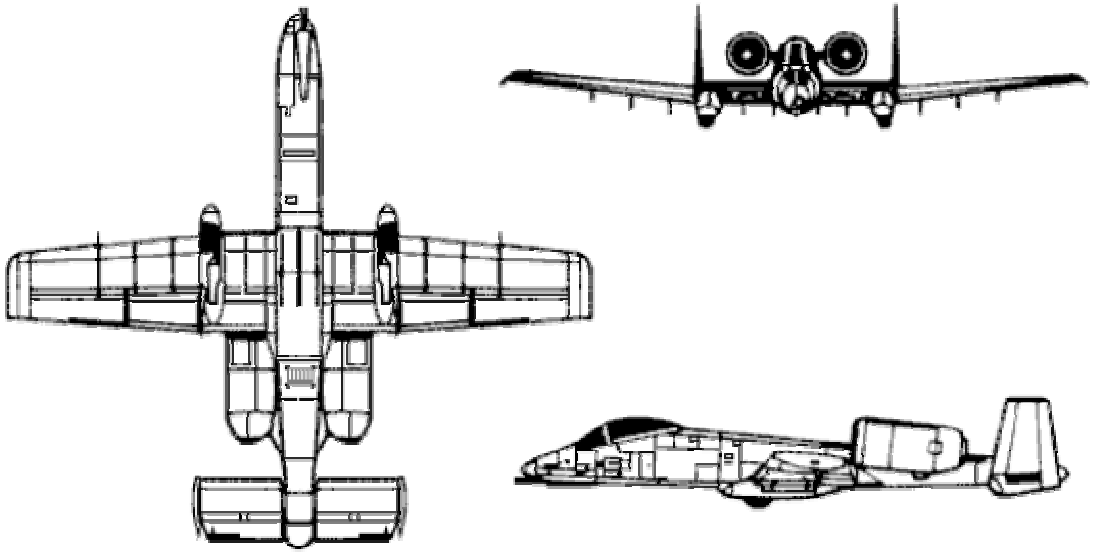
WEAPONS AND ORDINANCE -- PS106IS Primer (v 1.0) [1]



For details, see http://www.globalsecurity.org/military/systems/index.html

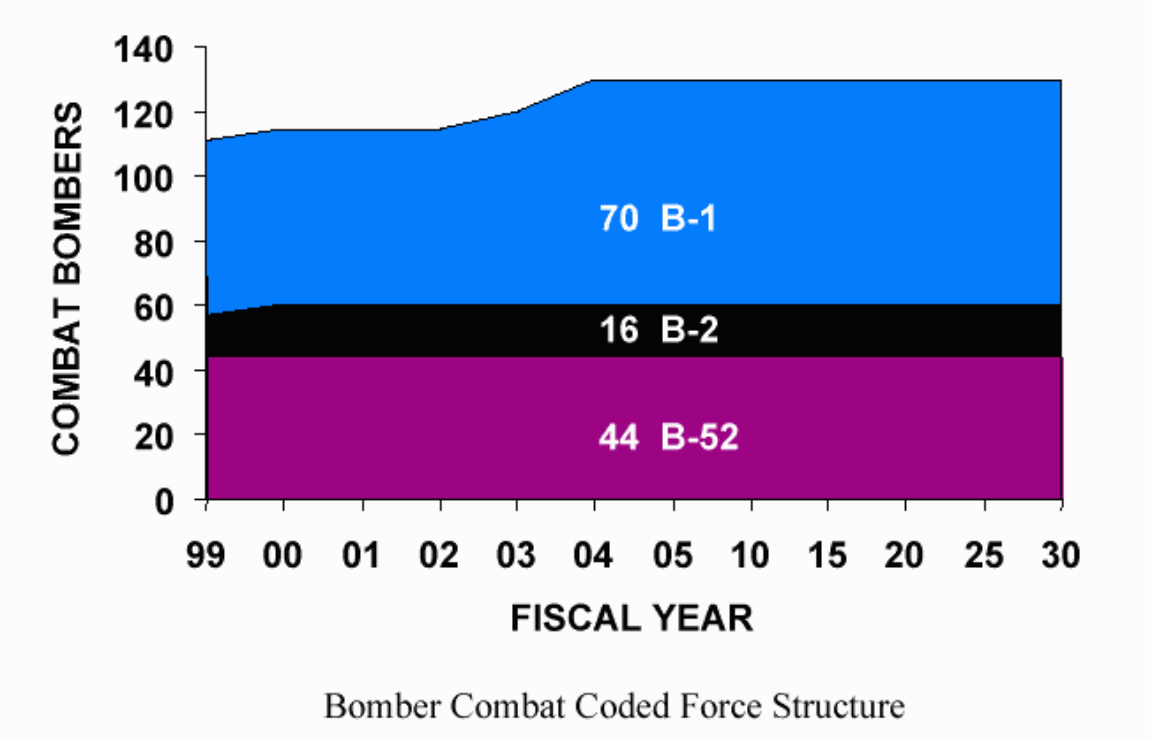
Airpower Overview

Aviation forces of the Air Force, Navy, and Marine Corps—composed of fighter/attack, conventional bomber, and specialized support aircraft—provide a versatile striking force capable of rapid employment worldwide. These forces can quickly gain and sustain air superiority over regional aggressors, permitting rapid air attacks on enemy targets while providing security to exploit the air for logistics, command and control, intelligence, and other functions. Fighter/attack aircraft, operating from both land bases and aircraft carriers, combat enemy fighters and attack ground and ship targets. Conventional bombers provide an intercontinental capability to strike surface targets on short notice. The specialized aircraft supporting conventional operations perform functions such as airborne early warning and control, suppression of enemy air defenses, reconnaissance, surveillance, and combat rescue. In addition to these forces, the U.S. military operates a variety of transport planes, aerial-refueling aircraft, helicopters, and other support aircraft. During FY 2000, the aviation

[1] PS 106IS Armed Forces Primer – All materials are from www.globalsecurity.org or ***www.army.mil***, unless otherwise indicated.

combat force structure will include 20.2 Air Force FWEs (72 aircraft each), 11 Navy carrier air wings (50 fighter/attack aircraft each), and four Marine aircraft wings (which are task organized and include varying numbers and types of aircraft).

BOMBERS



Bomber Combat Coded Force Structure

B-52 Stratofortress

The B-52H BUFF [Big Ugly Fat Fellow] is the primary nuclear roled bomber in the USAF inventory. It provides the only Air Launch Cruise Missile carriage in the USAF. The B-52H also provides theater CINCs with a long range strike capability. The bomber is capable of flying at high subsonic speeds at altitudes up to 50,000 feet (15,000 meters). It can carry nuclear or conventional ordnance with worldwide precision navigation capability. With a gross weight of 488 000 pounds, the B-52H is even today one of the heaviest offensive military aircraft operated by any nation in the world. Maximum speed of the B-52H is 639 miles per hour at 20,700 feet, or a Mach number of 0.91, and cruising speed is 525 miles per hour. Mission radius is 4,480 miles with a weapons load of 10,000 pounds. Many other combinations of payload and range are, of course, possible. Range is, of course, greatly increased by in-flight refueling.

B-1

The B-1B is a multi-role, long-range bomber, capable of flying intercontinental missions without refueling, then penetrating present and predicted sophisticated enemy defenses. It can perform a variety of missions, including that of a conventional weapons carrier for

theater operations. Through 1991, the B-1 was dedicated to the nuclear deterrence role as part of the single integrated operational plan (SIOP). Converting the B-1B to the conventional role was a gradual process, beginning in 1993 and culminating in October 1997 when the 7th Bomb Wing at Dyess AFB flew the last nuclear mission.

B-2 Spirit

The B-2 Spirit is a multi-role bomber capable of delivering both conventional and nuclear munitions. Along with the B-52 and B-1B, the B-2 provides the penetrating flexibility and effectiveness inherent in manned bombers. Its low-observable, or "stealth," characteristics give it the unique ability to penetrate an enemy's most sophisticated defenses and threaten its most valued, and heavily defended, targets. Its capability to penetrate air defenses and threaten effective retaliation provide an effective deterrent and combat force well into the 21st century. Four General Electric F118-GE-100 non-afterburning turbofan engines (each delivering approximately 19,000 lbs. of thrust) drive the airplane to a maximum speed described as "high subsonic," and to altitudes near 50,000 ft. They also provide an unrefueled range of approximately 6,000 nautical miles. A single aerial refueling extends this to some 10,000 miles and multiple visits to air tankers stretches the range indefinitely. The B-2's low observability is derived from a combination of reduced infrared, acoustic, electromagnetic, visual and radar signatures. These signatures make it difficult for the sophisticated defensive systems to detect, track and engage the B-2. Many aspects of the low-observability process remain classified; however, the B-2's composite materials, special coatings and flying-wing design all contribute to its "stealthiness."

B-3 Future Strike Aircraft

Under current plans, the B-52, along with the younger B-1B Lancer and the new stealthy B-2 Spirit, will be kept around until approximately 2037, by which time the Air Force calculates that attrition will have reduced the fleet below the minimum 170 aircraft. The B-52s may fly to 2045.

FIGHTERS AND STRIKE AIRCRAFT

A-10/OA-10 Thunderbolt II

The A-10 and OA-10 Thunderbolt IIs are the first Air Force aircraft specially designed for close air support of ground forces. They are simple, effective and survivable twin-engine jet aircraft that can be used against all ground targets, including tanks and other armored vehicles. The primary mission of the A-10 is to provide day and night close air combat support for friendly land forces and to act as forward air controller (FAC) to coordinate and direct friendly air forces in support of land forces. The A-10 has a secondary mission of supporting search and rescue and Special Forces operations. It also possesses a limited capability to perform certain types of interdiction. All of these missions may take place in a high or low threat environment. The A-10/OA-10 have excellent maneuverability at low air speeds and altitude, and are highly accurate weapons-delivery platforms. The A-10 has half the turning radius of the Air Force's other primary CAS aircraft, the F-16.

AC-130 Gunship

The AC-130 gunship's primary missions are close air support, air interdiction and armed reconnaissance. Other missions include perimeter and point defense, escort, landing, drop and extraction zone support, forward air control, limited command and control, and combat search and rescue. These heavily armed aircraft incorporate side-firing weapons integrated with sophisticated sensor, navigation and fire control systems to provide surgical firepower or area saturation during extended periods, at night and in adverse weather.

F-16 Fighting Falcon

The F-16 Fighting Falcon is a compact, multirole fighter aircraft. It is highly maneuverable and has proven itself in air-to-air combat and air-to-surface attack. It provides a relatively low-cost, high-performance weapon system for the United States and allied nations. In an air combat role, the F-16's maneuverability and combat radius (distance it can fly to enter air combat, stay, fight and return) exceed that of all potential threat fighter aircraft. It can locate targets in all weather conditions and detect low flying aircraft in radar ground clutter. In an air-to-surface role, the F-16 can fly more than 500 miles (860 kilometers), deliver its weapons with superior accuracy, defend itself against enemy aircraft, and return to its starting point. An all-weather capability allows it to accurately deliver ordnance during non-visual bombing conditions. The original F-16 was designed as a lightweight air-to-air day fighter. Air-to-ground responsibilities transformed the first production F-16s into multirole fighters.

F/A-18 Hornet

The F/A-18 "Hornet" is a supersonic, single seat (A and C models) or tandem seat (B and D models), twin engine, all weather, night, combined fighter and attack aircraft and can be refueled in flight. The F/A-18 multi-mission aircraft can operate from either aircraft carriers or land bases. The F/A-18 fills a variety of roles: air superiority, fighter escort, suppression of enemy air defenses, reconnaissance, forward air control, close and deep air support, and day and night strike missions. The F/A-18 Hornet replaced the F-4 Phantom II fighter and A-7 Corsair II light attack jet, and also replaced the A-6 Intruder as these aircraft were retired during the 1990s. The combat-proven F/A-18 Hornet is the first tactical aircraft designed from its inception to carry out both air-to-air and air-to-ground missions. The F/A-18, (models A, B, C and D), can deliver conventional air-to-air, air-to-ground decoy expendables, and can carry airborne control pods for various missions. The combination of excellent thrust-to-weight ratio, and maneuverability an unmatched combat capability. The F/A-18 is in service with the U.S. Navy, U.S. Marine Corps and the air forces of Canada, Australia, Spain, Kuwait, Finland, Switzerland, and Malaysia. As of May 1999 Hornet pilots had accumulated more than 3.7 million flight hours and, in the process, are establishing new records daily in safety, reliability, maintainability and mission performance.

F-14 Tomcat

When it launches off the deck of an aircraft carrier, it is the most feared fighter in the sky. The roar of it's engine is unforgettable. It is the most storied aircraft in the world today, a veteran of countless sorties in peacetime and conflict, and popularized in novels and on the silver screen. It is the F-14B Tomcat, and it is the backbone of naval aviation. The F-14 Tomcat is a supersonic, twin-engine, variable sweep wing, two-place fighter designed to attack and destroy enemy aircraft at night and in all weather conditions. The F-14 can track

up to 24 targets simultaneously with its advanced weapons control system and attack six with Phoenix AIM-54A missiles while continuing to scan the airspace. Armament also includes a mix of other air intercept missiles, rockets and bombs. Manufactured by Grumman Aircraft Corporation, the F-14 employs variable geometry wings to optimize aircraft performance throughout the flight envelope. The multiple tasks of navigation, target acquisition, electronic counter measures (ECM), and weapons firing are divided between the pilot and the radar intercept officer (RIO). Overall, the Navy's Grumman F-14 Tomcat is without equal among today's Free World fighters. Six long-range AIM-54A Phoenix missiles can be guided against six separate threat aircraft at long range by the F-14's AWG-9 weapons control system. For medium-range combat, Sparrow missiles are carried; Sidewinders and a 20mm are available for dogfighting. In the latter role, the Tomcat's variable-sweep wings give the F-14 a combat maneuvering capability that could not have been achieved with a "standard" fixed planform wing.

F-15 Eagle

The F-15 Eagle is an all-weather, extremely maneuverable, tactical fighter designed to gain and maintain air superiority in aerial combat. The Eagle's air superiority is achieved through a mixture of maneuverability and acceleration, range, weapons and avionics. The F-15 has electronic systems and weaponry to detect, acquire, track and attack enemy aircraft while operating in friendly or enemy-controlled airspace. Its weapons and flight control systems are designed so one person can safely and effectively perform air-to-air combat. It can penetrate enemy defense and outperform and outfight current or projected enemy aircraft.

F-117 Nighthawk

The F-117A Nighthawk is the world's first operational aircraft designed to exploit low-observable stealth technology. The F-117A is a single-seat attack and defense suppression aircraft for the Air Force. The F-117 is designed to penetrate dense threat environments as well as attack high value targets with pinpoint accuracy. The unique design of the single-seat F-117A provides exceptional combat capabilities. About the size of an F-15 Eagle, the twin-engine aircraft is powered by two General Electric F404 turbofan engines and has quadruple redundant fly-by-wire flight controls. Air refuelable, it supports worldwide commitments and adds to the deterrent strength of the U.S. military forces. The F-117A can employ a variety of weapons and is equipped with sophisticated navigation and attack systems integrated into a state-of-the-art digital avionics suite that increases mission effectiveness and reduces pilot workload. Detailed planning for missions into highly defended target areas is accomplished by an automated mission planning system developed, specifically, to take advantage of the unique capabilities of the F-117A.

ROTORCRAFT

V-22 OSPRAY

The V-22 Osprey is a tiltrotor vertical/short takeoff and landing (VSTOL), multi-mission air-craft developed to fill multi-Service combat operational requirements. The V-22 is the first tilt-rotor aircraft to be fielded in the military. It is a

hybrid aircraft, combining selected capabilities of an airplane and a helicopter. The Federal Aviation Administration (FAA) has classified tilt rotors as powered lift aircraft, neither airplane nor rotorcraft. The V-22 uses many unique items to achieve its configuration and capability. The airframe incorporates new materials and structural designs. Advanced avionics provide mission enhancement while new wiring technologies increase reliability and reduce weight. New hydraulic technology is also applied. Redundant digital systems such as fly-by-wire flight controls are used in lieu of traditional hybrid redundancies. New processes are applied in the operation and maintenance of the V-22. Examples include the mission planning station used by aircrew before flight, and the maintenance station used between flights to automatically identify defects and conduct trend analysis to predict future maintenance actions.The MV-22 will replace the current Marine Corps assault helicopters in the medium lift category (CH-46E and CH-53D), contributing to the dominant maneuver of the Marine landing force, as well as supporting focused logistics in the days following commencement of an amphibious operation. The Air Force variant, the CV-22, will replace the MH-53J and MH-60G and augment the MC-130 fleet in the USSOCOM Special Operations mission. The Air Force requires the CV-22 to provide a long-range VTOL insertion and extraction capability. The tiltrotor design combines the vertical flight capabilities of a helicopter with the speed and range of a turboprop airplane and permits aerial refueling and world-wide self deployment. The aircraft is manned by a pilot, copilot, and enlisted aircrew appropriate for the specific service and type of mission being flown. The V-22 is optimized to transport troops (i.e., 24 combat-equipped Marines, or 10,000 pounds of external cargo) to austere landing sites from aviation capable amphibious ships and expeditionary forward operating bases ashore. The V-22 will be capable of flying over 2,100 nautical miles with one aerial refueling, giving the Services the advantage of a Vertical/Short Takeoff and Landing aircraft that can rapidly self-deploy to any location in the world.

AH-1 COBRA

The AH-1 Super Cobra is a two-place, twin-engine attack helicopter capable of land- or sea-based operations. It provides rotary-wing close air support (CAS), anti-armor/anti-helicopter, armed escort, armed and visual reconnaissance, and supporting arms coordination (SAC) during day/night and adverse weather conditions. The Bell AH-1 Cobra helicopter has struck fear in the hearts of the enemy for more than 30 years. Armed helicopters came into widespread use in Vietnam in the early Sixties. Limitations of the modified armed utility helicopters used led to the specially configured attack helicopter. Instead, the AH-1F Cobra, with its proven firepower and maneuverability, went on to fight in every major US military operation since Vietnam. The Cobra continues its service with the US Marines, as well as eight other foreign nations. The Cobra traces its lineage from the UH-1 Huey and was originally developed for the US Army in the mid-sixties. The original Cobra retained the Huey's engine, transmission, and other major parts, but replaced the Huey's bulky fuselage with a thin profile fuselage with tandem seating. The Marine Corps later adopted a twin engine variant of the airframe to perform troop helicopter escort and provide autonomous tank killing capability. Through the years, the Cobra has gone through extensive modernization. Today's Marine Corps AH-1W Super Cobra boasts an advanced Night Targeting System (NTS) and a full suite of survivability equipment. The primary missions of the Cobra are helicopter Close Air Support (CAS), escort of transport helicopters and ground convoys, armed reconnaissance, helicopter air-to-air attack, anti-shipping operations, and coordination and terminal control of fixed wing CAS, artillery, mortars, and naval gunfire.It is the only western attack helicopter with a proven air-to-air and anti-radar missile capability. The rear seat pilot is primarily responsible for maneuvering

the aircraft. The front pilot controls the aircraft's weapons systems, but he also has a full set aircraft controls.

Apache

Conducts rear, close, and shaping missions including deep precision strike. Conducts distributed operations, precision strikes against relocatable targets, and provides armed reconnaissance when required in day, night, obscured battlefield and adverse weather conditions. Description and Specifications
The AH-64 Apache is The Army's heavy division/corps attack helicopter. The AH-64D Longbow remanufacture effort incorporates a millimeter wave fire control radar (FCR), radar frequency interferometer (RFI), fire-and-forget radar-guided HELLFIRE missile and cockpit management and digitization enhancements. The combination of the FCR, RFI, and the advanced navigation and avionics suite of the aircraft provide increased situational awareness, lethality and survivability.

Combat mission speed:	167 mph
Combat range:	300 miles
Combat endurance:	2.5 hours
Length:	49 ft 5 in
Mission weight:	16,600 lbs
Armament:	HELLFIRE missiles, 2.75" rockets and 30mm chain gun
Crew:	2 (pilot and co-pilot gunner)

Blackhawk

Mission: Provide air assault, general support, aeromedical evacuation, command and control and special operations support to combat and stability and support operations. Entered Army Service: 1979. Description and Specifications: The UH 60 Blackhawk is a utility tactical transport helicopter that replaces the UH-1 "Huey". The versatile Blackhawk has enhanced the overall mobility of The Army, due to dramatic improvements in troop capacity and cargo lift capability, and will serve as The Army's utility helicopter in the Objective Force. On the asymmetric battlefield, it provides the commander the agility to get to the fight quicker and to mass effects throughout the battlespace across the full spectrum of conflict. An entire 11-person, fully-equipped infantry squad can be lifted in a single Blackhawk, transported faster than in predecessor systems, in most weather conditions. The Blackhawk can reposition a 105mm Howitzer, its crew of six, and lift up to 30 rounds of ammunition in a single lift. The aircraft's critical components and systems are armored or redundant, and its airframe is designed to progressively crush on impact to protect the crew and passengers.

	UH-60A	UH-60L
Mass gross weight:	20,250 lbs	22,000 lbs, 23,500 (external cargo)
Cruise speed:	139 kt	150 kt
Endurance:	2.3 hrs	2.1 hrs
Max range:	320 nm	306 nm
External load:	8000 lbs	9000 lbs
Internal load:	2640 lbs (or 11 combat-equipped troops)	
Crew:	4 (2 pilots; 2 crew chiefs)	
Armament:	Two 7.62mm machine guns	

CH-47 Chinock

Mission: Transport ground forces, supplies, ammunition and other battle-critical cargo in support of worldwide combat and contingency operations. Entered Army Service 1962.
Description and Specifications: The venerable twin-engine, tandem rotor Chinook helicopter has undergone numerous upgrades since the first CH-47A model was delivered to the Army for use in Vietnam. Beginning in 1982 and ending in 1994, all CH-47A, B and C models were upgraded to the CH-47D version, which remains the U.S. Army standard and features composite rotor blades, an improved electrical system, modularized hydraulics, triple cargo hooks, avionics and communication improvements, and more powerful engines that can handle a 19,500 lb load – nearly twice the Chinook's original lift capacity. An upgrade program exists to remanufacture 300 of the current fleet of 425 CH-47D's to the CH-47F standard. The MH-47E is the Special Forces variant of the Chinook and will be remanufactured to the MH-47G. Large external loads such as 155mm howitzers can be transported at speeds up to 260km/h using the triple hook load configuration. Multiple external loads can be delivered to two or three separate destinations in one sortie.
The cabin provides 42 cubic meters of cargo space and 21 square meters of cargo floor area and can accommodate two HMMWVs (High Mobility Multipurpose Wheeled Vehicle) or a HMMWV together with 105mm howitzer and gun crew. The main cabin can hold up to 33 fully-equipped troops. For medical evacuation, the cabin can accommodate 24 litters (stretchers).

ORDINANCE (Bombs and Missiles)

What's New With Smart Weapons

A Precision Guided Munitions [PGM] is a missile, bomb or artillery shell equipped with a terminal guidance system. It contains electrical equipment that guides it in the last phase before impact. The terminal guidance unit is designed to sense emitted or reflected EMR (electromagnetic radiation) within its field of view.

Target Acquisition (TA) systems must be used to employ a PGM, and include the human eye, which is the most commonly employed TA system. Others include radar, TV and forward-looking IR sensor display systems, and systems using laser quidance.

The classic target acquisition cycle is composed of the following five steps:
(1)Detection of target area,
(2) Detection of the target itself,
(3) Orientation of the target,
(4) Target recognition,
(5) Weapon release,

PGM Components.
(1) Seeker or Guidance Unit. The seeker discriminates differences in energy received by its sensor. Each sensor has a threshold contrast level, and contrast levels below the threshold will not activate the unit. Each sensor has a maximum energy level. Too much energy will saturate and perhaps damage the unit.
(2) Tracker or Control Unit. The tracker controls the flight of the PGM to the target. "Lock-on" refers to activation of the tracker unit. The two types of trackers are as follows:
(a) Edge Tracker - flies the PGM to the area of more intense contrast between target and background,
(b) Centroid Tracker - flies the PGM to the point of maximum or minimum emitted or reflected EMR. For example, a visual centroid tracker will fly towards the center of a bright or dull spot. An IR centroid tracker will fly towards the center of a hot or cold spot.

Active guidance systems respond to energy which originates from the PSM and is reflected from the target, Semiactive guidance responds to energy which originates at a source other than the PGM and is reflected from the target (e.g. it may respond to EMR reflected from a laser designator at a remote location), Passive guidance responds to naturally emitted or naturally reflected EMR from the target. Most systems are passive.

In 1944, it took 108 B-17s dropping 648 bombs to destroy a point target. In Vietnam, similar targets required 176 bombs. Now, a few precision guided munitions (PGM) can do the job. Precision munitions also enhance strategic agility. For example, just over three C-5 sorties per day could have supplied every PGM used by the Air Force during the Gulf War. But the types of weapons in the US inventory remained largely unchanged since the end of the Vietnam War. During the 1980s a variety of "transitional" weapons were acquired in small numbers, carried on a limited number of platforms. Desert Storm demonstrated the current weapons' effectiveness, and revealed their shortcomings.

Since Desert Storm, the Air Force has:

- Tripled the number of precision-capable platforms since the war
- Boosted PGM inventories by 25 percent above pre-war levels
- Developed new generations of PGMs with enhanced accuracy, standoff, and adverse weather capabilities

Although a number of these new-generation precision munitions are entering production, as of late 1998 only relatively trivial numbers were actually available for combat. While tens of thousands of these weapons are slated for delivery over the coming decade, no more than a few dozen were combat ready.

Beginning in the mid-1980s, the Air Force and Navy began development of "next generation" weapons to fulfill the shortcomings of the earlier weapons. All of these are now in development, or in the initial stages of production.

- Joint Stand-off Weapon (JSOW) is an adverse-weather, short-range, stand-off anti-armor/SEAD dispenser weapon. A small number of these weapons became operational with the Navy in December 1997.
- Joint Direct Attack Munition (JDAM) is an Inertial Navigation System (INS)/GPS guidance tail kit that converts dumb bombs into accurate adverse-weather capable weapons. JDAM was certified as operational capable on the B-2 in July 1997, and achieved operational status with other selected Air Force units in late 1998, including Limited Initial Operational Capability which was achieved on the B-52 in December 1998. JDAM modification kits will be installed on an initial block of seven B-1B bombers by January 1999.
- Wind Corrected Munitions Dispenser (WCMD) provides a similar capability for cluster munition dispensers. Achieving an accuracy of less then 30 feet in tests, the munition is expected to enter general service by April 1999 following approval on 03 August 1998 for initial production. WCMD Limited Initial Operational Capability was achieved on the B-52 in November 1998.
- The Sensor Fused Weapon follow-on (SFW P3I), which will increase the accuracy, enlarge the pattern, and offer greater kills-per-pass than the original SFW, is slated for deployment around the turn of the century.
- Joint Air-to-Surface Stand-off Missile (JASSM) provides long-range, precision strike with a limited hard target penetration capability. Currently in development, it will enter the inventory by around 2001.

These new weapons are all autonomously guided and have adverse weather capability. These weapons are being integrated into virtually every American combat aircraft.

Since Desert Storm, the Navy's ability to attack targets with precision weapons has increased more than five-fold. Every air wing has the capability of employing standoff and through-the-weather precision weapons, such as the Stand-off Land Attack Missile-Expanded Response, Joint Stand-Off Weapon and Joint Direct Attack Munition. The Navy's focus has shifted from the number of sorties per target to the number of aimpoints per sortie. Yet, challenges remain, including the number of precision weapons, pods, training ordnance and the availability of ranges.

Laser Guided Bombs

Laser guided bombs [LGBs] remain the most numerous precision guided munition, with roughly 25,000 in the current inventory. During Desert Storm, the F-111F and the F-117 accounted for the majority of the guided bomb tonnage delivered against strategic targets. The Navy's A-6E, which is no longer in service, and other aircraft, were used to deliver LGBs was used only sparingly. Demonstrated accuracies are estimated at between three and eight meters. Subsequent improvements include:

- In Desert Storm, 229 US aircraft were capable of delivering laser-guided munitions. By 1996 the expanded installation of low-altitude navigation and targeting infrared for night (LANTIRN) pods on F-15Es and block 40 F-16s had increased this capability within the Air Force to approximately 500 platforms.
- Only four AAS-38 Nite Hawk laser target designator systems were available for the Navy's F/A-18 Hornet during the Gulf War. The improved AAS-38A Laser Target

Designator/Rangefinder (LTD/R) was cleared for Fleet service on Hornet-C/Ds in January 1993.

- The LANTIRN laser guided bomb designator system, modified for the Navy's F-14 Tomcat Strike Fighter, became operational in June 1996. While only a few aircraft deployed aboard the USS Enterprise (CVN-65) are currently so equiped, eventually all 210 F-14 Tomcat fighter aircraft will receive the LANTIRN upgrade.

Although laser-guided bombs have demonstrated the ability to destroy point targets with only a few rounds per aim point, their employment faces several constraints. The primary limitation on their use is the requirement for a clear line of sight between the bomb's laser seeker and the laser spot-beam designating the target, which is not possible under adverse weather conditions [rain, clouds, dust, etc]. Additionally, laser designators are deployed on only a limited number of aircraft, and the number of platforms that can deliver LGBs is much larger than the number that have independent target designation capabilities.

Global Positioning System Munitions

The impending massive expansion of precision munition inventories is largely a product of the introduction of relatively inexpensive and highly accurate guidance systems incorporating receivers for the Navstar Global Positioning System [GPS]. These new munitions will provide accuracies comparable to LGBs, while overcoming adverse weather limitations, and eliminating the need for laser target designation systems.

These GPS munitions will also facilitate accurate delivery of area munitions from the higher altitudes that are characteristic of post-Cold War air operations. Low level employment is one of the most demanding tasks facing fighter/attack crews, but during the Cold War these tactics were dictated by the nature of the Warsaw Pact air defense threat. The major disadvantage of a low level delivery is the requirement to fly over the target and its associated air defense weapons. During the Gulf War air campaign initial aircraft losses early in the air campaign resulted from low-altitude munition deliveries. Subsequently the majority of bombs were released from aircraft flying above 12,000 to 15,000 feet. Higher altitudes provided a relative sanctuary from most air defenses but resulted in a major compromise in terms of bomb accuracy and, ultimately, effectiveness. Although quite inexpensive and less restricted by low visibility, unguided munitions cannot reliably be employed against point targets from medium and high altitudes. The addition of JDAM and WCMD will solve these problems.

But pending the arrival of these new munitions, American air operations in Kosovo during early 1999 largely depended on the same precision munitions used [or available for use] in Desert Storm in 1991, or Deliberate Force in 1995. These were supplemented, though not yet replaced, by the small numbers of more sophisticated "transitional" weapons that entered the inventory in the early 1990s, as well as very limited numbers of the newer "next generation" weapons now transitioning to operational units.

Environmental Effects

Environmental effects of weather can influence the success of a mission by affecting the use of Precision Guided Munitions. In order to brief weather conditions that may affect PGMs, an understanding of their operation is important.

Visible Systems. Passive systems which respond to naturally emitted or reflected EMR in the visible spectrum. Environmental limitations are as follows:
(1) Clouds or Fog,
(2) Precipitation, blowing snow or blowing spray,
(3) Poor illumination,
(4) Low sun angle.

Near-IR Passive Systems. A TV-silicon vidacon which senses radiation between .5 and 1.2 microns. The longer wavelength of these systems enhances the sensor's ability to penetrate atmospheric aerosols such as haze. Near-IR systems cause an increase in contrast between natural and painted objects than at visual wavelengths. Environmental limitations are the same as for visible systems except that atmospheric aerosols are less of a problem.

IR Semiactive Systems. These employ a laser designator operating at IR wavelengths. The point of maximum reflected energy is sensed and tracked using a centroid tracker. These systems have the advantage of day or night operations. Environmental limitations:
(1) Clouds/Fog, other than very thin (they absorb IR energy),
(2) Haze and other dry aerosols (for near IR systems only),
(3) High absolute humidity (for far IR and far IR systems only).

Bombs for Beginners

Aircraft bombs are released over enemy targets to reduce and neutralize the enemy's war potential. This is done by destructive explosion and fire. Aircraft bomb ammunition is used strategically to destroy installations, armament, and personnel; and tactically in direct support of land, sea, and air forces engaged in offensive or defensive operations. Bombs are designed to be carried either in the bomb bay of aircraft or externally under the wings or fuselage.

At the outset of the Vietnam War, tactical aviation pilots were achieving a 750-foot circular error probable (CEP)--the radius from the aim point that half of the bombs dropped will fall within. This number is sufficient for the impact of a tactical nuclear weapon but is far from adequate for conventional weaponry. It took several years for the CEP to be lowered to a manageable 365 feet. [SOURCE] The advantage of guided bombs was revealed when compared with the F-105' s work in Vietnam. The F-105s achieved a circular error probable (CEP) of 447 feet and 5.5 percent direct hits during the end of Rolling Thunder, compared with guided bombs' CEP of 23 feet and 48 percent direct hits during the period of February 1972 through February 1973. [SOURCE]

Robust Munitions are munitions having a ratio of the explosive weight to the empty case weight less than 1.00 and a nominal wall thickness of 0.4 inches. Examples of robust ammunition include MK 80 series bombs, Ml07 projectiles, Tomahawk and Harpoon penetration warheads and 20,25, and 30 mm cartridges. Examples of non-robust ammunition include CBUs, torpedo warheads, underwater mines and TOW, HELLFIRE, Sparrow, and Sidewinder Missiles. Unless otherwise noted, all air-to-air missile warheads are defined as non-robust.

A bomb is an explosive filler enclosed in a casing. Bombs are generally classified according to the ratio of explosive material to total weight. The principal classes are general-purpose (GP), fragmentation, penetration and cluster bombs.

Approximately 50-percent of the **General Purpose [GP]** bomb's weight is explosive materials. These bombs usually weigh between 500 and 2,000 pounds and produce a combination of blast and fragmentation effects. The approximately one-half-inch-thick casing creates a fragmentation effect at the moment of detonation, and the 5O-percent explosive filer causes considerable damage from blast effect. The most common GP bombs are the MK-80 series weapons.

General-purpose bombs were the type of ordnance most frequently employed in the Gulf War. According to Iraqi prisoners of war, formations of B-52s dropping general-purpose bombs were one of the most feared aircraft-weapon combinations of the war. GP bombs served as the basic building blocks for many of the other munitions used during the Gulf War.

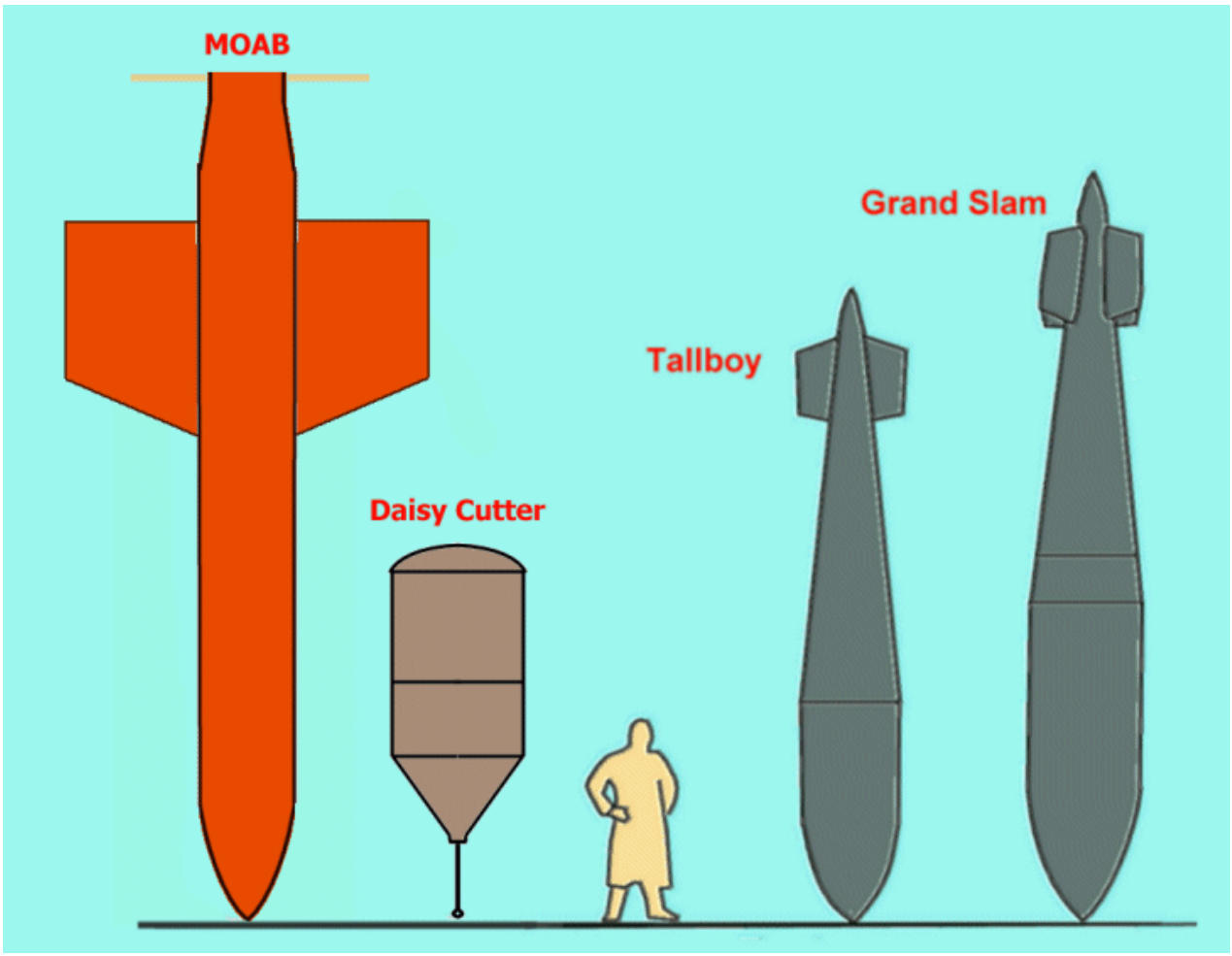
Only ten to twenty percent of a **fragmentation** bomb's weight is explosive material; the remainder include specially scored cases that break into predictably sized pieces. The fragments, which travel at high velocities, are the primary cause of damage.

Penetration bombs have between twenty-five and thirty percent explosive filler. The casings are designed to penetrate hardened targets such as bunkers before the explosives detonate. Penetration is achieved by either kinetic energy of the entire projectile or the effects of a shaped-charge.

Cluster bombs are primarily fragmentation weapons. Cluster bombs, like GP bombs, can feature mix and match components (submunitions, fuzes, etc.) to produce the desired effect.

Fuel Air Explosives: Fuel-Air Explosives [FAE] disperse an aerosol cloud of fuel which is ignited by an embedded detonator to produce an explosion. The rapidly expanding wave front due to overpressure flattens all objects within close proximity of the epicenter of the aerosol fuel cloud, and produces debilitating damage well beyond the flattened area. The main destructive force of FAE is high overpressure, useful against soft targets such as minefields, armored vehicles, aircraft parked in the open, and bunkers.

Incendiary Explosives: The purposes of incendiaries are to cause maximum fire damage on flammable materials and objects and to illuminate. Incendiary agents are used to burn supplies, equipment, and structures. Initial action of the incendiary munition may destroy these materials, or the spreading and continuing of fires started by the incendiary may destroy them. Even experienced troops may suffer increased battle fatigue when confronted with a surprise enemy weapon, tactic, or attack. Examples include napalm bombs (Israel against Egypt, US against North Vietnam).



MOAB - Massive Ordnance Air Blast Bomb
"Mother Of All Bombs"

The US Air Force has developed the 21,000-lb., or 95-hundred kilogram, satellite-guided Massive Ordnance Air Blast Bombs (MOAB) as a successor to the the 15,000-lb. "Daisy Cutters" used in Vietnam and Afghanistan. The Air Force is said to call MOABs (pronounced MOE-ab) the mother of all bombs. As with the earlier Daisy Cutter, these huge bombs are dropped out of the rear of the C-130 cargo plane.

Unlike the Daisy Cutter, the MOAB is released without the use of a parachute. As a result, the aircraft releasing the bomb can fly at higher altitudes, thus making it safer for US pilots. This replacement for the BLU-82 bomb uses more of the slurry of ammonium nitrate and powdered aluminum used in the BLU-82. Other reports indicate that

the MOAB might use tritonal explosive as opposed to the gelled slurry explosive of the BLU-82.

Testing began at Eglin as part of an Air Force Research Lab Technology Demonstration Project.

Work on the program began in 2002 and was set for completion in 2003.

Rockets for Rookies

Popular terminology makes a distinction between jets and rockets: a jet takes in air from the atmosphere; a rocket needs no air supply, as it carries its own supply of oxygen. Both types of engines operate by expelling a stream of gas at high speed from a nozzle at the after end of the vehicle. Rockets are distinguished by the means used to produce exhaust material. The most common type of rocket engine obtains its high-pressure gases by burning a propellant. This propellant consists of both fuel and oxidizer and may be solid or liquid.

Propellants are classified as either solid propellants or liquid propellants. Nearly all of the rocket-powered weapons in use by the United States use solid propellants. Liquid propellants are still used in some of the older ICBMS and will be used in future cruise missiles. Liquid fuels are more powerful than solid fuels; but other than this advantage, a liquid-fuel rocket is not ideally suited as a weapon-propulsion system. Because of their high volatility and corrosive nature, liquid fuels cannot be stored for long periods of time, which usually means the system must be fueled just prior to launch. This negates its ability to be a quick-reaction weapon, which is usually required in combat situations.

The size and type of a missile selected for a particular function are based on the target, the launch vehicle or platform, range and maneuverability requirements, altitude envelope, and storage requirements. Minimum size and weight may not be the most efficient architecture, and it is often best to employ various types of structures for different sections of the missile to obtain certain design or maintenance advantages.

GROUND BASED SYSTEMS

The fundamental mission of armor and other direct fire weapons is to close with and destroy the enemy. The ability to move, shoot, communicate, and provide armored protection is a decisive factor on the modern battlefield. In accomplishing its assigned missions, armor uses fire, maneuver, and shock effect, synchronized with other maneuver elements and with combat support (CS) and combat service support (CSS) assets. When properly supported, it is capable of conducting sustained operationsagainst any sophisticated threat.

The entire purpose of the tank is to carry the main gun into battle. The armor is provided to ensure that the crew is protected from shrapnel (the main cause of battlefield casualties) and

small arms fire. The crew exists solely to serve the main gun. The driver gets the vehicle to firing position, the tank commander selects targets, the loader ensures the weapon is loaded with the correct ammunition for the target selected, and the gunner makes sure the round strikes the target in the area of maximum vulnerability.

Since its inception during the First World War, the tank has been the preeminent system used in maneuver forces. They embody the mobile protected firepower needed to fight the close combat maneuver battle. In the attack, tanks functioning as a part of a combined arms mounted force must enter the close combat battlespace in order to win; driving the enemy from an objective or destroying him. In the defense, mounted units must also fight and destroy enemy forces moving into this battlespace. The operational capabilities of survivability, lethality, and mobility are defined by the need to fight and win against any system entering or engaging tanks in the battlespace. Survivability must be maximized against any weapon system capable of engaging in the close combat battlespace. This includes threat tanks firing KE projectiles, guided and unguided (infantry fired) anti-tank weapons and high precision and conventional artillery delivered munitions. Most threat weapons can be defeated with base armor, but improved ATGMs and new top-attack weapons require armor solutions that would exceed weight limitations. New technologies such as sensors and countermeasure suites and signature management have been shown to greatly enhance survivability against the vast majority of these systems. Lethality requirements are driven by the need for the tank to engage and destroy any vehicle entering the close combat battlespace. Enemy tanks with heavy base armors and sophisticated appliques present the greatest challenge to our tanks. Finally, tanks must be able to maneuver quickly over the battlefield in order to bring our lethality and survivability assets to bear. So far, only fully tracked vehicles can provide load carrying capacity and cross-country mobility needed to effectively fight the maneuver battle.

Tanks offer an impressive array of capabilities on the modern battlefield: excellent cross-country mobility, sophisticated communications, enhanced target acquisition, lethal firepower, and effective armor protection. In combination, these factors produce the shock effect that allows armor units to close with and destroy the enemy in most weather and light conditions. Tanks can move rapidly under a variety of terrain conditions, negotiating soft ground, trenches, small trees, and limited obstacles. In addition, global positioning systems (GPS) and inertial position navigation (POSNAV) systems allow today's tanks to move to virtually any designated location with greater speed and accuracy than ever before. Use of visual signals and the single channel ground/airborne radio system (SIN CGARS) facilitates rapid and secure com munication of orders and instructions. This capability allows tank crews to quickly mass the effects of their weapon systems while remaining dispersed to limit the effects of the enemy's weapons. On-board optics and sighting systems enable the crews to acquire and destroy enemy tanks, armored vehicles, and fortifications using the main gun or to use machine guns to suppress enemy positions, personnel, and lightly armored targets. The tank's armor protects crew members from small arms fire, most artillery, and some antiarmor systems.

Military theorists generally agree that a defending army could hope for success if the attacking enemy had no greater than a 3:1 advantage in combat power. The best intelligence estimates in the 1970s, however, concluded that the Warsaw Pact armies enjoyed a much larger advantage. Continuing budget constrictions made unlikely the possibility of increasing the size of the American military to match Soviet growth. To solve the problem of how to fight an enemy that would almost certainly be larger, the United States relied, in part, on technologically superior hardware that could defeat an enemy at ratios higher than 1:3. To

achieve that end, the Army in the early 1970s began work on the "big five" equipment systems: a new tank, a new infantry combat vehicle, a new attack helicopter, a new transport helicopter, and a new antiaircraft missile.

The second of the big five systems was the companion vehicle to the Abrams tank: the M2 Bradley infantry fighting vehicle, also produced in a cavalry fighting version as the M3. Its predecessor, the M113 armored personnel carrier, dated back to the early 1960s and was really little more than a battle taxi. The 1973 Arab-Israeli War demonstrated that infantry should accompany tanks, but it was increasingly clear that the M113 could not perform that function because it was far slower than the M1, its obsolescence aside. European practice also influenced American plans for a new vehicle. German infantry used the well-armored Marder, a vehicle that carried seven infantrymen in addition to its crew of three, was armed with a 20-mm. gun and coaxial 7.62-mm. machine gun in a turret, and allowed the infantrymen to fight from within the vehicle. The French Army fielded a similar infantry vehicle in the AMX-1OP in 1973. The Soviets had their BMP-ls, which had a 73-mm. smoothbore cannon and an antitank guided missile, as early as the late 1960s. Variations of the BMP were generally considered the best infantry fighting vehicles in the world during the 1980s. The United States had fallen at least a decade behind in the development of infantry vehicles. General DePuy and General Starry, who at that time commanded the U.S. Army Armor Center and School at Fort Knox, Kentucky, agreed the Army needed a new infantry vehicle and began studies in that direction.

M-9 Bayonet

Mission: Defeat the enemy in hand-to-hand combat. Also used as a general field and utility knife. Entered Army Service M6 (1957), M7 (1964), M9 (1987). Description and Specifications: The M9 multipurpose bayonet system is used as a bayonet on the M16 series rifle, on the M4 series carbine, as a hand weapon, as a general field and utility knife as well as a wire cutter together with its scabbard, and as a saw.

	M6	M7	M9
Blade length:	6.75 in	6.5 in	7 in
Total length:	11.5 in	11.75 in	12 in

M-9 Pistol

Mission: Deter, and if necessary, compel adversaries by enabling individuals and small units to engage targets with accurate, lethal, direct fire. Entered Army Service 1990. Description and Specifications: A semi-automatic, single-action / double-action pistol. The M9 is the primary sidearm of The U.S. military, replacing the .45 caliber model M1911A1. The M9 has a 15-round staggered magazine with a reversible magazine release button that can be positioned for either right- or left-handed shooters.

M-16 Assault Rifle

Deter and, if necessary, compel adversaries by enabling individuals and small units to engage targets with accurate, lethal, direct fire. Entered Army Service 1964. Description and Specifications: A lightweight, air-cooled, gas-operated, magazine-fed rifle designed for either automatic or semi-automatic fire through use of a selector lever. There are four variants - the

M-16A1/A2/A3/A4. The M-16A2 incorporates improvements in iron sight, pistol grip, stock and overall combat effectiveness. Accuracy is enhanced by incorporating an improved muzzle compensator, three-round burst control, and a heavier barrel; and by using the heavier NATO-standard ammunition, which is also fired by the squad automatic weapon.

Caliber:	5.56 mm
Weight:	8.8 lbs (includes sling & one loaded magazine)
Range:	800 meters for an area target / 550 meters for a point target

Manufacturer

Colt Manufacturing and Fabrique Nationale Manufacturing Inc.

M203 Grenade Launcher

Mission: Deter and, if necessary, compel adversaries by enabling individuals and small units to engage targets with accurate, lethal grenade fire. Entered Army Service early 1970s. Description and Specifications: The M203 grenade launcher is a single-shot weapon designed for use with the M16 series rifle and fires a 40mm grenade. The M203A1 grenade launcher is a single-shot weapon designed for use with the M4 series carbine and also fires a 40mm grenade. Both have a leaf sight and quadrant site. The M203 is also being used as the delivery system for a growing array of less-than-lethal munitions.

M-249 Squad Automatic Weapon

Mission: Deter, and if necessary, compel adversaries by enabling individuals and small units to engage targets with accurate, lethal, direct automatic fire. Entered Army Service 1987. Description and Specifications: A lightweight, gas-operated, one-man-portable automatic weapon capable of delivering a large volume of effective fire at ranges up to 800 meters. Two M249s are issued per infantry squad. It is scheduled to replace the M60 7.62 medium machine gun in certain units.

M-240B Machine Gun

Mission: Deter, and if necessary, compel adversaries by enabling individuals and small units to engage targets with accurate, lethal, direct automatic fire. Entered Army Service 1997. Description and Specifications: A ground-mounted, gas-operated, crew-served machine gun. This reliable 7.62mm machine gun delivers more energy to the target than the smaller caliber M-249 SAW. It is being issued to infantry, armor, combat engineer, special force/rangers, and selected field artillery units that require medium support fires and will replace the ground-mounted M-60 series machine guns currently in use.

Caliber:	7.62 mm
Weight:	27.6 lbs
Max effective range:	1800 m (area target) 800 m (point target)
Rate of fire:	200-600 rounds per minute

Manufacturer
FN Manufacturing (Columbia, SC)

TANKS AND ARMORED PERSONNEL CARRIERS

M1A2 Abrams Battle Tank

The Abrams tank closes with and destroys enemy forces on the integrated battlefield using mobility, firepower, and shock effect. There are three variants in service: M1, M1A1 and M1A2. The 120mm main gun on the M1A1 and M1A2, combined with the powerful 1,500 hp turbine engine and special armor, make the Abrams tank particularly suitable for attacking or defending against large concentrations of heavy armor forces on a highly lethal battlefield.

Bradley (Armored Personnel Carrier)

Mission: Provides protected transport of an infantry squad on the battlefield and overwatching fires to support the dismounted infantry; is employed to suppress and defeat enemy tanks, reconnaissance vehicles, infantry fighting vehicles, armored personnel carriers, bunkers, dismounted infantry and attack helicoptors; and performs cavalry scout and other essential (Bradley-equipped fire support and Stinger teams) missions in the 21st century. The infantry version (M2) is used most often to close with the enemy by means of fire and maneuver. The primary tasks performed by the cavalry version (M3) as part of a troop and/or squadron are reconnaissance, security and flank guard missions. Entered Army Service 1981.

M113A3 (Armored Personnel Carrier)

Mission: Provide a highly mobile, survivable, and reliable tracked-vehicle platform that is able to keep pace with Abrams- and Bradley-equipped units and that is adaptable to a wide range of current and future battlefield tasks through the integration of specialized mission modules at minimum operational and support cost. Entered Army Service 1960. Description and Specifications: After more than four decades, the M113 family of vehicles (FOV) is still in service in the U.S. Army (and in many foreign Armies). The original M113 Armored Personnel Carrier (APC) helped to revolutionize mobile military operations. These vehicles carried 11 soldiers plus a driver and track commander under armor protection across hostile battlefield environments. More importantly, these vehicles were air transportable, air-droppable, and swimmable, allowing planners to incorporate APCs in a much wider range of combat situations, including many "rapid deployment" scenarios. The M113s were so successful that they were quickly identified as the foundation for a family of vehicles. Early derivatives included both command post (M577) and mortar carrier (M106) configurations. Today's M113 fleet includes a mix of these A2 variants together with other derivatives equipped with the most recent A3 RISE (Reliability Improvements for Selected Equipment) package. The standard RISE package includes an upgraded propulsion system (turbocharged engine and new transmission), greatly improved driver controls (new power breaks and conventional steering controls), external fuel tanks, and 200 AMP alternator with 4 batteries. Additional A3 improvements include incorporation of spall liners and provisions for mounting external armor. The future M113A3 fleet will include a number of vehicles that will have high speed digital networks and data transfer systems. The M113A3 digitization program includes applying appliqué hardware, software, and installation kits and hosting them in the M113 FOV.

HMMWV (Hummer)

Mission: Provide a common light tactical vehicle capability. Replaced the quarter-ton jeep, M718A1 ambulance, half-ton Mule, 1.25-ton Gamma Goat, and M792 ambulance. Entered Army Service: 1985. Description and Specifications: The HMMWV (High-Mobility Multipurpose Wheeled Vehicle) is a light, highly mobile, diesel-powered, four-wheel-drive vehicle equipped with an automatic transmission.

INDIRECT FIRE AND ARTILLERY

Indirect Fire

Indirect fire weapons include artillery units equipped with either field guns (howitzers), or heavy mortars. Artillery is that part of an army that controls the bigger, long range weapons, formerly referred to as cannons. In battle, the artillery's role is to provide fire support for the infantry, cavalry, armor and other units. The projectile, rocket, missile, and bomb are the weapons of indirect-fire systems. Indirect fire can cause casualties to troops, inhibit mobility, suppress or neutralize weapon systems, damage equipment and installations, and demoralize the enemy. Historically, more combat deaths have been caused by indirect fire weapons than by any other means, hence the designation of artillery as the King of Battle. Most casualties to troops in an indirect-fire attack are caused by the initial rounds. Best results are achieved by a short engagement at a high rate from as many weapons as possible.

The precision revolution progressed more slowly to indirect fire because to hit an unseen target with the first round required refinements in the ability to locate both the target and the firing position, as well as the ability to predict very accurately the ballistic course of a projectile. Ballistic refinement arrived with the development of digital fire-control computers, precise weather-measuring devices, and devices to measure the velocity of a projectile in flight. Target-acquisition radars, laser range finders, and the now indispensable GPS allowed a similar precision in locating targets and firing positions. If all of the parts are assembled and employed properly, the radius of error for a "dumb" artillery projectile is easily cut in half. DPICM or bomblet artillery munitions, in turn, have almost tripled the kill radius for artillery. This quantum jump in precision and lethality mean that for the first time in history the artillery kill radius was greater than its radius of error. In other words, if American artillery shoots at a target, it died.

Effects of Fire. A commander will decide what effect fire support must have on a particular target. There are three types of fire: destruction, neutralization, and suppression.

Destruction. Destruction puts a target out of action permanently. Direct hits with high-explosive (HE) or concrete-piercing (CP) shells are required to destroy hard materiel targets. Usually, destruction requires large expenditures of ammunition and is not considered economical, except for nuclear weapons.

Neutralization. Neutralization knocks a target out of action temporarily. It can be achieved by use of any type of shell-fuze combination suitable for attacking a particular type of target. Neutralization does not require an extensive expenditure of ammunition and is the most practical type of mission. Most missions are neutralization fire.

Suppression. Suppression of a target limits the ability of the enemy Personnel in the target area to perform their jobs. Firing HE/VT or smoke creates apprehension and confuses the enemy. The effect of suppressive fires usually lasts only as long as the fires are continued.

Suppression requires a low expenditure of ammunition; however, since its effects are not lasting, it is unsuitable for most targets.

Categories of Indirect Fire. Indirect fires are divided into two basic categories: observed and unobserved.

Observed fire. Observed fire is fire for which the points of impact or burst can be controlled by an observer. Seldom will there be enough indirect-fire units or ammunition available to meet all the demands for indirect-fire support. By ensuring fire is observed when accuracy cannot be guaranteed, the most effective and economical use of indirect-fire weapons is attained. Observed fire will result in target damage assessment (TDA) reports.

Unobserved fire. Unobserved fire is fire for which the points of impact or burst are not observed. It involves predicting where targets are, or will be, and placing fire on them. Use of unobserved fire requires follow-up activity to assess effectiveness.

Javelin

Provide a man-portable, highly lethal and survivable medium anti-tank weapon system to the infantry, scouts, and combat engineers. Entered Army Service 1996. Description and Specifications: Javelin is the first "fire-and-forget" shoulder-fired anti-tank missile now fielded to the U.S. Army and U.S. Marine Corps, replacing Dragon. Javelin's unique top-attack filght mode, superior self-guiding tracking system and advanced warhead design allows it to defeat all known tanks out to ranges of 2500m. Javelin's two major components are a reusable command launch unit (CLU) and a missile sealed in a disposable launch tube assembly. Javelin's fire-and-forget guidance mode enables gunners to fire and then immediately take cover, greatly increasing survivability. Special features include a selectable top-attack or direct-fire mode (for targets under cover or for use in urban terrain against bunkers and buildings), target lock-on before launch, and a very limited back-blast that enables gunners to safely fire from enclosures and covered fighting positions.

Weight (missile and CLU):	49.5 lbs
Length overall:	3 ft 6 in
Range:	In excess of 2500m
Crew:	2

TOW Missile

Mission
Defeat threat armored vehicles and urban enclosed threats at extended ranges in all expected battlefield conditions. Entered Army Service 1970. Description and Specifications: The TOW (Tube-launched, Optically-tracked, Wire command-link guided) Missile System consists of a tripod, traversing unit, missile guidance set, launch tube, optical sight, battery assembly and any of five missile variations. The TOW missile system also includes a thermal sight that provides a capability for operations at night, in reduced visibility, and in a countermeasure environment. TOW missiles are all-up rounds encased in a disposable container.The TOW system is mounted on various platforms including the Bradley Fighting

Vehicle, the improved TOW vehicle, the Humvee and the AH-1F Cobra helicopter. In addition, it can be operated in a dismounted ground mode. The TOW is guided to its target merely by the gunner keeping the cross-hairs on the target. Corrective information is sent to the missile by two thin wires that deploy in flight.

	TOW 2A	TOW 2B
Missile weight:	47.1 lb	49.8 lb
Missile length :	46.1 in	46.1 in
Min range:	65 m	200 m
Max range:	3,750 m	3,750 m
Launcher weight with TOW 2 mods:	204.6 lb	
Crew:		

M224 Mortar Launcher

Mission: Provide long-range indirect fire support to airborne, air assault, light infantry, mountain, and special operations forces. Entered Army Service 1978. Description and Specifications: The M224 is a high-angle weapon used for close-in support of ground troops. The M224 system consists of the M25 Cannon (tube), M170 Bipod, M7 Baseplate for conventional mode firing or M8 Baseplate for hand-held mode firing , and the M64A1 Sight Unit. This smooth bore system can be gravity-fired or fired by using a manual spring-loaded firing system.

Cannon length:	40 in (1.02 m)
Maximum range:	3,490 m (conventional); 1,340 (handheld)
Minimum range:	70 m (conventional); 75 m (handheld)
Weight:	48 lbs (conventional firing mode) 18 lbs (hand-held firing mode)
Rate of fire:	(dependent on ammunition round fired) Max --18-30 per minute for 1 to 4 minutes Sustained -- 8 to 20 per minute
Ammunition	High-explosive / multioption fuze, high-explosive point detonating fuze, white phosphorous

M119A2 Howitzer

Mission: Provide destructive, suppressive and protective indirect and direct field artillery fires in support of combined arms operations. Entered Army Service 1989. Description and Specifications: The M119A1/A2 105mm towed howitzer is a lightweight towed weapon that provides direct support fires to light, airborne and air assault forces. The prime mover for the M119 is the HMMWV. However, it can be dropped by parachute or airlifted with its basic load of ammunition by UH60 and CH47 helicopters or C130 aircraft.

Length:	20.75 feet
Width:	5.83 feet
Height:	7.25 feet
Weight:	4,270 lbs
Crew:	7
Range:	14,000 m standard 19,500 m rocket-assisted
Max rate of fire:	6 rounds per minute for first 2minutes
Sustained rate of fire:	3 rounds per minute
Ammunition:	The M119A1/A2 fires all standard NATO 105mm artillery ammunition, including the M1 High Explosive, M314 Illuminating, M60/M60A2 White Phosphorous (smoke). In addition, it fires the M913 and M760 extended range ammunitions.

M198 (155mm Howitzer)

Mission: Provide destructive, suppressive and protective indirect and direct field artillery fires in support of combined arms operations. Entered Army Service 1979. Description and Specifications: The M198 155mm towed howitzer is a medium artillery system that provides direct support fires on an interim basis to the Stryker Brigade Combat Teams and direct general support fires to light and special purpose forces (Airborne and Air Assault). As the successor to the older M114A1 155mm towed system fielded in World War II, the M198 provides significant improvements in lethality, range, reliability, availability, emplacement and movement. Normally towed by a 5-ton truck, the M198 system can also be dropped by parachute or transported by a CH47 Chinook helicopter or C130 aircraft. The carriage of the M198 has a retractable suspension system and a top carriage which can be rotated 180 degrees to decrease overall length for shipment or storage. The fire control equipment may be used by one or two crewman for direct or indirect fire. The gunner on the left side controls left and right (traversing) settings and the assistant gunner on the right side controls up and down (elevation) settings.

Length:	40.7 feet (in tow); 36.2 feet (firing)
Width:	9.2 feet (in tow)
Height:	9.5 feet (in tow)
Weight:	16,000 lbs
Crew:	10
Range:	22,400 m standard 30,000 m rocket-assisted
Max rate of fire:	4 rounds per minute for first 2minutes
Sustained rate of fire:	2 rounds per minute
Ammunition:	The M198 will fire all current 155mm NATO-standard ammunition, to include high explosive (HE), smoke (HC, WP), dual purpose improved conventional munitions (DPICM), family of scatterable mines (FASCAM), cannon launched guided projectiles (Copperhead), and illumination. The HE round weighs 95 pounds.

M102 (105MM) Towed Howitzer

Provide destructive, suppressive and protective indirect and direct field artillery fires in support of combined arms operations. Entered Army Service 1964. Description and Specifications: The M102 105mm towed howitzer is a lightweight towed weapon that provides direct support fires to light, airborne and air assault forces. It can be towed by a 2-ton truck or HMMWV, dropped by parachute or transported with its basic load of ammunition by UH60 or larger helicopter and C130 aircraft. It is nearly three-quarters of a ton lighter than the World War II-era M101A1 105mm towed howitzer that it replaced. When emplaced, the howitzer's high volume of fire compensates in large measure for the lower explosive weight of the projectile compared to the 155mm howitzers. It has a very low silhouette when firing and a roller tire attached to the trail assembly of the M102 permits the weapon to be rotated 360 degrees around a firing platform, which provides the pivot for the weapon. The weapon can be elevated from -5 degrees to a maximum of 75 degrees. The M102 has been replaced in the active Army by the M119A1 105mm towed howitzer. The M102 is still found in several Army National Guard units and the Air Force uses the same cannon and recoil system in the AC130 gunship.

Length:	17.1 feet
Width:	6.4 feet
Height:	5.2 feet
Weight:	3,004 lbs
Crew:	8
Range:	11,500 m standard 15,100 m rocket-assisted
Max rate of fire:	10 rounds per minute for first 3 minutes
Sustained rate of fire:	3 rounds per minute
Ammunition:	The M102 fires all standard NATO 105mm ammunition, but not the newer extended range ammo.

Paladin

Mission: Provide the primary artillery support for armored and mechanized infantry divisions. Entered Army Service 1963 (M109). Description and Specifications The M109A6 (Paladin) howitzer is the most technologically-advanced self-propelled cannon system in The U.S. Army. The "A6" designation identifies several changes to the standard model that provide improvements to weapon survivability, responsiveness, reliability, availability and maintainability, armament and terminal effects. The fire-control system is fully automated, providing accurate position location, azimuth reference and on-board ballistic solutions of fire missions. The howitzer has a servo-driven, computer-controlled gun drive with manual backup. Paladin uses state-of-art components to achieve dramatic improvements in the following:

Max unassisted range:	22,000 m
Max assisted range:	30,000 m
Minimum range:	4,000 m
Max rate of fire:	4 rounds/minute for three minutes
Sustained rate of fire:	1 round/minute (dependent on thermal warning devices)
Max speed:	38 mph (highway)
Weight (empty):	56,400 lbs
Weight (combat loaded):	approximately 63,615 lbs
Crew:	4 (accompanying

Patriot

Provide defense of critical assets and maneuver forces belonging to the corps and to echelons above corps against aircraft, cruise missiles, and tactical ballistic missiles. Entered Army Service 1985. Description and Specifications: The combat element of the PATRIOT (Phased Array Tracking Intercept of Target) missile system is the fire unit, which consists of a phased array radar set (RS), and engagement control station (ECS), an electric power plant, an antenna mast group (AMG), a communications relay group (CRG), and up to eight launching stations (LS). The Patriot Advanced Capability-3 (PAC-3) upgrade program incorporates significant upgrades to the RS and ECS, and adds the new PAC-3 missile, which utilizes hit-to-kill technology for greater lethality against TBMs armed with weapons of mass destruction. Additionally, up to 16 PAC-3 missiles can be loaded per launcher, increasing firepower and missile defense capabilities.

MLRS

Mission
Provide counterfire and suppression of enemy air defenses, light materiel, and personnel targets at ranges from 15 to 300+ kilometers. Entered Army Service 1983. Description and Specifications: The MLRS (Multiple Launch Rocket System) is a high-mobility automatic system based on an M270 weapons platform. The MLRS is capable of supporting and delivering all freeflight basic and extended-range (ER-MLRS) rockets and the Army Tactical Missile System (ATACMS) Block I missiles. The MLRS launcher unit comprises an M270 launcher loaded with 12 rockets, packaged in two six-rocket pods. The launcher, which is mounted on a stretched Bradley chassis, is a highly automated self-loading and self-aiming system. It contains a fire control computer that integrates the vehicle and rocket launching operations. Without leaving the cab, the crew of three (driver, gunner and section chief) can fire up to twelve MLRS rockets in less than 60 seconds.

BOATS FOR BEGINNERS

The floors of a ship are called decks, the walls are called bulkheads, and the stairs are called ladders. There are no halls or corridors in a ship, only passageways. There are no ceilings in a room, only the overhead in the compartment. Openings in the outside of the ship are ports, not windows. Entrances from one compartment to another are called doors. Openings from one deck to another are called hatches. The handles on the watertight hatch or door are called dogs.

When you close a door or watertight hatch, you secure it. If you close down the dogs on the door or hatch, you dog it down. You never scrub the floor or wash the walls, rather you swab the deck and scrub the bulkheads. When you get up to go to work, turn to. You never go downstairs, you lay below, and if you are going up from one deck to another, you lay topside. If you are going up the mast or into the rigging you are going aloft.

A ship, to be classed as a fighting ship, must be capable of inflicting damage and of sustaining or avoiding damage. She must possess sufficient speed and, maneuverability to execute her mission and the capacity to proceed independently to a scene of action. The type of a warship is determined by the degree to which each of these qualities has been stressed in her design.

Aircraft Carriers

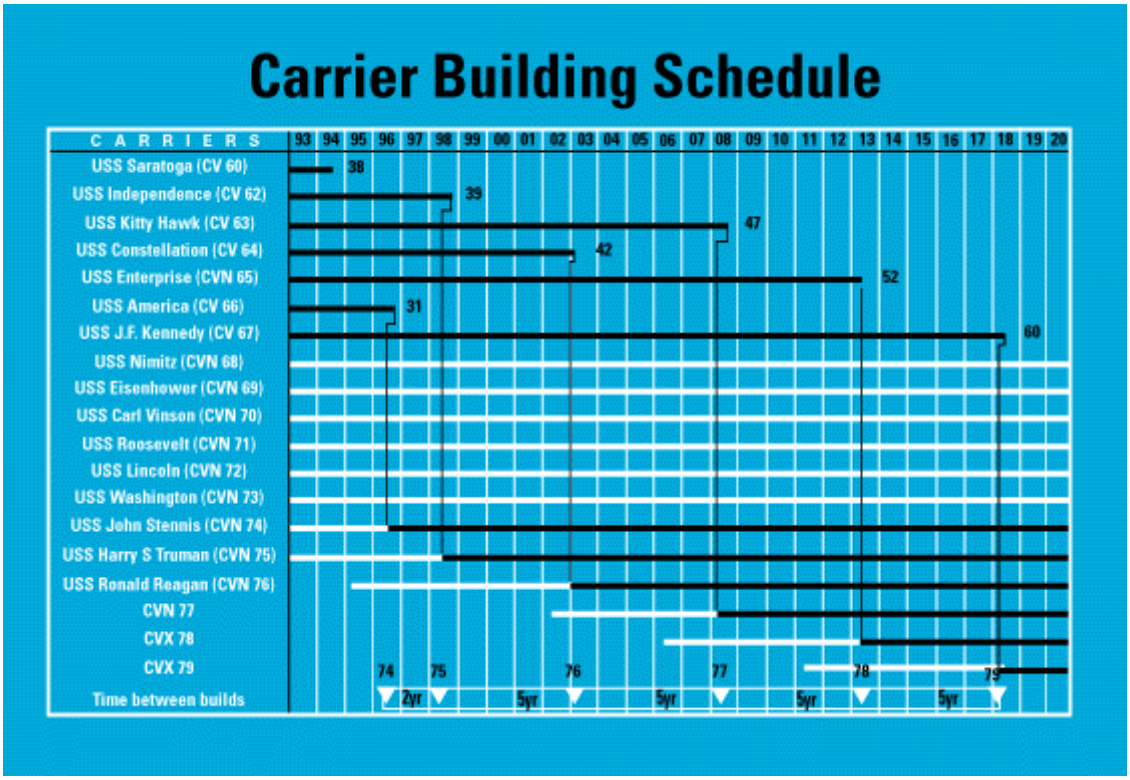
Throughout the 1960s and most of the 1970s, the Navy pursued a goal of creating a fleet of nuclear carrier task forces. The centerpiece of these task forces, the nuclear-powered aircraft carrier, would be escorted by nuclear-powered surface combatants and nuclear-powered submarines. In deciding to build nuclear-powered surface combatants, the Navy believed that the greatest benefit would be achieved when all the combatant ships in the task force were nuclear powered. Nonetheless, the Navy procured the last nuclear- powered surface combatant in 1975 because this vessel was so expensive. More recently, relatively new and highly capable nuclear-powered surface combatants have been decommissioned because of the affordability problems facing the Navy.

Aircraft Carriers

(Number of Years in Service)

		92	93	94	95	96	97	98	99	00	01
Forrestal	CV 59	37	(R)								
Saratoga	CV 60	36	37	(R)							
Ranger	CV 61	35	(R)								
Independence	CV 62	33	34	35	36	37	38	(R)			
Kitty Hawk	CV 63	31	32	33	34	35	36	37	38	39	40
Constellation	CV 64	30	31	32	33	34	35	36	37	38	39
Enterprise	CVN 65	RC	RC	RC	34	35	36	37	38	39	40
America	CV 66	27	28	29	30	(R)					
Kennedy	CV 67	24	25	26	27	28	29	30	31	32	33
Nimitz	CVN 68	17	18	19	20	21	22	RC	RC	RC	26
Eisenhower	CVN 69	14	15	16	17	18	19	20	21	22	RC
Vinson	CVN 70	10	11	12	13	14	15	16	17	18	19
Roosevelt	CVN 71	5	6	7	8	9	10	11	12	13	14
Lincoln	CVN 72	2	3	4	5	6	7	8	9	10	11
Washington	CVN 73	(C)	1	2	3	4	5	6	7	8	9
Stennis	CVN 74					(C)	1	2	3	4	5
Truman	CVN 75							(C)	1	2	3
Reagan	CVN 76				(P)						

(R) Retire (C) Commissioning (P) Procurement RC Refueling Complex Overhaul



Flexibility of operations, such as the ability to steam at high speeds for unlimited distances without refueling; increased capacity for aviation fuel; increased capacity for other consumables, such as munitions; and the higher speeds of the advanced nuclear carrier over conventional carriers are some of the factors that need to be considered when evaluating nuclear- and conventionally powered carriers. Other considerations include the availability and location of homeports and nuclear-capable shipyards for maintenance and repairs and other supporting infrastructure, such as for training; the effect of out-of-homeport maintenance on the amount of time personnel are away from their homeport; and the disposal of nuclear materials and radioactively contaminated materials.

Surface Warfare

During the 1980s, the Navy pursued a 600-ship force goal as part of its maritime strategy to prepare for a global war against the Soviet Union. This goal included 238 surface combatants. In August 1990, the President announced a shift in U.S. defense strategy from a Soviet threat to major regional conflicts (MRC) against uncertain adversaries. The following year, DOD proposed a "base force" plan to reflect the new strategy that reduced the force structure to about 450 ships (including 150 surface combatants), which would be a sufficient level to counter a possible reemergence of the Soviet threat.

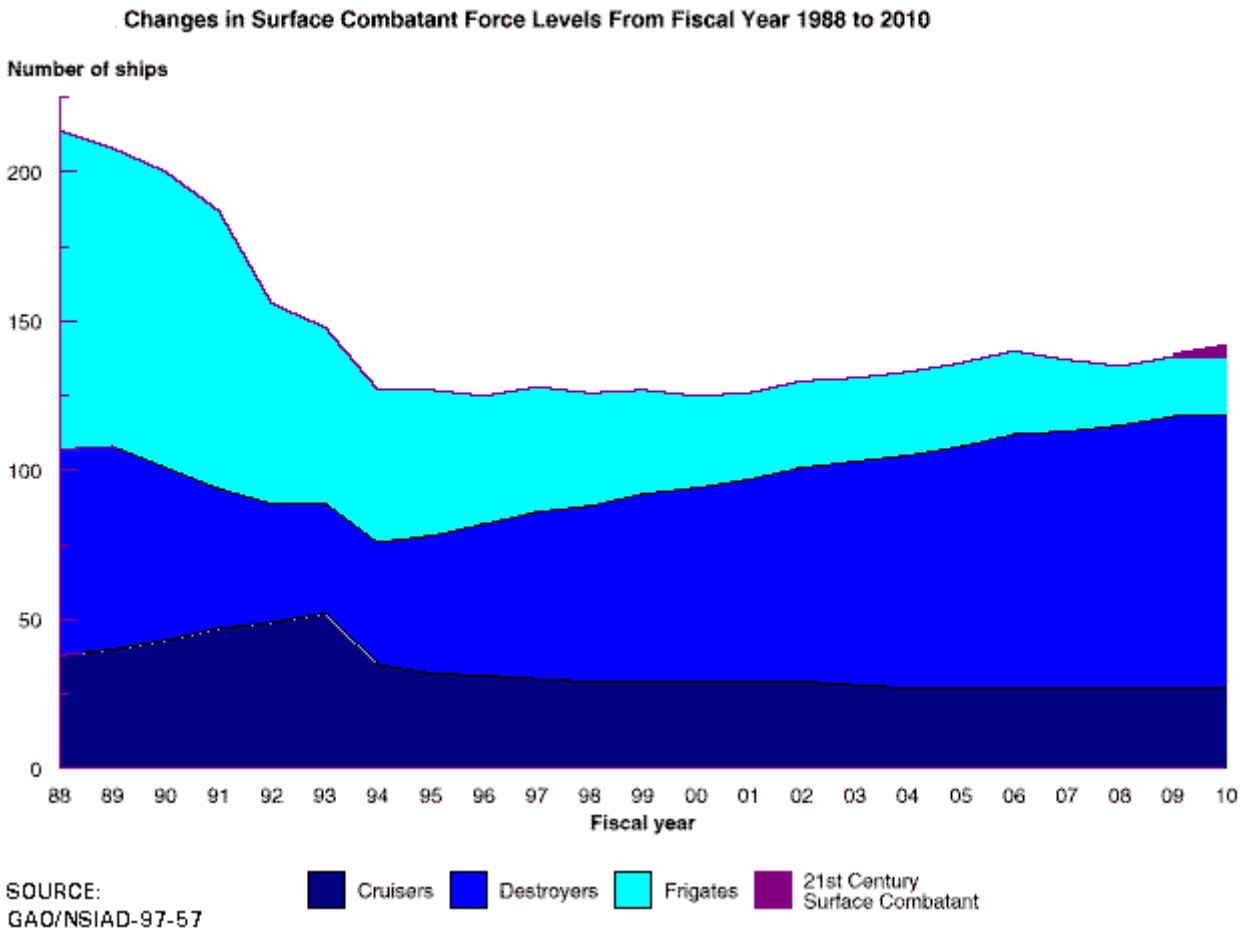
With the end of the Cold War, the Navy significantly reduced its number of surface combatants from about 220 in the late 1980s to 125—115 active cruisers, destroyers, and frigates and 10 reserve frigates—at the end of fiscal year 1996. The number of ships remained at or about the 1996 level through fiscal year 2001 but will gradually increase through the next decade to 142 ships in fiscal year 2010.

The Navy's Surface Warfare Division's August 1995 Surface Combatant Force Level Study concluded that 165 cruisers, destroyers, and frigates would be needed through 2010 to meet war-fighting requirements of two nearly simultaneous MRCs. According to the study, however, this number could be reduced to 145 ships, including 10 reserve frigates, with use of allied surface combatants. The subsequent 21st Century Surface Combatant Force Architecture Assessment, completed in February 1996 by the Naval Surface Warfare Center, suggested that the surface combatant force level from 2010 to 2030 could be even smaller than the 145-ship force recommended by the earlier study.

The Department of Defense (DOD) and the Navy are pursuing a surface combatant force size and construction program based largely on budget priorities, industrial base concerns, and operational requirements. However, DOD has not clearly explained the link and any underlying assumptions between the force and the national military strategy. DOD and Navy studies illustrate that the size of the force can vary widely depending on the specific assumptions considered.

Several factors could affect the size, composition, and overall capability of the surface combatant force through the middle of the next century. These factors include decisions related to the appropriate size and mix of surface combatants within the Navy and other DOD priorities and force efficiency strategies, such as expanded overseas home porting and alternative deployment schemes, which could help to increase force availability and use.

Technological innovations could also affect the requirement for surface combatants. These improvements could provide greater efficiencies in the use of the force and allow changes in doctrine and operational concepts that could reduce force requirements. These include improvements to the Tomahawk cruise missile, which could allow the missile to be used for tactical applications in support of ground operations; modifications to the Aegis combat system and Standard missile, which could provide a defense against theater ballistic missile attacks while operating in littoral areas; and introduction of the Cooperative Engagement Capability on existing and new combatants, other ships, and airborne elements, which will enhance ship self-defense capabilities by increasing response time and the amount of information available to defend against antiship cruise missile threats. It is also possible that the introduction of the Arsenal Ship, which would carry a large inventory of missiles and potentially serve several military purposes, could permit the Navy and the other services to retire or forego purchases of some assets, such as aircraft carriers, surface combatants, ground-based launchers, or combat aircraft.



Potential changes in operational practices could increase the availability of ships for deployment in peacetime. These changes include consideration of additional overseas home ports and changes to deployment schemes and personnel policies, such as shortening the time between deployments. Lengthening the deployment period, rotating crews, increasing transit speeds, and using different maintenance schemes are other potential options to increase the availability of ships for deployment in peacetime. These options may offer opportunities for the Navy to achieve national security objectives more efficiently as it operates with a smaller force structure and possibly smaller budgets.

The Navy's ability to achieve and sustain a desired force size is affected by the service lives of existing ships. Navy cruisers and destroyers have historically been retired by 30 years of service and frigates by 22 years of service. In recent force planning for ships, the Navy uses notional estimated service lives of 35 years for Aegis-capable cruisers and all current classes of destroyers and 24- to 32-year service lives for most Oliver Hazard Perry-class frigates retiring after fiscal year 1999.

SUBMARINES

In the midst of significant changes in mission requirements spawned by advances in technology and the threat, the Navy's attack submarine (SSN) force remains an important

multimission component capable of conducting covert operations in forward regions. SSN missions include gathering surveillance data, communicating tactical information, controlling the surface and undersea battlespace, and delivering strike weapons or special operations forces ashore in contingencies. The QDR reinforced the ongoing shift in SSN missions from open-ocean antisubmarine warfare and surveillance toward power projection, support of special operations forces, and littoral ASW, while making a modest reduction in force size by the end of the FYDP.

As directed by the QDR, the ongoing deactivation of older SSNs will decrease the force from 65 units in FY 1998 to 50 units in FY 2003. This force structure reflects continued deactivations of SSN-637 and older 688-class submarines, deliveries of the remaining two Seawolf-class (SSN-21) units through FY 2003, and subsequent deliveries of the New Attack Submarine (NSSN) class starting in FY 2004.

The existing DOD guidance calls for a force of 50 attack submarines, although some Navy studies suggest that current operational requirements demonstrate a need for a force of at least 72 submarines. These studies, which included the Joint Staff Submarine forces of the Future Study (1992-93) and the Navy Fleet Commander's Study on SSN requirements (1996-97), concluded that 51-72 SSNs were required and that the peacetime requirement for forward presence was most limiting.

OTHER

Non-Lethal Weapons

US forces increasingly operate in challenging environments known as military operations other than war. These operations include humanitarian assistance, military support to civil authorities, peacekeeping and peacemaking operations, and non-combatant evacuations. US Forces are involved in support and stability operations (SASO) throughout the globe. Maintaining and establishing law and order, reducing civil disturbances and responding to varied levels of threat have become mission assignments. Countering these with varied levels of force become recurring tasks for military forces involved in joint multinational and interagency operations.

Non-Lethal munitions applications will be used by military personnel to apply the minimum force necessary while performing missions of crowd control and area security at key facilities around the globe. These devices will aid military forces/commanders in situations of hostages rescue, capture of criminals, terrorists, or control of other adversarial persons.

Malodorants and irritants are two types of nonlethal weapons designed to temporarily mark, incapacitate, or drive away persons from an area. Environmental assessments have been performed on the malodorants Bathroom Malodor and Who-Me?, and the irritants Oleoresin Capsicum (OC), CS-Mace, and CN-Mace.

A running gear entanglement system (RGES) is proposed to protect Navy ships in port, and other waterside assets such as museums and marinas. The entanglement device will foul the propeller of unauthorized vessels attempting to approach restricted areas.

A pulsed-energy projectile (PEP) is under development that uses a chemical laser technology to produce a large flash, bang, and shock wave to temporarily disorient and incapacitate individuals in a crowd.

The advanced tactical laser (ATL) concept involves an infrared laser carried in an aircraft for air-to-ground strike missions, providing pinpoint accuracy and minimum damage.

Anti-traction material (ATM) is a very slippery, gel-like substance sprayed on ground surfaces to prevent access to areas by people and vehicles.

Nonlethal airburst munitions are 20mm weapons designed to emplace liquids, aerosols, powders and other objects at a precise location in space.

Thermobaric technology is a nonlethal weapon, in development, that causes extended flash, sound, temperature, and pressure conditions to disorient and/or temporarily incapacitate individuals.

The temporary discomfort and confusion generated by some of these Non-Lethal munitions provides the tactical team the few seconds necessary to exploit the situation by redirecting the actions of a targeted individual or group and enhances the ability to apprehend same. The shade of light green has been selected to be the ammunition color-coding for all Non-lethal ammunition components. Non-Lethal devices are intended to confuse, disorient, or momentarily distract potential threat persons. They are designed to produce only temporary incapacitation to either innocent bystander or threatening individuals.

Minor injuries can and will occur (bruises, stings, etc.) to individuals who are struck by payloads of Non-Lethal munitions. In fact, even if properly employed severe injury or death are still a possibility. Non-Lethal weapons shall not be required to have a zero probability of producing fatalities or permanent injuries. However while complete avoidance of these effects is not guaranteed or expected, when properly employed, Non-Lethal weapons should significantly reduce them as compared with physically destroying the same target.

Non-lethal capabilities expand the number of options available to commanders confronting situations in which the use of deadly force is not the preferred response. Non-lethal capabilities provide flexibility by allowing forces to apply measured force with reduced risk of serious non-combatant casualties, but in a manner that provides force protection and effects compliance - ensuring the success of the military mission.

Political, diplomatic and economic demands dictate that future operations, where possible, minimize U.S. casualties while limiting collateral civilian casualties and collateral damage to civilian objects. Crowd control in conducting peacekeeping and humanitarian assistance missions is as likely a task for the Army as is destroying enemy armor and infantry forces in war.

The advent of an era when the military services were increasingly required to perform Operations Other Than War (OOTW) has led to the need for NLWs. In early 1995, USMC LtGen Anthony Zinni was charged with protecting the final withdrawal of UN forces from Somalia and explored the prospects of using NLW. LtGen Zinni asked for quick response to field a NLW capability. The US Marine Corps and the US Army teamed to provide available NLW technology for use in and around Mogadishu. Although the NLW effects were marginal, LtGen Zinni's aggressive support added credibility to the NLW effort.

General John J. Sheehan, USACOM Commander, spoke at the Non-Lethal Defense Conference II, which was held in Washington, DC on 07 Mar 96. In his speech given at the conference, General Sheehan examined the global requirements for use of non-lethal weapons and emphasized the necessity for those weapons as standard-issue military hardware. On 09 Jul 96, DoD Directive 3000.3 was issued. The directive established joint service organizational responsibilities and provided guidelines for the development and employment of non-lethal weapons. The directive designated the Commandant of the US Marine Corps as Executive Agent (EA) for the DoD Non-Lethal Weapons Program, with the responsibility of providing "...program recommendations and for stimulating and coordinating non-lethal weapons requirements."

The Commandant of the Marine Corps has been designated as the Executive Agent for the Department of Defense (DoD) Joint Non-Lethal Weapons (NLW) Program with the responsibility for providing program recommendations and for stimulating and coordinating Joint Non-Lethal Weapon requirements. As the Army's proponent lead for non-lethal weapons, the Infantry worked closely with the sister services and DoD to develop a coherent joint operational concept. The U.S. Army Military Police School (USAMPS, at Fort Leonard Wood, MO) is the designated single proponent for Army Non-Lethal Applications, effective 12 September 2000. USAMPS serves as the U.S. Army Training and Doctrine Command's single voice for all developments and initiatives to field NL capabilities.

The Non-Lethal Capability Set (NLCS) is specifically designed to support Army units selected to participate in ground force operations where a non-lethal (NL) capability may be required. The components are specifically designed and primarily employed to incapacitate personnel or materiel, while minimizing fatalities or permanent injury to intended targets and collateral damage to property and the environment. The components are intended to enhance a unit's capability across the range of military operations; the NLCS is not intended to replace, but to augment currently fielded weapon systems and munitions. The NLCS will provide a significant increase in the capability of U.S. Forces to accomplish the objectives of military action in situations where use of lethal force is not the preferred or desired method of operation. However, when NL systems are used they will always be backed-up by a lethal system.

Mines

A land mine is an explosive device that is designed to destroy or damage equipment or personnel. Equipment targets include ground vehicles, boats, and aircraft. A mine is detonated by the action of its target, the passage of time, or controlled means. There are two types of land-based mines-- anti-tank (AT) and anti-personnel (AP).

AT mines are designed to immobilize or destroy vehicles and their occupants. An AT mine produces a mobility kill (M-Kill) or a catastrophic kill (K-Kill). An M-Kill destroys one or more of the vehicle's vital drive components (for example, breaks a track on a tank) and immobilizes the target. An M-Kill does not always destroy the weapon system and the crew; they may continue to function. In a K-Kill, the weapon system and/or the crew is destroyed.

AP mines can kill or incapacitate their victims. The mines commit medical resources, degrade unit morale, and damage nonarmored vehicles. Some types of AP mines may break or damage the track on armored vehicles.

US mine warfare has undergone a remarkable transition in the last 30 years. The U.S. inventory of old-fashioned "dumb" mines has been significantly reduced and their use restricted. The most modern mines in the US inventory all possess self-destruct or self-neutralization features, they cease to function at predetermined times. These mines lose the ability to inflict casualties once their military utility on the battlefield is gone.

Mines are intended to produce an obstacle effect on enemy maneuver and reduce his options for courses of action when he attacks. Unlike other obstacles, however, mines can inflict casualties, just as other weapons of war do.

New, smaller, lightweight, more lethal mines are now providing the capability for rapid emplacement of self-destructing anti-armor (AT) and AT/antipersonnel (AP) minefields by a variety of delivery modes. These range form from manual emplacement to launchers on vehicles and both rotary and fixed-wing aircraft.

Even more radical changes are coming in mines that are capable of sensing the direction and type of threat. These mines will also be able to be turned on and off, employing their own electronic countermeasures to ensure survivability against enemy countermine operations.

Land mines cause about 26,000 casualties worldwide every year. Although most of these casualties are the result of the indiscriminate and irresponsible use of mines, they have caused antipersonnel (AP) mines to be severely stigmatized by the international community. As a leader of the "responsible" international community, the United States has chosen to pursue the regulation of AP mines. In setting a standard that we hope others will follow, the President announced a significant change in US policy for AP mines on 16 May 1996. The US unilaterally undertook not to use, and to place in inactive stockpile status with the intent to demilitarize by the end of 1999, all nonself-destructing AP mines not needed to train personnel engaged in demining and countermine operations, and to defend the United States and its allies from armed aggression that crosses the Korean Demilitarized Zone.

The US views the security situation on the Korean Peninsula as a unique case and in the negotiation of this agreement will protect the right to use AP mines there until alternatives become available or the risk of aggression has been removed. This policy eliminated the use of M14 blast AP mines and M16 bounding fragmentation mines outside the Republic of Korea. It did not affect the use of self-destructing mines or command-detonated weapons (M18 claymore).

The use of antipersonnel landmines (APL) can be traced to World War II when they were developed for use in antitank (AT) minefields to discourage foot soldiers from disabling AT mines. Unfortunately, even when used according to the generally accepted doctrine of marking and recording, these non self-destructing APL continued to pose hazards long after the end of the conflict. Although the U.S. has since adopted self-destructing and self-deactivating landmines, the increased cost has limited their use to only NATO allies and a few other countries. Because the bulk of the mines still in use around the world are neither self-deactivating nor self-destructing, the humanitarian consequence of deploying these mines has led to an effort to achieve a global ban on APL.

In response to this effort, Presidential Decision Directive (PDD) 48 announced a new APL policy. The Directive allowed the U.S. to keep its mixed antitank (AT), self-destructing mine systems and directed the Department of Defense to develop and field alternatives to pure APL systems throughout the armed forces. The APL Alternatives program began as a two-

track approach. A second directive, PDD 64, provided additional direction for mixed systems and added a third track to the program.

Track 1 RADAM is an effort to redesign, repackage, and retrofit our current mixed (antitank and antipersonnel) scatterable artillery-delivered mines into a single round to be called the Remote Area Denial Artillery Munition (RADAM). Track 1 NSD-A is involved with development and implementation of non-self destructing alternative (NSD-A) to meet the requirements currently met by our antipersonnel landmines. Track 2 is a Defense Advanced Research Projects Agency effort to investigate innovative maneuver denial approaches that may take advantage of advanced technologies. Track 3 explores a wide range of materiel and operational concepts as alternatives to AP submunitions within mixed systems and to all mixed systems.

This three-track approach to develop antipersonnel landmine alternatives is on going. The goal is to enable the U.S. to be in a position to sign the Ottawa Convention banning APLs if suitable alternatives can be identified and fielded.