because of the strong push and vibration delicacy the use is rather difficult. Alfred Nobel succeeded in storing nitroglycerin in Kieselgur. The originating dynamite is easier to use. Later nitroglycerin than explosive component became because of his high freezing point almost completely by Nitroglykol (Ethylenglykoldinitrat; EGDN) substituted which freezes only with-22 °C.
Nitroglycerin is against it even today an important component of a lot of propelling charge powder. In the medicine it is used because of his vessels-extending effect under the name Glyceroltrinitrat as means with angina Pectoris, cardiac insufficiency and also as acute means with a cardiac infarction.

Nitro-glycol (Glycoldinitro)

Structure



$C_3H_4N_3O_9$

$(CH_2ONO_2)_2 \rightarrow 2\ CO_2 + 2\ H_2O + N_2$

Qualities

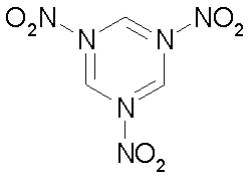
Molecular weight = 125.1g/mol
Melting point = -22°C
Boiling point = Decomposes at 114°C
Density = 1.48g/cm^3
Colour = colourless
Cloud volume = 815L/kg
Oxygen balance = 0%
Detonation velocity = 7300m/s
Detonation heat = 7390kJ/kg

Areas of application

Nitro-glycol is most used in mixtures for commercial explosives.

Hexogen (hexahydro-1,3,5-trinitro-1,3,5-triazine; RDX)

Structure



$C_3H_6N_6O_6$

Qualities

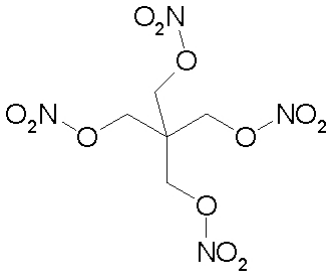
Molecular weight = 222.1g/mol
Melting point = 204°C
Boiling point = starts to decompose at 170°C
Density = 1.82g/cm^3
Colour = colourless
Cloud volume = 920L/kg
Oxygen balance = -21.6%
Detonation velocity = 8750m/s
Detonation heat = 5720kJ/kg

Areas of application

Widely used by the military. There are many interpretations of its acronym including (but not limited to) Royal Demolition eXplosive and Research Department eXplosive. In fact the latter is nearest to the mark. New explosives were given an identification number preceded by the letters 'RD' indicating 'Research and Development'. For some reason, this explosive was unable to be given a number (the story goes that the department that issued the numbers had just blown itself up - but this may be apocryphal). Instead the letter 'X' was appended to indicate 'unknown' with the intention of adding the number later. Although a number was issued, the term 'RDX' stuck.
RDX forms the base for a number of common military explosives: Composition A (wax-coated, granular explosive consisting of RDX and plasticizing wax), composition A5 (mixed with 1.5% stearic acid), composition B (castable mixtures of RDX and TNT), composition C (a plastic demolition explosive consisting of RDX, other explosives, and plasticizers), composition D, HBX (castable mixtures of RDX, TNT, powdered aluminium, and D-2 wax with calcium chloride), H-6, Cyclotol and C4.
It was widely used during World War II, often in explosive mixtures with TNT such as Torpex (TNT (42%),RDX (40%) and aluminium (18%)). RDX was used in one of the first plastic explosives.

Penthrite (PETN)

Structure



$C_5H_8N_4O_{12}$

$C(CH_2ONO_2)_4 \rightarrow 3\ CO_2 + 2\ CO + 4\ H_2O + 2\ N_2$

Qualities

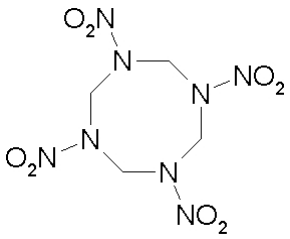
Molecular weight = 314.1g/mol
Melting point = 141°C
Boiling point = decompose
Density = 1.77g/cm^3
Colour = colourless crystals
Cloud volume = 820L/kg
Oxygen balance = -10.1%
Detonation velocity = 8400m/s
Detonation heat = 6400kJ/kg

Areas of application

Nitropenta is preferred in explosive strings. In the military area it is used as a mixture with Trinitrotoluol.

Octogen (Homocyclonite; octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine; HMX)

Structure



$C_4H_8N_8O_8$

Qualities

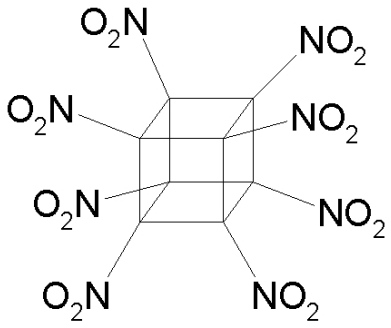
Molecular weight = 296.2g/mol
Melting point = 276 to 286°C
Boiling point = decomposes at 280°C
Density = 1.96g/cm^3
Colour = colourless crystals
Cloud volume = 920L/kg
Oxygen balance = -21.6%
Detonation velocity = 9100m/s
Detonation heat = 5680kJ/kg

Areas of application

First made in 1930, it is used almost exclusively in military applications including as the detonators in nuclear weapons and as a solid rocket propellant. It is usually blended with TNT or some other material to reduce its sensitivity.
Octogen has similar explosive qualities like Hexogen and likewise counts to an important basic substance of military and commercial explosives.
Octogen originates as a by-product in the Hexogen production.
Like RDX, it has various mistranslations of its acronym including High Melting eXplosive, Her Majesty's eXplosive or even High velocity Military eXplosive.

Octanitrocubane (ONC)

Structure



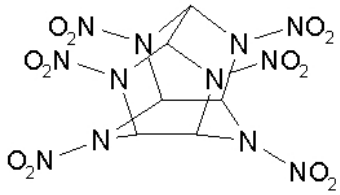
$C_8N_8\ O_{16}$

Qualities
Molecular weight = 464.1g/mol
Density = ~2g/cm^3
Colour = colourless crystals
Detonation velocity = ~10000m/s

Areas of application
Octanitrocubane is a shock-insensitive high explosive. Unlike Trinitrotoluene (TNT) it is not detonated by shock.
Octanitrocubane is thought to have 20 to 25 percent greater performance than HMX (octogen); the state-of-the-art military explosive at present.

CL-20 (2,4,6,8,10,12-hexanitrohexaazaisowurtzitane; HNIW)

Structure



$C_6H_6N_{12}O_{12}$

Qualities

Molecular weight = 438.2g/mol
Melting point = >273°C
Density = 2.04g/cm^3
Colour = colourless monocline crystals
Detonation velocity = 10500m/s

Areas of application

CL20 1987 was discovered by researchers of the Naval of Air Warfare Center Weapon division in China Lake, California.
For a commercial use he is too expensive because of the costly synthesis and the high production costs linked with it up to now.
As an explosive ~14% than Oktogen. Thermal stability much more slightly than from Oktogen. Vapour pressure considerably smaller than from Oktogen.

ACRONYMS AND CODENAMES

A-B (http://www.hazegray.org/faq/acr1.htm)

C-E (http://www.hazegray.org/faq/acr2.htm)

F-H (http://www.hazegray.org/faq/acr3.htm)

I-K (http://www.hazegray.org/faq/acr4.htm)

L-N (http://www.hazegray.org/faq/acr5.htm)

O-Q (http://www.hazegray.org/faq/acr6.htm)

R-T (http://www.hazegray.org/faq/acr7.htm)

U-W (http://www.hazegray.org/faq/acr8.htm)

X-Z (http://www.hazegray.org/faq/acr9.htm)

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UPDATE:

The TacRef Group is no more active. Due to private life and work we stopped this project. I am the last one who works sequencely a little on the Handbook.
So if you have questions or want to work further on this project you can contact me here: michael.huber.mh1@gmx.de