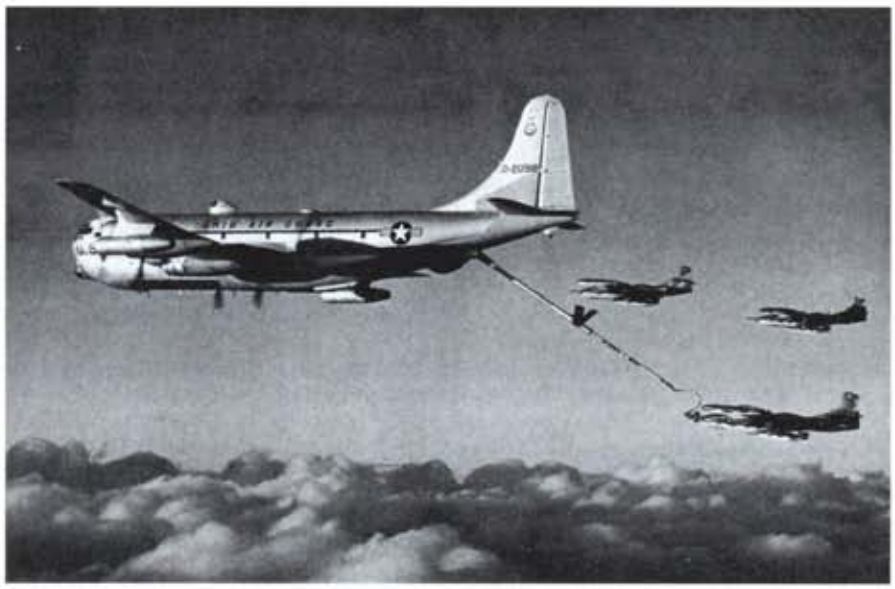
The B-50 Lucky Lady II dramatically demonstrated the efficacy of air refueling during a record-setting, nonstop, around-the-world flight in 1949. Capt. James G. Gallagher commanded the aircraft on the 94-hour flight, which began and ended in Fort Worth, Tex. The converted Superfortress was refueled four times during the flight by KB-29s, such as the top aircraft at right.

Ray Pamplin via Warren Thompson

The KB-50 did not last in the bomber force for long. The bulk of its service life was spent in the refueling and reconnaissance roles. Here, a KB-50, which could refuel three aircraft simultaneously, helps an F-104 Starfighter stay airborne over Spain in the 1960s. J47 jet pods had to be added to the tanker to boost its speed because Tactical Air Command fighters had difficulty going slowly enough to refuel from it.



Another early tanker that eventually needed a jet assist was the KC-97, originally a transport variant of the B-29. Though purpose-built KC-135s began to replace it in 1957, the KC-97 saw service in Vietnam and into the 1970s (right) with such units as the Ohio Air National Guard. This photo was taken very late in the KC-97's career—note the O before the serial number, which stands for "Obsolete." ■

USAF Almanac

Gallery of USAF Weapons

By Susan H. H. Young ■ Edited by John W. R. Taylor

Attack and Observation Aircraft

A-10/OA-10 Thunderbolt II

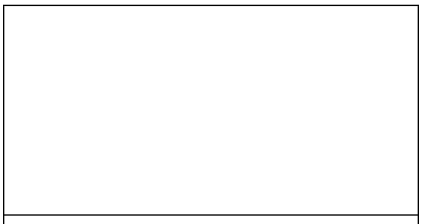
Large military load, long loiter, and wide combat radius combine to make the A-10 a formidable weapon for the close air support (CAS) mission. In a typical antiarmor mission, the A-10, affectionately nicknamed "Warthog," can fly 150 miles and remain on station for an hour. It can carry up to 16,000 lb of mixed ordnance with partial fuel or 12,086 lb with full internal fuel. The 30-mm GAU-8/A gun provides a cost-effective weapon with which to defeat the whole array of ground targets encountered in the CAS role, including tanks. Equipment includes an inertial navigation system (INS), head-up display (HUD), night vision goggles (NVGs), the Low-Altitude Safety and Targeting Enhancement (LASTE) system (which provides ground collision avoidance), Pave Penny laser target identification pod, electronic countermeasures (ECM), target penetration aids, self-protection systems, and associated equipment for AGM-65 Maverick missiles and AIM-9 Sidewinder air-to-air missiles.

The first operational squadron was activated at Myrtle Beach AFB, S.C., in June 1977 and achieved operational capability in October of that year. Delivery of 713 A-10s was completed in March 1984. In October 1987, the first **OA-10**s entered service for use in the forward air control (FAC) mission, providing coordination for, and control of, CAS assets. These aircraft are A-10s that have been redesignated and are intended to be used for airborne FAC of fighter aircraft, combat escort, search and rescue, and visual reconnaissance. The 30-mm GAU-8/A gun is retained, but underwing stores are normally restricted to canisters of white phosphorous rockets for target marking.

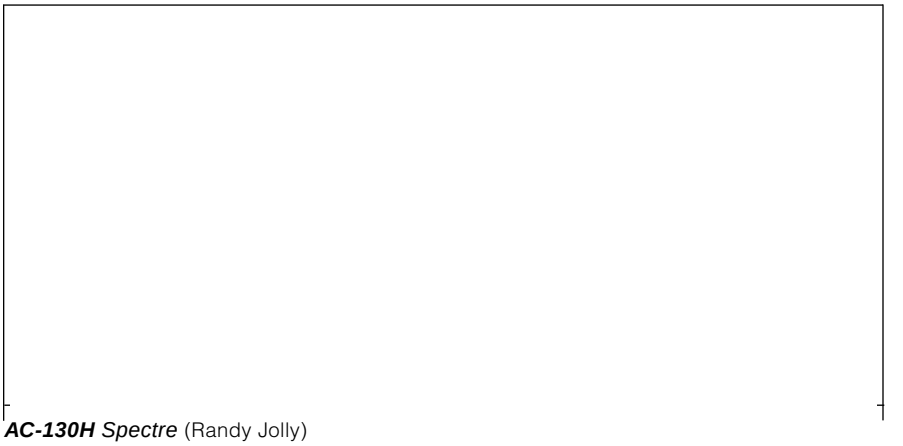
A/OA-10-equipped units include US Air Forces in Europe's 52d FW at Spangdahlem AB, Germany; Air Combat Command's 23d Wing, Pope AFB, N.C.; 347th Wing, Moody AFB, Ga.; and 355th Wing, Davis-Monthan AFB, Ariz.; and Pacific Air Forces' 354th FW, Eielson AFB, Alaska, and 51st FW, Osan AB, South Korea. The 57th Wing, Nellis AFB, Nev., has A-10s supporting the 422d TES and the USAF Weapons School. The first first-line aircraft to be assigned to the ANG, A-10s are the subject of a near-term night-capability upgrade. Together with OA-10s, they equip the 103d, 104th, 110th, 111th, and 124th FWs, and 175th Wing, at Bradley IAP, Conn., Barnes MAP, Mass., W.K. Kellogg Airport, Mich., Willow Grove ARS, Pa., Boise Air Terminal, Idaho, and Baltimore, Md., respectively. AFRC units equipped with A/OA-10s include the 47th and 303d FSs at Barksdale AFB, La., and Whiteman AFB, Mo., respectively.

A-10s were used extensively during the Persian Gulf War. They are currently deployed to Aviano AB, Italy, where they are operated by active-duty, ANG, and AFRC personnel, currently in support of NATO operations in Bosnia. In addition, a squadron of 24 A-10s, based permanently at Al Jaber AB in southern Kuwait, provides on-call airpower in that area, supplementing Operation Southern Watch. *(Data for A-10.)*

Contractor: Fairchild Republic Company, Division of Fairchild Industries.
Power Plant: two General Electric TF34-GE-100 turbofans; each 9,065 lb thrust.
Accommodation: pilot only, on zero-height/518 mph–zero-speed ejection seat.
Dimensions: span 57 ft 6 in, length 53 ft 4 in, height 14 ft 8 in.
Weights: empty 28,000 lb, max gross 52,000 lb.



***A-10** Thunderbolt II* (Guy Aceto)



***AC-130H** Spectre* (Randy Jolly)

Performance: combat speed at S/L, clean, 439 mph; range with 9,500 lb of weapons and 1.7 hr loiter, 20 min reserve, 288 miles.
Armament: one 30-mm GAU-8/A gun; eight underwing hardpoints and three under fuselage for up to 16,000 lb of ordnance, incl various types of free-fall or guided bombs, Combined Effects Munition (CEM) dispensers, gun pods, up to six AGM-65 Maverick missiles, up to four AIM-9 Sidewinder missiles, and jammer pods. Chaff and flares carried internally to counter radar-directed or infrared-directed threats. The centerline pylon and the two flanking fuselage pylons cannot be occupied simultaneously.

AC-130H/U Spectre

Air Force Special Operations Command's 16th SOW, based at Hurlburt Field, Fla., operates two versions of the AC-130 Spectre gunship. Eight **AC-130H**s serve with the 16th SOS, each equipped with a digital fire-control computer, two fixed 20-mm Vulcan cannon, one trainable 40-mm cannon, and a trainable 105-mm howitzer. They employ electro-optical (EO) sensors and target-acquisition systems, including forward-looking infrared (FLIR) and low-light-level television (LLLTV), and are capable of in-flight refueling. Fire-control computers, navigation, communications, and sensor suites have been upgraded. AC-130Hs have been deployed to Somalia, Bosnia, and Liberia.

Thirteen new **AC-130U**-configured gunship conversions by Rockwell International have been delivered to the 16th SOW's 4th SOS. These aircraft have greater altitude capability and combine increased firepower, reliability, and superior accuracy, with the latest methods of target location. The AC-130U has the same 40-mm and 105-mm guns as the H model but replaces the two 20-mm cannon with one trainable 25-mm Gatling gun. All weapons can be slaved to the APQ-180 digital fire-control radar, FLIR, or all-light-level television (ALLTV) for true adverse weather ground-attack operations.

ECM on all versions of the gunship enhances survivability in a low-to-medium-threat environment. Other equipment includes a HUD, combined INS, Navstar Global Positioning System (GPS), and Spectra ceramic armor protection. Each model is capable of providing precise surgical firepower and of performing special operations and conventional missions, including escort, surveillance, armed reconnaissance/interdiction, CAS, and air base defense. *(Data basically as for the C-130.)*

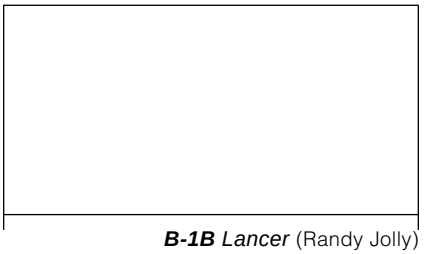
Bombers

B-1 Lancer

The B-1's speed, superior handling qualities, and large payload capability make it a key element of any composite strike force, in either a penetration or standoff role. Each of Air Combat Command's 95 B-1s possesses the flexibility to deliver Mk 82 conventional gravity general-purpose bombs, CBU-87 and -89 cluster munitions, and the CBU-97 Sensor-Fuzed Weapon, or to carry additional fuel, as required. The M117 750-lb conventional gravity bomb and Mk 62 500-lb naval mine will be added to the B-1's list of weapons this fiscal year. The B-1's conventional capability is being significantly enhanced by the ongoing Conventional Mission Upgrade Progam (CMUP). This gives the B-1 greater lethality and survivability through the integration of precision and standoff weapons and a robust ECM suite. Future phases of CMUP include installation of GPS receivers, a MIL-STD-1760 weapon

interface, secure radios, and improved computers to support precision weapons, including, initially, the Joint Direct Attack Munition (JDAM), eight each on three modified bomb bay rotary launchers, followed by the Joint Standoff Weapon (JSOW) and the Joint Air-to-Surface Standoff Missile (JASSM).

The B-1 has a blended wing/body configuration with variable-geometry wings. The unswept wing setting permits rapid takeoff from shorter runways and less sophisticated airfields. The fully swept position is used in supersonic flight and for the primary role of high-subsonic, low and medium altitude penetration. The bomber's offensive avionics include a modern forward-looking radar and terrain-following radar (TFR),



***B-1B** Lancer* (Randy Jolly)

***B-2A** Spirit* (Ted Carlson)

an extremely accurate INS, computer-driven avionics, strategic Doppler radar, and a radar altimeter.

The current defensive avionics package, built around the ALQ-161 ECM system, is supplemented by chaff and flares to protect against radar-homing and heat-seeking missiles. Aircraft structure and radar-absorption materials reduce the aircraft's radar signature to approximately one percent of that of a B-52.

Initial operational capability (IOC) for the B-1 was achieved at Dyess AFB, Tex., in September 1986, and deliveries were completed in April 1988. Current active-duty unit locations are at Dyess AFB, Ellsworth AFB, S.D., and Mountain Home AFB, Idaho. Current ANG units locations include McConnell AFB, Kan., and Robins AFB, Ga.

Contractors: Rockwell International, North American Aircraft; Eaton Corporation, AIL Systems; Boeing Military Airplanes; General Electric.

Power Plant: four General Electric F101-GE-102 turbofans; each 30,780 lb thrust.

Accommodation: four: pilot, copilot, and two systems officers (offensive and defensive), on ejection seats.

Dimensions: span spread 136 ft 8½ in, fully swept 78 ft 2½ in, length 147 ft 0 in, height 34 ft 0 in.

Weights: empty equipped 192,000 lb, max operating weight 477,000 lb.

Performance: max speed at low level high subsonic (supersonic at altitude); range intercontinental.

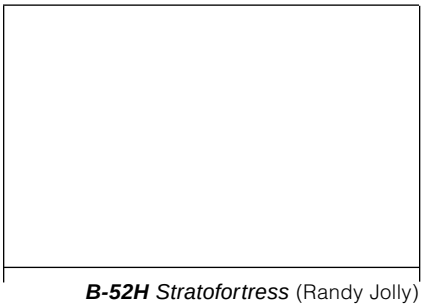
Armament: three internal weapons bays capable of accommodating in a nuclear role 24 B61 or B83 free-fall nuclear bombs; in a nonnuclear role up to 84 Mk 82 (500-lb) bombs or Mk 62 mines; from FY 1997, up to 30 CBU-87/89/97s and up to 12 M117 bombs.

B-2 Spirit

This unique advanced-technology aircraft was conceived originally as a highly survivable strategic bomber to supplement, and ultimately replace, the B-1 in its penetration role. More recently, the focus has turned to the B-2's conventional capabilities, casting it as a lead weapon system used to bring about the early engagement and destruction of an enemy's warmaking assets and potential. The B-2 employs sophisticated technologies, notably low-observable (LO) stealth techniques and the Hughes AN/APQ-181 low-probability-of-intercept radar, to minimize the possibility of detection. This capability allows the B-2 to attack heavily defended targets and neutralize enemy defenses, allowing less stealthy systems to operate.

Procurement of 21 operational B-2s will enable the 509th Bomb Wing, Whiteman AFB, Mo., to field two squadrons, each with eight operational aircraft. IOC with the 393d Bomb Squadron is scheduled this year. Full operational capability (FOC) with the 715th BS should occur by the end of 1999.

Of flying wing configuration, the B-2 has no vertical



***B-52H** Stratofortress* (Randy Jolly)

tail surfaces. The smoothly blended "fuselage" section accommodates a two-person flight crew, with room for a third person, and two large weapon bays side by side in the lower centerbody. These bays contain rotary launchers or bomb rack assemblies capable of carrying a total weapons load of 40,000 lb; however,16 nuclear weapons would be normal under the nation's Single Integrated Operational Plan (SIOP). Mounted in pairs within the wing structure are four nonafterburning turbofans, with scalloped overwing intake ducts and shielded overwing trailing-edge nozzles. The aircraft has a quadruple-redundant fly-by-wire digital flight-control system, actuating moving surfaces at the wing trailing edges that combine aileron, elevator, and rudder functions. A landing gear track of 40 ft enables the B-2 to use any runway that can handle a Boeing 727 airliner.

B-2 production is in three blocks of capability. Block 10 aircraft (nos. two to 16) can carry B83 nuclear bombs or 16 Mk 84 2,000-lb conventional munitions. Block 20 aircraft (nos. 17 to 19) additionally carry the B61 nuclear bomb and the GPS-Aided Targeting System/GPS-Aided Munition (GATS/GAM) that will provide an "early, interim, near-precision" strike capability. Up to 16 GAMs can be carried on two rotary launcher assemblies. Upgrade of Block 10 aircraft to Block 20 standard began in 1996. Block 20 aircraft are currently being delivered direct from the assembly line, so the fleet at Whiteman AFB will be composed entirely of Block 20 aircraft early this year and then will begin transition to Block 30 capability. The last two aircraft (nos. 20 and 21) will be delivered in Block 30 configuration, with full PGM capability, including up to 16 JDAMs on the rotary launcher assemblies, and will carry the Mk 82 500-lb bomb, cluster munitions, including Sensor-Fuzed Weapons, the M117 750-lb bomb, and the Mk 62 air-delivered sea-mine on a bomb rack assembly. Other Block 30 enhancements will include fully operational defensive and offensive avionics, a more sophisticated mission planning system, and additional operating modes for the synthetic aperture radar (SAR). All aircraft will reach Block 30 capability by 1999. Extensions to the B-2's conventional capabilities beyond Block 30 configuration are under consideration, including the introduction of such new weapons as JSOW and upgraded communications, within a framework of reduced operation and maintenance costs.

The first B-2 made its first flight from Air Force Plant 42 in Palmdale, Calif., to Edwards AFB, Calif., in July 1989 and was eventually put in storage. The first production aircraft was delivered to Whiteman AFB on December 17, 1993. First overseas mission took place on June 10, 1995, in a 12-hour, 4,900-mile flight between Whiteman and Paris Le Bourget, with a simulated bomb drop at a range in the Netherlands en route. The 1996 appropriations bill provided an extra $493 million of unspecified funding for the B-2, enabling the first B-2 to be removed from storage and refurbished for service as an operational bomber by 2000, providing a total fleet of 21 aircraft.

Prime Contractor: Northrop Grumman Corporation, with Boeing, LTV, and General Electric as key members of the development team.

Power Plant: four General Electric F118-GE-100 turbofans; each 17,300 lb thrust.

Accommodation: basic crew of two, on ejection seats, with provision for a third seat.

Dimensions: span 172 ft 0 in, length 69 ft 0 in, height 17 ft 0 in.

Weights: empty 100,000–110,000 lb, gross 376,000 lb.

Performance: approach speed 161 mph, ceiling 50,000 ft, typical estimated unrefueled range for a hi-lo-hi mission with 16 B61 nuclear free-fall bombs 5,000 miles, with one aerial refueling more than 11,000 miles.

Armament: in a nuclear role: up to 16 B61 nuclear bombs, or 16 B83 nuclear bombs, or a combination. In a conventional role: 16 Mk 84 2,000-lb bombs or 16 2,000-lb GAMs. Various other conventional weapons, incl the Mk 82 500-lb bomb, M117 750-lb bomb, Mk 62 500-lb naval mine, JDAM, JASSM, and CBU-87/89/97 cluster bombs, will be incorporated in the B-2 beginning FY 1998 and completing FY 2002.

B-52 Stratofortress

The only version of the Stratofortress still in service is the B-52H. Its still-expanding weapons capability reflects this bomber's continuing ability to perform a wide variety of missions, including show of force, maritime interdiction, precision strikes, and defense suppression. Deliveries of 106 B-52Hs began in May 1961; 94 remain operational in active and reserve units.

Improvements introduced in the early 1970s included an AN/ASQ-151 EO viewing system, using FLIR and LLLTV sensors to enhance low-level flight capability; Phase VI avionics, including ALQ-122 SNOE (Smart Noise Operation Equipment) and AN/ALQ-155(V) advanced ECM; an Air Force satellite communications kit permitting worldwide communications via satellite; a Dalmo Victor ALR-46 digital radar warning receiver; Westinghouse ALQ-153 pulse-Doppler tail warning radar; and an improved ITT Avionics ALQ-172 ECM jamming system. A digital-based solid-state offensive avionics system with inertial guidance, TERCOM (terrain comparison) guidance, and microprocessors to upgrade the navigation and weapon delivery systems was also fitted.

Deployment of the B-1 and B-2 led to a change in the primary role of the B-52 to ALCM (AGM-86) and, latterly, ACM (AGM-129) carrier. A typical profile envisaged multiple cruise missile launches at high altitude, often followed by B-52 low-level descent to attack additional targets using gravity weapons.

Currently, the conventional capabilities of the remaining B-52 fleet are being enhanced to extend the bomber's service life well into the next century, with the ability to provide massive firepower in low-threat environments supplemented by a standoff attack capability. Upgrades include the installation of GPS terminals, secure radios, and MIL-STD-1760 interfaces; addition of a third AN/ALQ-172 EWS; weapons capability to include naval mines, precision guided weapons, such as Harpoon, AGM-142 Have Nap, and AGM-86C CALCM (a conventional variant of the ALCM), and advanced weapons, such as JDAM, JSOW, Wind-Corrected Munitions Dispenser, and JASSM. Installation of a heavy stores adapter beam will standardize aircraft to carry all B-52-certified munitions. A universal bomb bay adapter will improve speed and safety in switching from nuclear to conventional weapons. A reengining option is under consideration.

On August 26, 1995, a B-52H broke the world speed record for an aircraft weighing 440,000–550,000 lb, with a payload of 11,000 lb, flying unrefueled for 6,250 miles at 549 mph.

Contractor: Boeing Military Airplanes.
Power Plant: eight Pratt & Whitney TF33-P-3 turbofans; each 17,000 lb thrust.
Accommodation: two pilots, side by side, plus navigator, radar navigator, and electronic warfare officer.
Dimensions: span 185 ft 0 in, length 160 ft 11 in, height 40 ft 8 in.
Weight: more than 488,000 lb.
Performance (approx): max level speed at high altitude 595 mph, ceiling 55,000 ft, range more than 10,000 miles.
Armament: eight nuclear free-fall bombs internally and 12 AGM-86B ALCMs or AGM-129A ACMs externally, with provision for eight more ALCMs or gravity weapons internally. Conventional weapons incl AGM-86C CALCMs, bombs up to 2,000 lb, air-dropped mines, cluster bombs, and, on some aircraft, three to four AGM-142A Have Nap missiles, or eight AGM-84 Harpoons in underwing clusters.

Fighters

F-15 Eagle

USAF's primary air-superiority fighter, the basic F-15 serves with ACC, PACAF, USAFE, Air Education and Training Command (AETC), and ANG. The original single-seat **F-15A** and two-seat **F-15B** were followed in June 1979 by the **F-15C** and **F-15D,** respectively, with 2,000 lb of additional internal fuel and provision for carrying conformal fuel tanks (CFTs). Basic F-15 equipment includes a Hughes Aircraft APG-63 or APG-70 lightweight X-band pulse-Doppler radar for long-range detection and tracking of small high-speed objects down to treetop level. An ongoing F-15 Multistage Improvement Program (MSIP) was initiated in February 1983, with the first production MSIP F-15C produced in 1985. Improvements include an upgraded central computer, a Programmable Armament Control Set allowing for advanced versions of AIM-7, AIM-9, and AIM-120A, and an expanded Tactical Electronic Warfare System that provides improvements to the ALR-56C radar warning receiver and ALQ-135 countermeasures set; the final 43 included Hughes APG-70 radar. More than 350 F-15C/Ds are scheduled to have their APG-63 radar upgraded from the end of the decade. F-15C/Ds deployed to the Persian Gulf in support of Operation Desert Storm accounted for 36 of the 39 USAF air-to-air victories. They have since been deployed to southern Iraq in support of Operation Southern Watch, to Turkey in support of Operation Provide Comfort, and to Bosnia, currently in support of NATO operations.

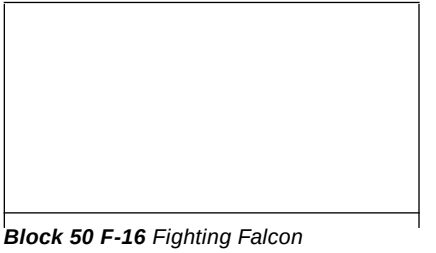
The **F-15E** is USAF's two-seat, dual-role, totally integrated fighter for all-weather air-to-air and deep interdiction missions. The rear cockpit is upgraded to include four multipurpose CRT displays for aircraft systems and weapons management, with 17 separate menu displays to choose from. Modifications to the front cockpit include redesigned controls, a wide-field-of-view HUD, and three CRT multipurpose displays. The F-15E is capable of carrying up to 24,500 lb of ordnance. The digital, triple-redundant Lear Siegler flight-control system permits coupled automatic terrain following, and navigational accuracy is improved by a Honeywell ring-laser gyro INS. For low-altitude, high-speed penetration and precision attack on tactical targets at night and in adverse weather, the F-15E carries a high-resolution Hughes APG-70 radar and LANTIRN (Low-Altitude Navigation and Targeting Infrared for Night) pods, with wide-field FLIR. GPS capability was scheduled for installation from 1997.

To accommodate the new avionics, internal fuel capacity was reduced slightly, but the F-15E is fitted with CFTs, adapted to carry ordnance tangentially to reduce drag. In addition to its primary load of guided and unguided bombs and other air-to-ground weapons, the F-15E retains its air-superiority performance and weapons. Armament options include AIM-7 Sparrow, AIM-9 Sidewinder, and AIM-120 AMRAAM, as well as EO, infrared (IR), and standard bombs; AGM-65 Maverick; dispenser munitions; and nuclear weapons. AGM-130 was integrated in 1993; future options include JSOW. The 4th Wing at Seymour Johnson AFB, N. C., was the first operational F-15E wing. F-15Es now equip ACC, PACAF, and USAFE units. Forty-eight USAF F-15Es were deployed to the Persian Gulf where they operated mainly at night, hunting Scud missile launchers and artillery sites using the LANTIRN system. They also forged a successful operational partnership with the Joint Surveillance and Target Attack Radar System (Joint STARS) aircraft. Recent deployments include AEF missions to the Middle East. A total of 221 F-15Es was authorized between FY 1986 and FY 1997; 132 are in combat-ready status in 1997.

An advanced experimental version of the F-15, the **F-15 short takeoff and landing/maneuvering technology demonstrator (SMTD),** has been used for research into advanced thrust-vectoring technology at the Air Force Flight Test Center at Edwards AFB, Calif. In testing, the aircraft demonstrated high maneuverability, in-flight thrust reversing, and reductions of 35 percent in takeoff distance and 65 percent in landing distance, as well as the ability to land autonomously at night and in poor weather. Tests begun in 1994 are to assess the performance and technology benefit of Pratt & Whitney's new axisymmetric, multidirectional, thrust-vectoring nozzle. The first supersonic flight using only nozzles for flight control took place June 1996. *(Data for F-15C, except where stated.)*
Contractor: McDonnell Aircraft Company, Division of McDonnell Douglas Aerospace.
Power Plant: F-15C: two Pratt & Whitney F100-PW-220 turbofans; each approx 23,450 lb thrust, standard since 1985. F-15E: two Pratt & Whitney F100-PW-220; each approx 23,450 lb thrust, or F100-PW-229 turbofans; each approx 29,100 lb thrust.
Accommodation: pilot only in F-15A/C; two seats in F-15B/D; crew of two in F-15E on zero/zero ejection seats.
Dimensions: span 42 ft 9¾ in, length 63 ft 9 in, height 18 ft 5½ in.
Weights: empty 28,600 lb, gross 68,000 lb in F-15A/B/C/D; empty 32,000 lb, gross 81,000 lb in F-15E.
Performance: F-15C: max speed Mach 2.5, ceiling 60,000 ft, T-O run 900 ft, landing run without braking parachute 3,500 ft, ferry range with external fuel tanks more than 2,878 miles, with CFTs 3,570 miles. F-15E: max level speed at height Mach 2.5, max range 2,762 miles.

F-15C Eagle (Guy Aceto)

F-15E (Guy Aceto)



Block 50 F-16 *Fighting Falcon* (Guy Aceto)

Armament: one internally mounted M61A1 20-mm six-barrel cannon; four AIM-9L/M Sidewinder and four AIM-7F/M Sparrow air-to-air missiles, or eight AIM-120 AMRAAMs, carried externally. Provision for carrying up to 24,500 lb of ordnance on weapon stations of F-15E.

F-16 Fighting Falcon

Since entering service with the 388th Tactical Fighter Wing at Hill AFB, Utah, in January 1979, the F-16 has deployed to units throughout the Air Force and equips the Thunderbirds team. The F-16 incorporated advanced technologies from the start, making the initial single-seat **F-16A** and two-seat **F-16B** versions two of the most maneuverable fighters ever built. Equipment includes a multimode radar with a clutter-free look-down capability, advanced radar warning receiver, a HUD, internal chaff/flare dispensers, and a 500-rd 20-mm internal gun.

Production of the F-16A and B for USAF ended in 1985, and most now belong to ANG. However, USAF and NATO operators have cooperated in an operational capabilities upgrade. Under this program, the radar, fire-control computer, stores-management computer, and avionics software are improved, giving F-16A/Bs the ability to use next-generation air-to-air and air-to-surface weapons. Reliability/maintainability improvements include a ring-laser gyro INS and installation of the upgraded F100-PW-220E turbofan.

A forward-looking plan for the aircraft, known as the Multinational Staged Improvement Program, was implemented by USAF in February 1980 to ensure the aircraft's ability to accept systems under development, thereby minimizing retrofit costs. All F-16s delivered since November 1981 have had built-in structural and wiring provisions and systems architecture that expand the single-seater's multirole flexibility. Stage II was applicable to Block 25 improved **F-16C** (single-seat) and **F-16D** (two-seat) versions, with cockpit, airframe, core avionics changes, and Westinghouse APG-68 radar, with increased range and advanced electronic counter-countermeasures (ECCM), of which deliveries to USAF began in July 1984.

Stage III extends to Block 50/52 F-16C/Ds and includes selected retrofits back to Block 25. These aircraft have Stage II capabilities plus advanced cockpit displays including a wide-angle HUD. Weapons improvements include multitarget AMRAAM compatibility. Also introduced at Block 40/42 were systems improvements that include core avionics hardware, installation of a LANTIRN nav/attack system, GPS, enhanced-envelope gunsight, digital flight controls, automatic terrain following, increased T-O weight and maneuvering limits, an 8,000-hour airframe, and expanded envelope 9*g* capability. Block 40 fighters specialize in night attack with precision guided weapons. Follow-on systems include ALE-47 improved defensive countermeasures, ALR-56M advanced radar warning receiver, advanced programmable signal processor employing very-high-speed integrated circuit (VHSIC) technology in the APG-68(V5) fire-control radar, full HARM capability, a ring-laser gyro INS, and Increased Performance Engines (IPEs) supplied by Pratt & Whitney (F100-PW-229) and General Electric (F110-GE-129).

F-16C/Ds had earlier acquired interim HARM capability for defense suppression/destruction missions in conjunction with the now-retired F-4G "Wild Weasels." The AN/ASQ-213 HARM Targeting System (HTS) gives the F-16 Block 50/52 autonomous capability to launch

HARMs in the range-known mode. USAF is acquiring more than 100 F-16 HTSs for use in conjunction with RC-135 Rivet Joint EW aircraft for SEAD missions. A program was begun in 1994 to equip 125 AFRES F-16C/Ds with British Aerospace Terprom (terrain profile matching) for ground collision avoidance.The 249 USAF F-16 multimission fighters deployed to the Persian Gulf theater flew more sorties than any other type during Operation Desert Storm, with 13,500 missions. F-16Cs are currently deployed to patrol the no-fly zones in southern Iraq and to Bosnia in support of NATO operations.

Of the original F-16A/Bs, 272 were modified to **F-16 ADF** (air defense fighter) standard, under a contract awarded in October 1986, to replace F-106s and F-4s in ANG continental air defense units. The F-16 ADF entered service in 1989, but most of the aircraft are now in storage.

In another program, 229 Block 50/52 USAF F-16C/Ds are to be retrofitted with a new modular mission computer (MMC) being developed under an F-16 midlife update codevelopment and coproduction program with the European participating governments of the F-16 Multinational Fighter Program.

Current proposals include the modification of 250 Block 40 F-16C/Ds as CAS/BAI aircraft in the late-1990s to early 2000s. Modifications include a new chaff and flare system and radar warning receiver, a missile warning system, night vision goggles with compatible cockpit lighting, and improved data modem. Meanwhile, ANG's 174th FW at Syracuse, N.Y., was the first unit to convert from A-10s to F-16As in the dedicated CAS/BAI role, with centerline GPU-5/A 30-mm gun pod.

No F-16s were procured for USAF in FY 1995, but $264 million was appropriated in FY 1997 for 12 new aircraft. In January 1995, Lockheed completed flight testing an F-16C fitted with mock conformal fuel tanks, an internal FLIR, two 2000-lb laser-guided bombs, two AMRAAMs, and two AIM-9 missiles to represent its new "enhanced strategic" **F-16ES** fighter. The new version would have a greatly extended range, with an unrefueled combat radius of more than 1,000 miles. Follow-on improvements to be considered as part of an MSIP Phase IV include Block 40 MMC, Joint Helmet Mounted Cuing System, AIM-9X, 600-gallon tanks, JTIDS, and improved weapons capabilities. *(Data for F-16C.)*

Contractor: Lockheed Martin Corporation.

Power Plant: one augmented turbofan. General Electric F110-GE-100 (27,600 lb thrust) and Pratt & Whitney F100-PW-220 (23,450 lb thrust) are alternative standard engines. IPEs in aircraft delivered from late 1991: Block 50: F110-GE-129 (29,000 lb thrust); Block 52: F100-PW-229 (29,100 lb thrust).

Accommodation: pilot only, on zero/zero ejection seat.

Dimensions: span over missiles 32 ft 9¾ in, length overall 49 ft 4 in, height 16 ft 8½ in.

Weights: empty (F100-PW-220) 18,238 lb, (F110-GE-100) 19,020 lb; gross, with external load (Block 40/42) 42,300 lb.

Performance: max speed Mach 2 class, ceiling more than 50,000 ft, radius of action, Block 40 with two 2,000-lb bombs, two AIM-9 missiles, and external fuel, hi-lo-lo-hi 852 miles.

Armament: one M61A1 20-mm multibarrel cannon, with 511 rd, mounted in fuselage; wingtip-mounted IR missiles; seven other external stores stations for fuel tanks and air-to-air and air-to-surface munitions.

F-22A

First flight of this new air-superiority fighter is expected in May this year. Designed as follow-on for the F-15, the F-22A combines a highly maneuverable airframe at both sub- and supersonic speeds with LO stealth technologies, enabling it to penetrate high-threat enemy airspace and achieve air superiority with a first-look, first-kill capability against multiple targets. It will cruise at supersonic speed without using its afterburners. Its fully integrated avionics and weapon systems will permit simultaneous engagement of multiple targets. A Hughes Common Integrated Processor (CIP) is being developed using VHSIC technology to tie together various avionics functions. The cockpit will feature six flat-panel displays with multifunction display (MFD) bezel buttons permitting pilot information-display choice.

The F-22's $20.4 billion engineering and manufacturing development (EMD) program has included provision for ground-attack capability since 1993 as a result of the Pentagon's Bottom-Up Review. Further mission capabilities are being explored, including strategic attack/interdiction, reconnaissance and surveillance, and lethal and nonlethal Suppression of Enemy Air Defenses (SEAD) missions. Projected armament includes an internal M61A2 20-mm gun, AIM-9 Sidewinders stored internally in the sides of the fuselage, and/or AIM-120 AMRAAMs in the main weapons bay; for ground attack, two 1,000-lb JDAMs will replace two AMRAAMs internally.

Two prototype YF-22s were built for competitive evaluation with two Northrop/McDonnell Douglas YF-23s. In April 1991, the Lockheed/Boeing/General Dynamics team (General Dynamics has since sold its aircraft business to Lockheed) was selected to build the production-configured F-22, with Pratt & Whitney chosen to develop, and more recently to study improvements to, the F119 engine for the aircraft. In August 1991, the F-22 successfully passed the Defense Acquisition Board Milestone 2 and commenced the EMD phase. In this phase USAF will receive nine single-seat F-22As and use two airframes for stress testing. The preliminary design review of all aspects of the design was completed in April 1993, and 231 Critical Design Reviews of subsystems were completed before the start of the air vehicle Critical Design Review in late February 1995. First flight test engine was delivered in September 1996. The first of a planned 438 production aircraft is expected to achieve IOC in 2004. Funding of $2.0 billion was authorized for FY 1997.

Contractor: Lockheed Martin Corporation, with Boeing and Pratt & Whitney as key members of the development team.

Power Plant: two Pratt & Whitney F119-PW-100 turbofans; each in 35,000 lb thrust class.

Accommodation: pilot only, on zero/zero ejection seat.

Dimensions: span 44 ft 6 in, length 62 ft 1 in, height 16 ft 7 in.

Weight: empty 40,000-lb class; gross approx 60,000 lb.

Performance (design target): max level speed at S/L 900+ mph, ceiling above 50,000 ft, range more than 2,000 miles.

F-117A Nighthawk

Operational with the 49th FW at Holloman AFB, N.M., since 1992, the F-117A was the first production combat type designed to exploit low-observable technology. Development and manufacture began simultaneously in November 1978 within a highly classified environment; 60 aircraft were built, and 59 deployed initially with the 37th TFW, at Tonopah Test Range Airfield, Nev., from which operations were restricted mainly to night flying in order to maintain secrecy, although three aircraft were lost in much-publicized accidents. Revealed officially in November 1988, the F-117A's first operational deployment was to Panama in support of Operation Just Cause. During the Persian Gulf War, more than 40 F-117As undertook 1,270 missions, attacking top-priority targets.

The F-117A embodies many components that were either transferred or modified from existing aircraft, in order to minimize the potential risks involved in the decision to proceed concurrently with full-scale development (FSD) and low-level production. Its designers at the Lockheed "Skunk Works" at Burbank, Calif., relied on the concept of faceting to give the aircraft its minimal radar signature. The skin panels of the arrowhead-shaped airframe (leading-edge sweep of 67.5°) are divided into many small, perfectly flat surfaces, which reflect at a variety of angles all signals from probing hostile ground or airborne radars. Much of the aircraft's external surface is made of composite radar-absorbent materials, with the trailing-edge parts now fabricated out of a newly developed resin that is not only harder to damage but can withstand higher temperatures. The F-117A's dull black finish reflects little light. The engine air intakes and exhaust nozzles are above the wings and rear fuselage, respectively, to shield them from IR seekers below.

Two General Electric F404 nonafterburning turbofans give the aircraft low noise signature and high subsonic performance. Quadruple-redundant fly-by-wire flight controls and a state-of-the-art digital avionics suite, complemented by a specially developed automated mission-planning system, are key features of the aircraft. A Pilot Activated Automatic Recovery System, which will recover a tumbling aircraft to straight and level flight, was delivered to Tactical Air Command (TAC, now ACC) in late 1990. Retractable radio antennas are located beneath the fuselage. High-precision INS is installed, with FLIR and DLIR (downward-looking infrared) housed in a steerable turret built into the underside of the aircraft, with a boresight laser designator and an autotracker, to ensure precision attack. Various major improvement programs have been under way since 1989, including installation of a "four-dimensional" flight management system and new cockpit instrumentation, featuring full-color multifunction displays and digital moving map; FLIR and DLIR upgrade (from 1994); and installation of GPS capability and ring-laser gyro INS (from 1991). A range of midlife improvements is being studied.

F-117A-equipped units at ACC's 49th FW include the combat-coded 8th and 9th FSs and the 7th FS, which serves as the F-117A FTU; the 79th TEG, Det. 1, operates one F-117A OT&E aircraft.

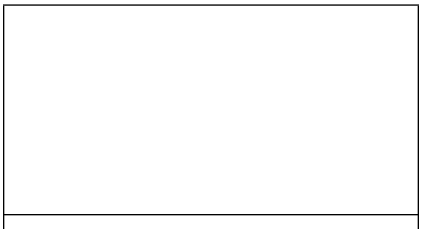
Contractor: Lockheed Martin Skunk Works.

Power Plant: two General Electric F404-GE-F1D2 nonafterburning turbojets; each 10,800 lb thrust.

Accommodation: pilot only, on zero/zero ejection seat.

Dimensions: span 43 ft 4 in, length 65 ft 11 in, height 12 ft 5 in.

Weights: empty (estimated) 29,500 lb, max gross 52,500 lb.



Block 40 F-16 *Fighting Falcon* (Guy Aceto)

YF-22 (Randy Jolly)

F-117A *Nighthawk* (Randy Jolly)

Performance: max level speed 646 mph, mission radius, unrefueled (5,000-lb weapon load) 656 miles.
Armament: full internal carriage of what is described as a wide variety of tactical weapons, incl laser-guided 2,000-lb munitions; alternatively, AGM-65 Maverick or AGM-88 HARM; provisions for AIM-9 Sidewinder.

Helicopters

HH-1H Iroquois

Used for missile site support duties by Air Force Space Command (AFSPC), the HH-1H is a general-purpose military version of the Bell Model 205 helicopter, first ordered by USAF in 1970.
Contractor: Bell Helicopter Textron Inc.
Power Plant: one Textron Lycoming T53-L-13B turboshaft; 1,400 shp.
Accommodation: two pilots and 12 passengers; or two crew and 2,400 lb of cargo.
Dimensions: rotor diameter 48 ft 4 in, length of fuselage 42 ft 0 in, height 13 ft 0 in.
Weight: gross 9,500 lb.
Performance: max speed 120 mph, ceiling at mission gross weight 13,450 ft, range with max fuel 347 miles.

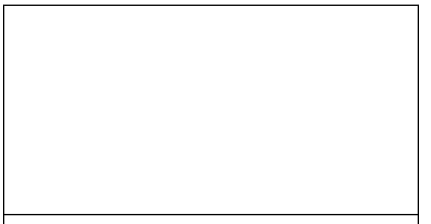
UH-1N Iroquois

A twin-engine version of the UH-1 utility helicopter, 79 UH-1Ns were ordered for USAF, most of which remain in the inventory for missile site support duties with AFSPC and for administrative airlift with AMC. The UH-1N is also used by the 58th SOW at Kirtland AFB, N.M., for training purposes.
Contractor: Bell Helicopter Textron Inc.
Power Plant: Pratt & Whitney Canada T400-CP-400 Turbo "Twin-Pac," consisting of two PT6 turboshafts coupled to a combining gearbox with a single output shaft; flat-rated to 1,290 shp.
Accommodation: two pilots and 14 passengers or cargo, or external load of 4,000 lb.
Dimensions: rotor diameter (with tracking tips) 48 ft 2¼ in, length of fuselage 42 ft 4¾ in, height 14 ft 10¼ in.
Weight: gross and mission weight 11,200 lb.
Performance: max cruising speed at S/L 115 mph, ceiling 13,000 ft, max range, no reserves, 261 miles.
Armament (optional): two General Electric 7.62-mm Miniguns or two 40-mm grenade launchers; two seven-tube 2.75-in rocket launchers.

MH-53J Pave Low/TH-53A

Equipping units of the special operations forces (SOF), **MH-53J** heavy-lift helicopters are HH/CH-53B/C and MH-53Hs upgraded to Pave Low III "Enhanced" standard. These highly sophisticated aircraft are equipped with a nose-mounted FLIR, an integrated digital avionics suite that includes Texas Instruments AN/APQ-158 terrain-following and terrain-avoidance radar, GPS, INS, Doppler, secure communications, armor plating, mounts for .50-caliber machine guns and/or 7.62-mm Miniguns, and an ECM suite consisting of AN/ALQ-162 continuous wave radar missile jammers, ALQ-157 IR missile jammers, ALE-40 flare/chaff dispensers, ALR-69 radar warning receivers, and AAR-47 missile launch detectors.

Programmed upgrades include the Integrated Defense Avionics System (IDAS)/multimission advanced tactical terminal (MATT) modification. The IDAS/MATT system blends on-board EW systems with off-board, over-the-horizon intelligence derived from national systems relayed through the MATT receiver and displayed graphically via a digital map on an NVG-compatible, color, multifunction cockpit display. Additionally, a Service Life Extension Program (SLEP) was implemented to upgrade the aircraft's hydraulics, wiring, and basic airframe structure for increased gross weight, as well as a shipboard fold/compatibility modification. MH-53Js were used extensively in Operations Just Cause and Desert Storm, performing both SOF and combat rescue missions, and more recently in Bosnia. Deliveries of 41 modified aircraft began in the summer of 1987 to the 20th SOS at Hurlburt Field, Fla., followed by the 21st SOS, now at RAF Mildenhall, UK. MH-53Js were also delivered to the 31st SOS at Osan AB, South Korea. The 542d CTW, now the 58th SOW, at Kirtland AFB, N.M., received four. This unit also uses six **TH-53A**s, modified USMC CH-53As, as basic qualification trainers. Modifications include the installation of General Electric T64-GE-100 engines, air refueling probe, and some standard USAF equipment. *(Data for MH-53J.)*
Contractor: Sikorsky Aircraft, Division of United Technologies Corporation.
Power Plant: two General Electric T64-GE-100 turboshafts; each 4,330 shp.
Accommodation: crew of six.



***UH-1N** Iroquois* (Guy Aceto)

***MH-53J** Pave Low* (Randy Jolly)

***MH-60G** Pave Hawk* (Randy Jolly)

Dimensions (HH-53B): rotor diameter 72 ft 3 in, length of fuselage (without refueling probe) 67 ft 2 in, height 24 ft 11 in.
Weight: gross 50,000 lb.

MH/HH-60G Pave Hawk

Ninety-eight Black Hawk helicopters were modified to MH/HH-60G Pave Hawk configuration to meet USAF combat search-and-rescue and SOF requirements. The 10 **MH-60G**s operated by AFSOC's 16th SOW provide a wide variety of SOF mission capabilities, including infiltration/exfiltration and personnel recovery as a collateral SOF mission and humanitarian relief. The **HH-60G**s, used by active-duty, AFRC, and ANG air rescue units, provide combat search and rescue and various mission-support activities worldwide. MH-60Gs are also operated by the 58th SOW for training purposes. Configuration varies between aircraft, but both versions are equipped with an integrated navigation system using GPS, INS, and Doppler, with input to a flight path–vectored FLIR. A weather/ground-mapping radar, with beacon tracking and KG-10 map reader, completes the tactical navigation suite; both have unsecure VHF and secure FM, HF, UHF, and SATCOM for communications. Further modifications include an integral rescue hoist and window-mounted 7.62-mm miniguns, with provisions for a .50-caliber machine gun and an external stores support system (ESSS) for weapons and additional fuel capability on SOF aircraft only. An air refueling system and removable long-range internal fuel tanks, combined with C-5 mobility modifications, permit rapid-response, long-range/loiter mission profiles requiring a broad scale of payload possibilities. *(Data for MH-60G.)*
Contractor: Sikorsky Aircraft, Division of United Technologies Corporation.
Power Plant: two General Electric T700-GE-700/701C turboshafts; each 1,560 shp.
Accommodation: crew of three or four; 11–14 troops, up to six litters, or internal or external cargo.
Dimensions: rotor diameter 53 ft 8 in, length of fuselage 50 ft 0¾ in, height 16 ft 10 in.
Weights: empty 10,624 lb, max gross 22,500 lb.
Performance: max speed 222 mph, ceiling 19,000 ft, max range, with reserves, 373 miles (internal fuel), 500 miles (auxiliary tank).

CV-22 Osprey

Development is continuing of this variant of the USMC MV-22, expected to fulfill Air Force SOF requirement for high-speed, long-range, V/STOL aircraft capable of low-visibility, clandestine penetration/extraction of denied areas in adverse weather. The CV-22 is a tiltrotor, multimission aircraft, based on Bell's XV-15, designed to have the maneuverability and lift capability of a helicopter and the speed of a fixed-wing aircraft. It is designed to carry 18 troops over a 575-mile combat radius at 265 mph, or 8,000 lb of internal cargo, with a capability to hover out of ground effect at 3,900 ft pressure altitude and 82° Fahrenheit. With less stringent midmission parameters, the range could exceed 865 miles. Self-deployment range will be 2,420 miles with one air refueling.

The CV-22 will be shipboard compatible and air refueling capable. Equipment will include a fully integrated precision navigation suite, with GPS and INS; FLIR; terrain-following/terrain-avoidance radar; digital map display; and NVG-compatible cockpit displays. The electronic warfare suite will include radar and missile warning receivers, radar and infrared missile jammers, and flare/chaff dispensers. The communications suite will include secure UHF, VHF (AM and FM), and SATCOM radios.

A Bell/Boeing consortium is the prime contractor. Boeing has overall responsibility for the aircraft's tail unit, overwing fairings, and fuselage, while Bell provides the wing, nacelles, transmissions, and rotor hub assemblies. Under subcontracts, Textron Aerostructures is responsible for the design and manufacture of the V-22's tail unit and General Electric for the digital fly-by-wire flight-control system.

First flight of a V-22 Osprey was made in March 1989, and four full-scale development (FSD) aircraft had flown by the end of 1991. Flight testing resumed in April 1993, following the incorporation of numerous design changes, leading to a significant reduction in empty weight. The aircraft have demonstrated speed in excess of 400 mph, completed initial sea trials, formation flying, and cross-country evaluations. The CDR was passed in December 1994. First flight of an EMD aircraft is imminent.

USAF is acquiring 50 CV-22s. AFSOC is scheduled to receive its first aircraft in 2003, with IOC for 12 Ospreys in 2005. In addition, USMC will receive 425 MV-22s and USN 48 HV-22s
Power Plant: two Allison T406-AD-400 turboshafts; each 6,150 shp.
Dimensions: proprotor diameter 38 ft 0 in, width, rotors turning 83 ft 10 in, fuselage length 57 ft 4 in, height over tailfins 17 ft 7¾ in.
Weights: normal mission weight, VTO 47,500 lb; gross, STO 60,500 lb.
Performance: max cruising speed in helicopter mode 115 mph, in airplane mode 316 mph, ceiling 26,000 ft, range with internal auxiliary tanks 1,700 miles.

Reconnaissance and Special-Duty Aircraft

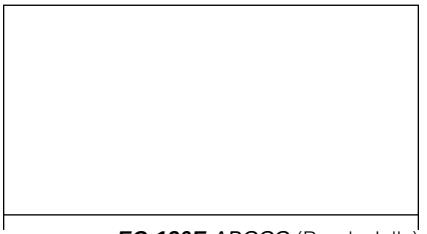
U-2R/RT/S/ST

The **U-2R** single-seat, single-engine, high-altitude reconnaissance aircraft, flown initially in 1967, is a significantly larger and more capable version of the original U-2 aircraft produced in the late 1950s. Structurally identical to the U-2R, the TR-1A first flew in 1981 and was designed for standoff tactical reconnaissance in Europe. The last U-2 and TR-1 aircraft were delivered to USAF in October 1989. In 1992, all U-2s and TR-1s were consolidated under the designation U-2R. The entire fleet (31 single-seat U-2Rs and four **U-2RT** two-seat trainers) is being reengined with the General Electric F118-101, a derivative of the engine used in the B-2, providing improved performance and supportability. Reengined aircraft are redesignated **U-2S/ST.** Conversion is expected to be completed by 1998.

The U-2 provides critical intelligence to national decision-makers and theater commanders through all phases of conflict, including peacetime indications and warning, crisis, low-intensity conflict, and large-scale hostilities. It is capable of collecting multisensor photo, electro-optic, infrared, and radar imagery, as well as performing other types of intelligence functions. U-2s are based at Beale AFB, Calif., and support national and tactical requirements from four operational detachments throughout the world. Current upgrades to its sensors will extend the U-2's usefulness well into the next century.

Contractor: Lockheed Corporation.
Power Plant: initially, one Pratt & Whitney J75-P-13B turbojet; 17,000 lb thrust; being reengined with F118-GE-101 turbojet.
Dimensions: span 103 ft 0 in, length 63 ft 0 in, height 16 ft 0 in.
Weight: gross 40,000 lb.
Performance: max cruising speed at above 70,000 ft more than 430 mph, ceiling U-2R: more than 70,000 ft, U-2S: more than 73,500 ft, range U-2R: more than 3,000 miles, U-2S: more than 4,500 miles, max endurance U-2R: around 12 hr, U-2S: around 15 hr.
Armament: none.

U-2R (Ted Carlson)



***EC-130E** ABCCC* (Randy Jolly)

***EC-130H** "Compass Call"* (Ted Carlson)

***RC-135V** Rivet Joint* (Ted Carlson)

SR-71 "Blackbird"

Three multisensored supersonic SR-71 "Blackbird" aircraft were reactivated in FY 1995 to provide wide-area reconnaissance and intelligence support. The refurbished aircraft are assigned to Edwards AFB, Calif., under the command of the 9th RW, Beale AFB. The SR-71 was retired originally in 1990 after 24 years of service.

Contractor: Lockheed Corporation.
Power Plant: two Pratt & Whitney JT11D-20B (J58) turbojet engines; each 34,000 lb thrust with afterburning.
Accommodation: crew of two in tandem, on ejection seats.
Dimensions: span 55 ft 7 in, length 107 ft 5 in, height 18 ft 6 in.
Weights: empty 60,000 lb, gross 172,000 lb.
Performance: max speed at 78,750 ft more than Mach 3, operational ceiling above 80,000 ft.
Armament: none.

EC-130

Several variants of the basic C-130 have been produced for specialized missions, including the following:

The **EC-130E ABCCC,** used as an Airborne Battlefield Command and Control Center by the 42d Electronic Combat Squadron at Davis-Monthan AFB, Ariz. Seven aircraft were updated by Unisys to ABCCC III standard. EC-130s have been deployed in support of NATO operations in Bosnia.

The **EC-130E "Commando Solo"** psychological operations broadcasting version operated by ANG's 193d SOW, Harrisburg IAP, Pa. Lockheed Aircraft Service (LAS) has upgraded the unit's four EC-130 Rivet Rider aircraft to the worldwide color television (WWCTV) configuration, plus two other conversions; the sixth aircraft was scheduled for delivery in February 1997. The 193d's EC-130Es have conducted numerous missions, more recently in support of Operations Just Cause and Desert Shield/Storm and in support of Haitian operations. They also have a role in civil emergencies. Secondary mission for Commando Solo aircraft is electronic attack in the military frequency spectrum.

The **EC-130H "Compass Call"** communications jammer, which played a vital role in disrupting Iraqi military communications at strategic and tactical levels during the Persian Gulf War. EC-130Hs are operated by the 41st and 43d ECSs at Davis-Monthan AFB, Ariz. Altogether, 14 EC-130Hs are in service.

As new C-130J aircraft are procured, priority for replacement will be given to special mission aircraft. *(Data basically as for C-130.)*

EC-135, etc.

Several aircraft in the KC-135 Stratotanker series were modified for specialized missions during production or at a later date. Thirty-nine are modified for strategic airborne command-and-control missions. Five KC-135A tankers were converted for Airborne Command Post use by Strategic Air Command (SAC) in 1960. Additional aircraft were modified in 1962, and 17 new-production KC-135B turbofan aircraft entered the system in 1965. Currently, **EC-135C/Y** aircraft are assigned to ACC, PACAF, and USAFE. They are fitted with extensive communications equipment to support strategic command-and-control missions of their respective CINCs. On July 24, 1990, EC-135Cs ceased to be on continuous airborne alert, but at least one of these air refuelable aircraft flies a mission each day, accommodating a flight crew of four, a general officer, and a staff of 18. Twelve are in service and have been adapted to provide control of Minuteman ICBMs.

Five **EC-135A/E advanced range instrumentation aircraft (ARIA)** are operated by the Air Force Flight Test Center's 452d FTS, Edwards AFB, Calif., as telemetry and voice relay stations to supplement land and sea receiver stations for DoD, NASA, and NATO customers. The aircraft's distinctive bulbous nose houses the world's largest airborne steerable antenna.

Versions of the C-135 Stratolifter series used for reconnaissance include turbofan **RC-135S**s, **RC-135U**s, **RC-135V**s, and **RC-135W**s, operated by ACC's 55th Wing, Offutt AFB, Neb., for specific reconnaissance tasks. RC-135s have operated in the Persian Gulf region since 1990. RC-135 Rivet Joints will help replace now-retired F-4Gs by loitering near battlefields and providing data on enemy air defense systems to crews of F-16 HTS aircraft. Funding for further Rivet Joint aircraft was approved in the FY 1997 budget. The 55th Wing also operates a modified version of the WC-135, designated **OC-135B,** with an infrared linescanner, synthetic aperture radar, and forward- and vertical-looking video cameras, to monitor the 1992 Open Skies Treaty; program requirement is for three aircraft.

To minimize the cost of retrofitting special-purpose -135s with more efficient turbofan engines, USAF installed in some aircraft refurbished Pratt & Whitney JT3D-3Bs taken from Boeing 707-100B aircraft, purchased as surplus from commercial air carriers. Additionally, the reengining of RC-135s with fuel-efficient CFM-56 engines was funded for FY 1996 and FY 1997 (two and four engines, respectively). *(Data basically as for C-135.)*

EF-111A Raven

Developed for defense-suppression missions in worldwide support of US tactical strike forces, the EF-111A is a conversion of the basic General Dynamics F-111A airframe. Specialized equipment includes the ALQ-99E primary jammer, a derivative of the Navy ALQ-99, carried internally. This system's frequency coverage, reliability, and effective use of available jamming power enables the EF-111A to suppress extremely dense electronic defenses. Other equipment includes self-protection systems from the F-111 (ALQ-137, ALR-62). The cockpit was revised, and the ALQ-99E receivers were housed in a new vertical stabilizer. The AN/ALE-40 tactical countermeasures dispenser provides self-protection expendables. Other improvements under the avionics modernization program included upgrade of the TFR and installation of GPS equipment and a new INS.

Forty-two EF-111As were produced for missions that include barrier standoff jamming, degradation of acquisition radars during CAS operations, and close-in jamming and direct support for deep-strike missions. Flight testing began in March 1977, and the first "production" EF-111s were delivered in late 1981 to the 366th TFW at Mountain Home AFB, Idaho, where they achieved IOC with the 390th ECS in December 1983. Second operational location, from February 1984, was the 42d ECS at RAF Upper Heyford, UK, from where Libyan targets were attacked in April 1986. During the Persian Gulf War, EF-111 area jamming was crucial to the maintenance of coalition air supremacy. More recently, deployments have been made to Operations Provide Comfort and Southern Watch and to Bosnia. The EF-111A is being phased out following the decision to consolidate the standoff jamming requirement of

both the Air Force and the Navy in the latter's EA-6B Prowler aircraft. Remaining aircraft have been assigned to the 429th ECS at Cannon AFB, N. M.; 24 were being retained into 1997 and 12 into 1998.
Contractor: Grumman Aerospace Corporation.
Power Plant: two Pratt & Whitney TF30-P-109 turbofans; each 19,600 lb thrust with afterburning.
Accommodation: crew of two, side by side in zero/zero escape module.
Dimensions: span spread 63 ft 0 in, fully swept 31 ft 11½ in, length 76 ft 0 in, height 20 ft 0 in.
Weights: empty 55,275 lb, gross 88,948 lb.
Performance: max combat speed 1,377 mph, ceiling with afterburning at combat weight 45,000 ft, combat radius with reserves 230–929 miles, according to mission.
Armament: none.

E-3B/C Sentry (AWACS)

The E-3 Airborne Warning and Control System (AWACS) aircraft is a mobile, flexible, survivable, and jam-resistant surveillance and command, control, and communications (C^3) system capable of all-weather, long-range, high- or low-level surveillance of all air vehicles, manned or unmanned, above all kinds of terrain. A modified Boeing 707-320B, AWACS carries an extensive complement of mission avionics, including computer, radar, IFF, communications, display, and navigation systems. The capability of AWACS is provided by its Westinghouse Electric Corp. look-down radar, which makes possible all-altitude surveillance over land or water.

The E-3 serves a dual role within USAF: as a command-and-control center to support quick-reaction deployment and tactical operations and as a survivable early warning command-and-control center for identification, surveillance, and tracking of airborne enemy forces and for the command and control of NORAD forces over the continental US.

Deliveries of the basic production version, designated **E-3A Sentry,** began in March 1977, when the first aircraft was handed over to TAC's (now ACC's) 552d ACW at Tinker AFB, Okla. Twenty-four were built. Twenty-two of them, plus two prototypes, were upgraded to **E-3B** configuration. Improvements included much-enhanced computer capabilities, antijam communications, an austere maritime surveillance capability, additional radio communications, and five additional display consoles.

A US/NATO Standard E-3A configuration was introduced starting with the twenty-fifth production USAF Sentry, delivered in December 1981. In this version, the data-processing capability was improved and a maritime detection capability included. Nine were built for USAF, and one of the original E-3As was upgraded to this standard. The 10 US Standard E-3A aircraft were subsequently upgraded to **E-3C**s, with additional command-and-control capability, in 1984–88. A further 17 Standard E-3As are operated by NATO as part of a cooperative program to upgrade the command and control of NATO's air defense forces.

The E-3 AWACS fleet is undergoing a major capabilities upgrade. All 33 USAF and 18 NATO E-3s are being equipped with the Joint Tactical Information Distribution System (JTIDS) for antijam digital communications. New passive detection systems, known as electronic support measures (ESM), will complement the active, beaming radar, enabling the aircraft to detect signals emitted by both hostile and friendly targets; trial installation was completed in 1995. Additional enhancements to US E-3s include the central computer memory upgrade and ability to employ GPS. Full-scale development (FSD) contracts for a major upgrade to the Westinghouse APY-1 and APY-2 radar, under the Radar System Improvement Program, were awarded in September 1989. This will enable the AWACS aircraft operating in the pulse-Doppler mode to detect targets with much smaller radar cross sections. IOC for these improvements is scheduled for FY 1999, with contract completion after 2000.

E-3s assumed a continental US air defense role in January 1979, when NORAD personnel began augmenting TAC E-3 flight crews on all operational NORAD missions by the 552d ACW at Tinker AFB, Okla. Overseas units include the 961st and 962d Airborne Air Control Squadrons, based at Kadena AB, Japan, and Elmendorf AFB, Alaska, respectively. The first AFRES Associate AWACS unit, the 513th ACG, was activated at Tinker AFB in March 1996. Deployments have been made to the Pacific, the Middle East, southwest Asia, the Mediterranean area, and Europe. AWACS aircraft are also used in support of the US drug enforcement program.
Contractor: Electronic Systems Division, Boeing Defense & Space Group.
Power Plant: four Pratt & Whitney TF33-PW-100/100A turbofans; each 21,000 lb thrust.
Accommodation: basic operational crew of 24, incl 20 AWACS mission specialists.
Dimensions: span 145 ft 9 in, length 152 ft 11 in, height 41 ft 9 in.
Weight: gross 335,000 lb.
Performance: max speed 530 mph, ceiling above 29,000 ft, endurance six hr on station 1,000 miles from base.

E-4B

Developed in support of the National Emergency Airborne Command Post (NEACP), now the National Airborne Operations Center (NAOC), three E-4As were built, using modified Boeing 747 airframes. They provided an interim capability by utilizing existing EC-135 C^3 equipment. The first of four fully developed E-4B Airborne Command Post aircraft (three of them converted from E-4As) entered service with SAC in January 1980, and the first operational mission was flown two months later. They are hardened against the effects of nuclear explosions, including electromagnetic pulse; are equipped for in-flight refueling; contain a 1,200-kVA electrical system designed to support advanced electronics; and have a wide variety of communications equipment. This includes an LF/VLF system, improved satellite communications system, and communications processing equipment. These systems will support operations in a nuclear environment over extended ranges. The E-4B system is capable of tying into commercial telephone and radio networks and could be used for radio broadcasts to the general population. Improvements have included a data-processing capability and more survivable C^3, including initial Milstar modification. ACC is the Air Force's single-resource manager for the E-4, with the main operating base at 55th Wing, Offutt AFB, Neb.
Contractor: Boeing Aerospace Company.
Power Plant: four General Electric CF6-50E2 turbofans; each 52,500 lb thrust.
Dimensions: span 195 ft 8 in, length 231 ft 4 in, height 63 ft 5 in.
Weight: gross 800,000 lb.
Performance: unrefueled endurance in excess of 12 hr.

EF-111 Raven (Guy Aceto)

E-3 Sentry (Ted Carlson)

E-4B (Ted Carlson)

E-9 (Guy Aceto)

E-8 Joint STARS

Delivery of the first production version of the USAF/US Army Joint Surveillance and Target Attack Radar System (Joint STARS), designated **E-8C,** took place in May 1996, to the 93d ACW at Robins AFB, Ga. Unusually, Joint STARS aircraft had aleady flown more than150 operational missions, during Operations Desert Storm (with two E-8A development aircraft) and Joint Endeavor (with one E-8A and one testbed E-8C), as part of their operational test and evaluation. As a result of their success, USAF expanded Joint STARS's original role, covering ground surveillance, targeting, and attack and battle management, to include bomb-damage assessment, Suppression of Enemy Air Defenses (SEAD), and Theater Missile Defense, with emphasis on the detection of mobile missile launchers and their decoys.

The original contract for FSD of the system was awarded to Grumman in September 1985. The company was made responsible for subsystems installation, integration, and flight testing of specialized equipment aboard two 707-300 airframes specially modified by Boeing for this purpose. The first flight of a fully Joint STARS–configured aircraft took place in December 1988. The second aircraft flew in August 1989 and became the primary test version, following the installation of additional equipment. Airborne equipment on the prototypes includes a Norden multimode side-looking radar antenna, some 25 ft long, faired into the belly of each aircraft. With a reported range in excess of 155 miles, this radar, which is integrated with GPS, operates in synthetic aperture radar mode to detect and locate stationary objects, such as parked tanks, and alternates between SAR and a Doppler-type mode to locate and track slow-moving targets. The Joint STARS then directs attack on the targets, in real time, via a jam-resisistant, high-capacity, digital data link or radio. Sensor and signal-processing systems are being upgraded. The two **E-8A** prototypes have 10 operations consoles and two communications stations. An estimated 386,100 square miles can be covered in a single eight-hour sortie, cruising at 30,000 to 40,000 ft. Because new Boeing 707 airframes are no longer available, USAF is purchasing and modifying used 707s for the E-8C production version. These carry a crew of USAF and Army specialists occupying 18 operations-and-control consoles, two of them doubling as communications stations, that display color-coded images of radar data of behind-the-lines terrain and of wheeled and tracked vehicles moving anywhere on it. The first E-8C flew in March 1994 and served as the preproduction test-bed.

Joint STARS is the US candidate to satisfy the NATO Alliance Ground Surveillance System requirement. The prototype Joint STARS was deployed to Europe for Eurostar 94. In November 1996, two E-8Cs deployed to Rhein-Main AB, Germany, again in support of Operation Joint Endeavor, to monitor withdrawal of forces from Bosnia. USAF plans to acquire 20 E-8Cs, with funding for Nos. 7 to 9 approved in the FY 1997 budget, and provision for advanced procurement for another. The two E-8A test aircraft will be upgraded to C standard and will be the last to be delivered. *(Data for E-8C.)*
Contractor: Northrop Grumman Corporation.
Power Plant: four Pratt & Whitney JT3D-3B turbojets; each 18,000 lb thrust.
Dimensions: span 145 ft 9 in, length 152 ft 11 in, height 42 ft 6 in.
Weights: empty 171,000 lb, gross 336,000 lb.
Performance: max operating speed Mach 0.84, ceiling 42,000 ft, endurance with one in-flight refueling 20 hr.

E-9A

Designated E-9A, two highly modified Boeing Canada (de Havilland) DHC-8 Dash 8M-100 aircraft are operated by the 475th Weapons Evaluation Group at Tyndall AFB, Fla., as airborne platform telemetry relay aircraft. Each is equipped with a sensor suite that includes an AN/APS-128D sea surveillance radar in a ventral radome and a five-beam, electronically steerable, 75-square-foot, phased-array telemetry antenna in a starboard-side fuselage fairing. This is capable of automatically detecting, tracking, and relaying data simultaneously from five pairs of distinct sources traveling at speeds of Mach 5 or more. It is used for low-altitude, over-the-horizon data-gathering during missile tests and for sea surveillance in order to keep boats out of the Gulf Test Range during tests.
Contractor: de Havilland Inc.

Power Plant: two Pratt & Whitney Canada PW120A turboprops; each 1,800 shp. (No military designation on these engines.)
Accommodation: three: pilot, copilot, and systems operator.
Dimensions: span 85 ft 0 in, length 73 ft 0 in, height 24 ft 7 in.
Weight: gross 33,000 lb fully fueled.
Performance: max speed at 25,000 ft 245 mph, max operational altitude 25,000 ft, loiter time 5 hr.

EC-18B/D

Operational since January 1986, **EC-18B advanced range instrumentation aircraft (ARIA)** are modified former American Airlines Boeing 707-320 series transports. Four replaced some of the EC-135 ARIAs operated by the Aeronautical Systems Center's 4950th TW at Wright-Patterson AFB, Ohio (now the 452d FTS, part of the 412th TW, Edwards AFB, Calif.). In common with the EC-135 ARIAs, the 707s are converted to house the world's largest airborne steerable antenna in a bulbous nose, with a probe antenna on each wingtip and a completely new cockpit configuration. Range, cabin space, and fuel efficiency are all increased to provide greater support for the expanding ARIA mission, including DoD and NASA space and missile programs. The aircraft can accommodate a crew of 16 to 24.

Two Boeing 707s have been modified by Chrysler Technologies Airborne Systems, Inc., for use as dedicated Cruise Missile Mission Control Aircraft. Specialized equipment includes an AN/APG-63 surveillance radar, telemetry receiver, and weather radar. Designated **EC-18D cruise missile mission control aircraft (CMMCA),** they are operated by the 452d FTS in support of USN and USAF missile testing. They are also capable of monitoring and controlling unmanned aerial vehicles.

WC-130H

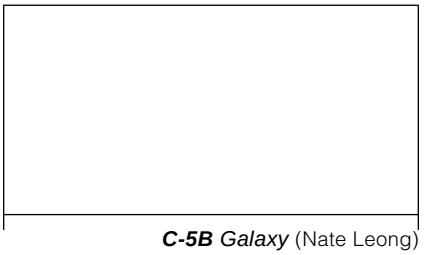
Modified C-130 Hercules transports, designated **WC-130H,** are equipped for weather reconnaissance duties, including penetration of tropical storms, to obtain data for forecasting storm movements. They are assigned to AFRC's 53d WRS at Keesler AFB, Miss. *(Data similar to those for C-130.)*

Transports and Tankers

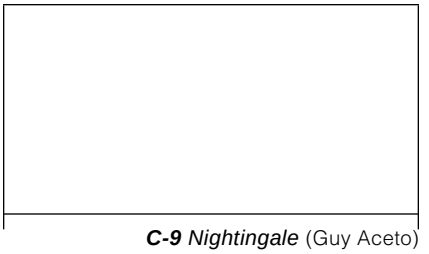
C-5A/B/C Galaxy

The C-5 is a long-range, air refuelable, heavy logistics transport that continues to satisfy a range of global airlift requirements, whether in a combat situation or in response to the many calls for humanitarian relief worldwide. It first flew in June 1968, and USAF took delivery of 81 basic **C-5A**s between December 1969 and May 1973. Under a subsequent major modification program, Lockheed produced component kits to extend the service life of the C-5A's wings by 30,000 flight hours, without load restrictions. These kits replaced only the five main load-carrying wing boxes, to which other existing components were transferred. The use of 7175-T73511 aluminum alloy provided greater strength and resistance to corrosion. Modification of all 77 aircraft in the inventory took place between 1982 and 1987. Two AFRC squadrons and one ANG squadron are C-5A-equipped. Two C-5As, redesignated **C-5C** and assigned to Travis AFB, Calif., have been modified to carry outsize space cargo by extending the cargo bay and modifying the aft doors.

The **C-5B** is generally similar to the C-5A but embodies all the improvements introduced since completion of C-5A production. These include the strengthened wings, General Electric TF39-GE-1C turbofans, and updated avionics, including Bendix color weather radar and Delco triple INS. The original MADAR (Malfunction Detection Analysis and Recording) instrument units were replaced by the more advanced MADAR II. The first C-5B flew for the first time in 1985 and was delivered to Altus AFB, Okla., in January 1986. Deliveries of 50 aircraft were completed in April 1989. C-5 units include AMC's 60th AMW at Travis AFB, Calif., the 436th AW at Dover AFB, Del., AFRC's 301st and 312th ASs (Assoc.) at Travis AFB, 326th and 709th ASs (Assoc.) at Dover AFB, 68th AS at Kelly AFB, Tex., 337th AS at Westover ARB, Mass., ANG's 105th AW at Stewart IAP, N.Y., and AETC's 97th AMW, at Altus AFB, Okla. The reliability and maintainability of the C-5A has been the focus of numerous AMC studies. Meanwhile, a program is in hand to upgrade the C-5A fleet with the avionics subsystems developed for the C-5B, including installation of MADAR II. All of USAF's 126 Galaxys are having their flight-management systems modernized and GPS receivers installed; new, safer interior panels are also being fitted. In addition, a prototype missile defense system, incorporating Tracor AN/ALE-40 flare dispensers and a Honeywell AN/AAR-47 missile warning system, has been installed on a number of C-5s by Lockheed Martin under the Pacer Snow project. *(Data for C-5B.)*
Contractor: Lockheed Martin Corporation.
Power Plant: four General Electric TF39-GE-1C turbofans; each 43,000 lb thrust.
Accommodation: crew of six, rest area for 15 (relief crew, etc.); seating for 75, and 36 standard 463L pallets or assorted vehicles, such cargo as two M60 tanks or three CH-47 Chinook helicopters, or a maximum of 340 passengers in an airbus configuration.
Dimensions: span 222 ft 8½ in, length 247 ft 10 in, height 65 ft 1½ in.
Weights: empty 374,000 lb, max payload 261,000 lb, gross (for 2*g*) 837,000 lb.
Performance: max speed at 25,000 ft 571 mph, ceiling (at 615,000 lb) 35,750 ft, T-O run at S/L 8,300 ft, landing run, max landing weight at S/L 2,380 ft, range with max payload 3,434 miles, range with max fuel 6,469 miles.



***C-5B** Galaxy* (Nate Leong)



***C-9** Nightingale* (Guy Aceto)

***C-17** Globemaster III*

C-9A/C Nightingale

In service since August 1968, the **C-9A** aeromedical airlift transport is a derivative of the DC-9 Series 30 commercial airliner, modified to include a special-care compartment with separate atmospheric and ventilation controls. Delivery of 21 to the former Military Airlift Command's (MAC's) 375th AAW, now redesignated (AMC's) 375th AW, was completed by February 1973; this unit is augmented by the 73d AS (Assoc.) of AFRC, collocated at Scott AFB, Ill. C-9As perform theater aeromedical evacuation in Europe and the Pacific, with four aircraft based at the 86th AW, Ramstein AB, Germany, and three at the 374th AW, Yokota AB, Japan. Because of the critical nature of its mission, the aircraft carries a flight mechanic and a small supply of spares. Three specially configured **C-9C**s were delivered to the 89th AW at Andrews AFB, Md., in 1975 for Presidential and other US governmental duties. *(Data for C-9A.)*
Contractor: Douglas Aircraft Company, Division of McDonnell Douglas Corporation.
Power Plant: two Pratt & Whitney JT8D-9 turbofans; each 14,500 lb thrust.
Accommodation: crew of three; 40 litter patients or 40 ambulatory patients, or a combination of both, plus five medical staff.
Dimensions: span 93 ft 3 in, length 119 ft 3 in, height 27 ft 6 in.
Weight: gross 108,000 lb.
Performance: max cruising speed at 25,000 ft 565 mph, ceiling 35,000 ft, range more than 2,000 miles.

C-12C Huron

Thirty military versions of the Beechcraft Super King Air 200 were delivered to USAF under the designation C-12A in support of attaché and military assistance advisory missions worldwide. These aircraft were subsequently refitted with PT6A-41 engines and redesignated C-12C. AETC uses two C-12Cs to train aircrews. PACAF uses five C-12s for the time-sensitive movement of people and cargo. *(Data for original C-12A.)*
Contractor: Beech Aircraft Corporation.
Power Plant: two Pratt & Whitney Canada PT6A-38 turboprops; each 750 shp.
Accommodation: crew of two; up to eight passengers or 4,764 lb of cargo. Convertible to aeromedical evacuation configuration.
Dimensions: span 54 ft 6 in, length 43 ft 9 in, height 15 ft 0 in.
Weight: gross 12,500 lb.
Performance: max speed at 14,000 ft 301 mph, ceiling 31,000 ft, range at max cruising speed 1,824 miles.

C-17A Globemaster III

Developed to meet US force-projection requirements, the C-17A is a heavy-lift, air refuelable cargo transport, designed to provide inter- and intratheater airlift of all classes of military cargo, including outsize items, such as the Army's M1A2 tank. It is able to operate routinely into small, austere airfields (3,000 ft x 90 ft) previously restricted to C-130s and provides the first capability to air-land or air-drop outsize cargo in the tactical environment. The C-17A not only enhances US airlift capability across the board but also provides much-needed force-structure modernization.

The C-17A made its first flight September 15, 1991, and completed its flight test program in June 1995. As of January, 29 production aircraft had been delivered to the Air Force. Initial operational capability of the first C-17 operational squadron was declared on January 17, 1995, at Charleston AFB, S. C., which now has two C-17 squadrons. Operational deployments have been made in support of Operation Vigilant Warrior in the Persian Gulf region and to Bosnia. The C-17 has set 22 world records for payload-to-altitude, time-to-climb, and short takeoff and landing with payload. In this last

category, an Edwards AFB C-17 took off and landed in less than 1,400 ft while carrying 44,000 lb of payload.

Forty-eight production aircraft have been approved through 1997, including the first year of a historic seven-year multiyear procurement. The Defense Acquisition Board had approved an additional 80 aircraft in November 1995 after several analyses indicated that an all-C-17 fleet was more cost-effective than a mix of C-17s and commercial freighters. In January 1996, the Defense Acquisition Board endorsed, pending implementing legislation, the Air Force proposal to procure the 80 additional aircraft through a seven-year multiyear procurement. Congress approved the program in April 1996. The first C-17 with newly designed, highly cost-efficient engine nacelles is scheduled for delivery in mid-1998. Planned disposition of the C-17 includes 48 aircraft each to Charleston AFB, S.C., and McChord AFB, Wash., eight to an AETC training unit at Altus AFB, Okla., and six to ANG's 172d AW at Jackson, Miss.; the remaining 10 aircraft will be used for backup.

The C-17 is the first military transport to feature a full digital fly-by-wire control system and two-person cockpit, with two full-time, all-function HUDs and four multifunction electronic displays.

Subcontractors for the C-17 program include Beech Aircraft Corp. (composite winglets), Delco Electronics Corp. (mission computer and electronic display system), Northrop Grumman Corp. (ailerons, rudder, elevators, vertical and horizontal stabilizers, and engine nacelles), GEC-Marconi (advanced HUD), Honeywell Inc. (support equipment and air data computers), and Lockheed Martin (tailcone and electronic flight-control system).

Prime Contractor: McDonnell Douglas Aerospace, Division of McDonnell Douglas Corporation.
Power Plant: four Pratt & Whitney F117-PW-100 turbofans; each 41,700 lb thrust.
Accommodation: normal flight crew of three (two pilots plus loadmaster). Provisions for the full range of military airlift missions, incl capacity for up to 154 passengers,102 paratroops, or 48 litters; range of military cargo incl tanks, jeeps, and up to three AH-64A helicopters; air-drop capability for up to 60,000-lb single platforms or 110,000-lb multiple platforms.
Dimensions: span over winglet tips 170 ft 0 in, length 174 ft 0 in, height 55 ft 1 in.
Weights: empty 277,000 lb, max payload (2.25*g*) 170,400 lb, gross 585,000 lb.
Performance: normal cruising speed at height 518 mph (Mach 0.77), ceiling 45,000 ft, range with 130,000 lb payload 3,200 miles.

C-20A/B/H Gulfstream III/IV

Ten off-the-shelf Gulfstream III transports, each with accommodation for five crew and 14 passengers, were acquired by USAF to replace aging, fuel-inefficient C-140Bs. Three **C-20A**s and a **C-20B,** delivered to the 89th AW, Andrews AFB, Md., in FY 1983 and FY 1984 under a lease/purchase agreement, were subsequently purchased. Another six C-20Bs, with advanced mission communications equipment and revised interior, were ordered in January 1986. As these were delivered to Andrews AFB, the original three C-20As were transferred to Ramstein AB, Germany, in support of the 58th AS's special airlift mission in Europe. The C-20s provide the Special Air Mission (SAM) fleet with intercontinental range and ability to operate from short runways. Two Gulfstream IV-SP aircraft, with advanced- technology flight-management systems and upgraded Rolls-Royce engines, were acquired by USAF to meet expanding SAM requirements. Designated **C-20H,** they are assigned to Andrews AFB. Two C-20B aircraft were retired. *(Data for C-20A/B.)*

Contractor: Gulfstream Aerospace Corporation.
Power Plant: two Rolls-Royce F113-RR-100 turbofans; each 11,400 lb thrust.
Accommodation: crew of five; 14–18 passengers.
Dimensions: span 77 ft 10 in, length 83 ft 1 in, height 24 ft 4½ in.
Weight: gross 69,700 lb.
Performance: max cruising speed 561 mph, ceiling 45,000 ft, range 4,050 miles.

C-21A

USAF assigns 79 C-21As for operation by active-duty and ANG units from nine US bases and four overseas locations. These aircraft provide operational support airlift for time-sensitive movement of people and cargo throughout the US and the Pacific and European theaters, including aeromedical missions if required. The first C-21A was delivered to USAF in 1984. In 1987, ANG acquired four C-21s to replace its T-39s based at Andrews AFB, Md. USAF realigned all Stateside C-21s to AMC on April 1, 1997.

Contractor: Learjet Inc.
Power Plant: two AlliedSignal TFE731-2 turbofans; each 3,500 lb thrust.
Accommodation: crew of two and up to eight passengers, or 3,153 lb cargo. Convertible to aeromedical evacuation configuration.

***C-20B** Gulfstream III* (Ted Carlson)

C-21A (Ted Carlson)

***C-23A** Sherpa* (Ted Carlson)

C-26A

Dimensions: span 39 ft 6 in, length 48 ft 8 in, height 12 ft 3 in.
Weights: empty, equipped 10,119 lb, gross 18,300 lb.
Performance: max level speed at 25,000 ft 542 mph, ceiling 41,000 ft, range with max passenger load 2,420 miles, with max cargo load 1,653 miles.

C-22B

Four Boeing 727 commercial transports were purchased and modified as C-22Bs for use by ANG on operational support airlift missions. Two of them have been further modified to accommodate an additional 1,100 gallons of fuel and landing gear rated for 170,000 lb gross landing weight.

C-23A Sherpa

Two C-23A Sherpa light transport aircraft are operated by Air Force Materiel Command (AFMC) from Edwards AFB, Calif. The Sherpa, which entered USAF service with MAC (now AMC) in 1984, is an all-freight version of the Shorts 330 regional airliner, with a 6-ft-6-in-square cabin section over an unimpeded hold length of 29 ft. Through-loading is provided via a large forward freight door, a full-width hydraulically operated rear ramp door, and removable roller conveyors.

Contractor: Short Brothers PLC.
Power Plant: two Pratt & Whitney Canada PT6A-45R turboprops; each 1,198 shp.
Accommodation: crew of three; up to 7,000 lb of freight, incl four LD3 containers, and engines the size of the F100 series.
Dimensions: span 74 ft 8 in, length 58 ft 0½ in, height 16 ft 3 in.
Weight: gross 25,500 lb.
Performance: max cruising speed at 10,000 ft 218 mph, range 770 miles with 5,000 lb payload.

VC-25A

Based on the Boeing 747-200B airframe, two VC-25A Presidential transports were delivered to the 89th AW at Andrews AFB, Md., in August and December 1990, replacing the former primary and backup "Air Force One" transports (C-137Cs). The VC-25As have a Bendix Aerospace EFIS-10 electronic flight instrument system and state-of-the-art on-board communications equipment. A pair of self-contained air-stairs are located on the left side and a built-in baggage loader on the right side. Together with a second auxiliary power unit, they allow the aircraft to be practically self-sufficient and reduce the need for ground-support equipment. Despite its long range, the VC-25A is air refuelable.

Contractor: Boeing Military Airplanes.
Power Plant: four General Electric F103-GE-102 turbofans; each 56,750 lb thrust.
Accommodation: crew of 23; up to 70 passengers.
Dimensions: span 195 ft 8 in, length 231 ft 10 in, height 63 ft 5 in.
Weight: long-range mission T-O weight 803,700 lb.
Performance: high speed cruise Mach 0.88–0.91, normal cruising speed Mach 0.84, unrefueled range 7,140 miles.

C-26A/B

Eleven Fairchild Metro III commuter transport aircraft were acquired by USAF, under the designation **C-26A,** to replace ANG C-131s. The first aircraft was delivered in March 1989 and was assigned to the 147th FIG at Ellington ANGB, Tex. Serving in the Air National Guard Operational Support Transport Aircraft role, C-26As have a quick-change interior, enabling passenger seats to be replaced by a medevac or cargo-carrying configuration. In addition, 30 **C-26B**s were ordered in 1991, with deliveries from January 1992. C-26Bs have TCAS II, GPS, and microwave landing systems. *(Data for C-26A.)*

Contractor: Fairchild Aircraft Corporation.
Power Plant: two AlliedSignal TPE331-11U-612G turboprops; each 1,100 shp.
Accommodation: crew of two; 19–20 passengers.
Dimensions: span 57 ft 0 in, length 59 ft 4¼ in, height 16 ft 8 in.
Weights: empty 9,494 lb, gross 16,000 lb.
Performance: max cruising speed at midcruise weight of 12,500 lb 321 mph, ceiling 26,700 ft, range with 19 passengers 1,224 miles.

C-27A Spartan

Ten commercially available Alenia G222 medium airlifters were modified by Chrysler, under contracts awarded in August 1990 and February 1991, to C-27A short takeoff and landing (STOL) intratheater transport standard. Modifications include new HF/VHF communications, autopilot, and INS. C-27As provide rapid-response airlift of personnel and cargo to remote locations accessible primarily through unimproved airfields with short, unprepared landing surfaces. They are assigned to Howard AFB, Panama.

Contractor: Chrysler Technologies Airborne Systems Inc.
Power Plant: two Fiat-built General Electric T64-GE-P4D turboprops; each 3,400 shp.
Accommodation (C-27A): crew of three; various configurations, incl provision for 34 fully equipped troops or 14,850 lb cargo.
Dimensions: span 94 ft 2 in, length 74 ft 5½ in, height 34 ft 8¼ in.
Weights: empty 35,500 lb, gross 56,878 lb.
Performance: max cruising speed 288 mph, ceiling 22,000 ft, ferry range with max fuel 1,727 miles.

C-32A

Four new Boeing 757-200s have been ordered for 1998 delivery, as C-32As, to replace C-137B/Cs.

C-130 Hercules

Still in production, the C-130 Hercules transport aircraft first flew 42 years ago and has been delivered to more than 60 countries. C-130s operate throughout USAF, serving with ACC, theater commands, AFRC, and ANG, fulfilling a wide range of operational missions in both peace and war situations. Basic and specialized versions perform a diversity of roles, including airlift support, DEW Line and Arctic ice cap resupply, aeromedical missions, aerial spray missions, fire-fighting duties for the US Forest Service, and natural disaster relief missions. In recent years, they have been used to bring humanitarian relief to many countries, including Haiti, Bosnia, Somalia, and Rwanda. Early C-130A, B, and D versions are now retired. The **C-130E** is an

extended-range development of the C-130B, with large underwing fuel tanks; 389 were ordered for MAC (now AMC) and TAC (now ACC), with deliveries beginning in April 1962. A wing modification to correct fatigue and corrosion on USAF's force of C-130Es has extended the life of the aircraft well into the next century. Ongoing modifications include a Self-Contained Navigation System (SCNS) to enhance navigation capabilities, especially in low-level environments. The SCNS incorporates an integrated communications/navigation management system that features the USAF standard laser gyro inertial navigational unit and the 1553B data bus; installation began in 1990. Other modifications include enhanced station-keeping equipment, 50 kHz VHF Omnirange/Instrument Landing System (VOR/ILS) receivers, secure voice capability, and GPS capability. Another major modification installs a state-of-the-art autopilot that incorporates a Ground Collision Avoidance System.

The basic **C-130H** is generally similar to the E model but has updated T56-A-15 turboprops, a redesigned outer wing, updated avionics, and other, minor improvements; delivery began in July 1974. More than 350 C-130Hs and derivatives were ordered for active and reserve units of the US services, including eight funded in FY 1996. Production of the H has now ended. Night Vision Instrumentation System was introduced from 1993; TCAS II in new aircraft from 1994. ANG and AFRC C-130Hs are used in fire-fighting missions. Specifically modified aircraft are used by the 757th AS, AFRC, based at Youngstown-Warren Regional Airport ARS, Ohio, for aerial spraying, typically to suppress mosquito-spread epidemics. Seven **LC-130H**s, modified with wheel-ski gear, are operated by ANG's 109th AW in support of Arctic and Antarctic operations. While continuing to upgrade through modification, the Air Force has budgeted to resume fleet modernization through acquisition of the **C-130J** version. This new model features a two-crew-member flight system, 6,000 shp Allison AE 2100D3 engines and all-composite Dowty R391 propellers, digital avionics and mission computers, enhanced performance, and improved reliability and maintainability. Beginning in FY 1996, the Air Force started procuring C-130Js as replacements for the older C-130Es and Hs. Priority for replacement will be combat delivery aircraft.

Other variants include **HC/MC-130, AC-130H/U,** and **WC-130H,** all described separately. Four HC-130Hs were modified as **JC-130H** with added equipment for aerial recovery of reentering space capsules, and two **DC-130H**s are used for drone control duties, together with one **DC-130A.**

The Air Force realigned Stateside theater airlift C-130s from ACC to AMC April 1, 1997. *(Data for C-130J.)*

Contractor: Lockheed Martin Corporation.

Power Plant: four Allison AE 2100D3 turboprops; each 4,591 shp.

Accommodation: crew of two, with provision for third person, plus loadmaster; up to 92 troops, 64 paratroops, 74 litter patients plus attendants, 54 passengers on palletized seating, or up to five 463L standard freight pallets, etc.

Dimensions: span 132 ft 7 in, length 97 ft 9 in, height 38 ft 10 in.

Weights: empty 75,562 lb, max payload 41,790 lb, gross 175,000 lb.

Performance: max cruising speed 400 mph, ceiling (at 147,000 lb) 30,560 ft, T-O run 1,800–3,290 ft, landing run (at 130,000 lb) 1,400 ft, range with 40,000-lb payload 3,262 miles.

MC-130E/H Combat Talon I and II

Supporting special operations forces worldwide, AFSOC's CONUS-based 8th SOS and 711th SOS (AFRC) employ 14 C-130Es, modified to **MC-130E (Combat Talon I)** standard and equipped for use in night/adverse weather, low-level, deep-penetration missions. All are modified to conduct air-to-air refueling with special operations helicopters and have explosion-suppressant fuel tanks and a modified cargo ramp area for high-speed aerial delivery. In addition, these aircraft have been modified to the Mod 90 configuration, which includes an improved APQ-122V(8) terrain-following radar; fully integrated navigation suite with dual INS, Doppler, and GPS; NVG head-up display; and new center wing. During Operation Desert Storm, the Combat Talon I proved a very adaptable and capable air delivery platform, particularly when called on to deliver the largest conventional weapon in the US arsenal, the 15,000-lb BLU-82.

Twenty-four **MC-130H (Combat Talon II)** aircraft have been acquired to supplement the Talon I. Equipment includes an in-flight refueling receptacle; explosion-suppressant fuel tanks; modified cargo ramp area for high-speed aerial delivery; AN/APQ-170 precision turning, terrain-following, and terrain-avoidance radar; dual radar altimeters; dual INS; integrated GPS receiver; flight stabilized Infrared Detection Set; extensive communications suite; fully integrated glass cockpit; and improved infrared and electronic defensive countermeasures. The 1st, 7th, and 15th SOSs employ the Combat Talon II, supporting unconventional warfare units from their bases in Japan, Europe, and CONUS, respectively. The 58th Special Operations Wing at Kirtland AFB, N.M., is responsible for MC-130H mission qualification training. *(Data similar to those for C-130.)*

***C-130H** Hercules* (Randy Jolly)

***C-130J** Hercules* (Guy Aceto)

***HC-130N** Combat Shadow* (Randy Jolly)

***MC-130H** Combat Talon II* (Randy Jolly)

***KC-135E** Stratotanker* (Ted Carlson)

***KC-135R** Stratotanker* (Ted Carlson)

MC/HC-130 Combat Shadow/Tankers

Twenty-eight active-duty **MC-130P** Combat Shadow aircraft (formerly HC-130N/P) are dedicated to special operations missions. Nine are assigned to the 9th SOS, Eglin AFB, Fla. Five each are assigned to the 17th SOS, Kadena AB, Japan, and to the 67th SOS, RAF Mildenhall, UK. The 5th SOS (AFRC), based at Duke Field, Fla., and the 58th SOW at Kirtland AFB, N.M., have five and four aircraft, respectively, the latter for training. All are modified with new secure communications, self-contained inertial navigation, and countermeasures systems, and NVG-compatible lighting. The aircraft's primary mission is to conduct single-ship or formation in-flight refueling of special operations forces helicopters in a low-threat to selected medium-threat environment. These missions involve NVG low-level flights using minimal lighting and communications-out procedures. These SOF MC-130Ps are being further modified with advanced integrated navigation equipment, including digital scan radar, ring-laser gyro INS, FLIR, GPS, and dual nav stations. They are also receiving new missile warning systems and countermeasures for refueling missions in hostile environments. Fifteen have been fitted with an in-flight refueling receptacle to extend their range indefinitely.

Nine additional search-and-rescue **HC-130** tanker aircraft are located with an active-duty unit at Patrick AFB, Fla.; 20 others are assigned to various AFRC and ANG units. *(Data similar to those for C-130.)*

KC-135E/R/T Stratotanker

Backbone of the USAF tanker fleet, the long-serving KC-135 continues to meet the aerial refueling requirements of USAF bomber, fighter, cargo, and reconnaissance forces, as well as the needs of the US Navy and Marines and allied nations. First flight was in August 1956; a total of 732 were built by 1966. Although similar in size and appearance to commercial 707 aircraft, the KC-135 was designed to military specifications, incorporating different structural details and materials, and was designed to operate at high gross weights. The KC-135 fuel tankage is located in the "wet wings" and in fuel tanks below the floor in the fuselage.

Ongoing modernization programs for the 551 KC-135s remaining in operational service will enhance their capability and extend their operational utility well into the next century. The JT3D reengining program upgraded 163 AFRC and ANG KC-135As to **KC-135E** standard with JT3D turbofans removed from surplus commercial 707s. In 1980, the 22,224 lb thrust CFM International F108-CF-100 (CFM56) fuel-efficient engine was selected for retrofit of the KC-135 fleet. Reengined aircraft are designated **KC-135R** and **KC-135T,** each with a gross weight of 322,000 lb. They embody modifications to major systems and subsystems and not only carry more fuel farther but have reduced maintenance costs, are able to operate from shorter runways, and meet Stage III requirements. The first KC-135R flight was in August 1982, and first deliveries to SAC were in July 1984; KC-135T aircraft retain the KC-135Q's ability to isolate two separate fuel types in order to refuel SR-71s; the program continues. The Life Extension Structural Modification provided for the renewal of the lower wing skin, enabling the fleet of KC-135s to remain fully operational past 2020. A further program will permit operation by a two-person flight crew. Several avionics upgrades are under way that will significantly improve systems reliability and maintainability. The first Pacer CRAG–modified KC/C-135 (see below) aircraft was delivered on July 19, 1996: upgrades include an FMS-800 flight-management system, FDS 255 flight displays, color weather radar, and integrated INS/GPS. A multipoint aerial refueling system is being procured for a select number of KC-135Rs to enhance interoperability and support to the Navy, NATO, and other allied receiver aircraft. During the Persian Gulf War, KC-135 aircraft made an invaluable contribution to the success of coalition operations, flying around-the-clock missions to maintain the operability of coalition warplanes. Recent KC-135 deployments have included support for operations in Somalia, Bosnia, Rwanda, Haiti, and the Middle East. AMC controls all CONUS-based KC-135s. Others serve with ACC, AETC, PACAF, USAFE, and with AFRC and ANG units. *(Data for KC-135R.)*

Contractor: Boeing Military Airplanes.

Power Plant: four CFM International F108-CF-100 turbofans; each 22,224 lb thrust.

Accommodation: crew of four; up to 80 passengers.

Dimensions: span 130 ft 10 in, length 136 ft 3 in, height 38 ft 4 in.
Weights: empty 119,231 lb, gross 322,000 lb.
Performance: max speed at 30,000 ft 610 mph, ceiling 50,000 ft, range with 120,000 lb of transfer fuel 2,128 miles, ferry mission 11,192 miles.

C-135 Stratolifter

Several C-135 transports and variants, without the KC-135's refueling equipment, remain operational within USAF. They were ordered originally to serve as interim jet passenger/cargo transports, pending delivery of C-141s. Three converted KC-135s were followed by 45 production Stratolifters in two versions: the **C-135A,** with J57-P-59W turbojets, and the **C-135B,** with Pratt & Whitney TF33-P-5 turbofans. Eleven Bs were retrofitted with revised interior for VIP transportation; others became **WC-135B**s and **RC-135E/M**s. ACC's 55th Wing, Offutt AFB, Neb., operates **TC-135S/W** variants. C-135s have been deployed in support of Bosnian operations. *(Data similar to KC-135, except where indicated.)*
Dimensions: length 134 ft 6 in.
Weights (C-135B): operating weight empty 102,300 lb, gross 275,500 lb.
Accommodation (C-135B): 60 passengers.
Performance (C-135B): max speed 600 mph, range with 54,000 lb payload 4,625 miles.

C-137B/C Stratoliner

Five specially modified Boeing 707 transports are operated by AMC's 89th Airlift Wing from Andrews AFB, Md., for VIP duties. Four Boeing 707-320s are designated **C-137C,** and one smaller 707-120, **C-137B.** Two of the C-137Cs were the original "Air Force One" aircraft. Replacement of these aircraft by four new Boeing 757-200s, designated C-32A, is scheduled for 1998.
Contractor: The Boeing Company.
Power Plant: four Pratt & Whitney JT3D-3 turbofans; each 17,200 lb thrust.
Dimensions: C-137B: span 130 ft 10 in, length 144 ft 6 in, height 42 ft 0 in; C-137C: span 145 ft 9 in, length 152 ft 11 in, height 42 ft 5 in.
Weights: C-137B: gross 258,000 lb; C-137C: gross 329,100 lb.
Performance (C-137C): max speed 627 mph, ceiling 42,000 ft, range 5,150 miles.

C-141A/B Starlifter

Longtime mainstay of USAF's airlift fleet, the 200-plus C-141 Starlifter aircraft are approaching the end of their projected service life and all will retire by 2006. The **C-141A** entered service with MAC in April 1965, and 285 were built, some of which were structurally modified to accommodate the 82,207-lb Minuteman ICBM. Subsequently, USAF funded modification of the entire then-available force of 270 aircraft to **C-141B** standard (except four AFMC aircraft used for test purposes) in order to realize the aircraft's full payload potential. The fuselage was lengthened by 23 ft 4 in, and an in-flight refueling capability was added. Deliveries of B aircraft took place between December 1979 and June 1982. The modification significantly increased MAC's airlift capability, giving USAF the equivalent of 90 additional C-141A aircraft. Under the Pave Center program initiated in 1987, 118 aircraft were slated for a center wing structural modification, which, coupled with other structural upgrades, was expected to extend the C-141's original flying life by 15,000 hours. A program to install a state-of-the-art autopilot and all-weather landing system with enhanced flight display instrumentation is a major modification to enhance maintenance supportability. Improved airdrop systems for the C-141 are also in production. However, further proposed C-141 service life extension programs (SLEPs) have been ruled out. One C-141A has been greatly modified as an **Advanced Radar Test-Bed (ARTB)** for use as an airborne laboratory platform to test a wide range of sensors in a dynamic ECM environment. Modification of 13 437th AW C-141Bs is aimed at increasing their SOLL (Special Operations Low Level) capability and survivability. AETC also operates C-141 aircraft at Altus AFB, Okla.

As of January this year, approximately 212 C-141Bs were in the inventory. Most recently, Starlifters have deployed in support of UN peacekeeping missions. AMC controls Air Force C-141s. *(Data for C-141B.)*
Contractor: Lockheed-Georgia Company.
Power Plant: four Pratt & Whitney TF33-P-7 turbofans; each 21,000 lb thrust.
Accommodation: crew of five; cargo on 13 standard 463L pallets. Alternative freight or vehicle payloads, 200 fully equipped troops, 155 paratroops, or 103 litter patients plus attendants.
Dimensions: span 159 ft 11 in, length 168 ft 3½ in, height 39 ft 3 in.
Weights: operating 150,000 lb; max payload 68,725 lb normal, 89,000 lb emergency war planning; gross 325,000 lb normal, 344,900 lb emergency war planning.
Performance: max cruising speed 566 mph, range with max payload 2,170 miles without air refueling.

***C-141B** Starlifter* (Ted Carlson)

***KC-10A** Extender* (Ted Carlson)

KC-10A Extender

The KC-10 is basically a DC-10 Series 30CF, modified to include fuselage fuel cells, a boom operator's station with aerial refueling boom and integral hose reel/drogue unit, a receiver refueling receptacle, and military avionics. In its primary role of enhancing worldwide air mobility, the KC-10A combines the tasks of tanker and cargo aircraft in a single unit. With this capability, the Extender supports fighter deployments, strategic airlift, strategic reconnaissance, and conventional operations and, as such, played a key role in deployment for the Persian Gulf War and in later humanitarian and UN peacekeeping missions. Because it has both types of tanker refueling equipment installed, the KC-10A can service US Air Force, Navy, and Marine Corps and allied aircraft on the same mission.

In many deployment situations, the KC-10A's refueling capabilities and long range permit it to dispense with the need for forward bases, leaving vital fuel supplies in the theater of operations untouched. Aircraft maintenance is performed under the contractor logistics support concept, where flight-line maintenance is provided by USAF while intermediate- and depot-level maintenance is supported by a contractor. In addition, extensive commonality with the commercial DC-10 allows USAF to capitalize on a worldwide network of spares and maintenance facilities.

First flight of a KC-10A took place in July 1980, with first SAC service mission in March 1981. The 59 aircraft in the inventory are operated by active-duty and Associate Reserve units, under the control of AMC, with major KC-10 operational bases at McGuire AFB, N. J., and Travis AFB, Calif. AFRC's 79th ARS operates from March ARB, Calif. The final production aircraft, delivered in April 1990, was used to test wing-mounted air refueling pods designed to supplement the standard fuselage hose reel/drogue unit and refueling boom. Plans called for 20 aircraft to be modified to accept the wing-mounted pods. An additional modification introduced an on-board loader that allowed pallet handling without prepositioning wide-body cargo loading equipment and so permitted autonomous cargo operations at austere locations.
Contractor: Douglas Aircraft Company, Division of McDonnell Douglas Corporation.
Power Plant: three General Electric CF6-50C2 turbofans; each 52,500 lb thrust.
Accommodation: crew of four; additional seating possible for up to 75 persons; max 27 pallets; max cargo payload 169,409 lb.
Dimensions: span 165 ft 4½ in, length 181 ft 7 in, height 58 ft 1 in.
Weight: gross 590,000 lb.
Performance: cruising speed Mach 0.825, ceiling 42,000 ft, range with max cargo 4,370 miles.

***T-1A** Jayhawk* (Nate Leong)

***T-3A** Firefly* (Guy Aceto)

Trainers

T-1A Jayhawk

Acquired by AETC for specialized undergraduate pilot training (SUPT), the first T-1A was delivered to USAF in January 1992. As leader of the T-1A contractor team, McDonnell Douglas is responsible for system integration; Quintron is supplying flight simulators, Raytheon Aircraft Company the aircraft. Designated Beechjet 400T, these are similar to the Beechjet 400A corporate transport. The flight deck is configured for a student in the left seat, an instructor in the right seat, and another student to the rear. Structural enhancements provide for a large number of landings per flight hour, increased birdstrike resistance, and an additional fuselage fuel tank. A Rockwell Collins avionics package includes a five-tube EFIS, turbulence detection radar, digital autopilot, tactical air navigation with air-to-air capability, and a central diagnostics and maintenance system.

The total buy of 180 aircraft has been ordered; 160 had been delivered by January 1, 1997. Instructor pilot training at the 64th Flying Training Wing, Reese AFB, Tex., began in September 1992, with student training following in January 1993; this base is scheduled to close this year. Instructor pilot training transfered to the 12th FTW, Randolph AFB, Tex., in August 1993. Jayhawks also equip the 14th, 47th, and 71st FTWs at Columbus AFB, Miss., Laughlin AFB, Tex., and Vance AFB, Okla., respectively. Pilots trained in the T-1A progress to transports, such as the C-5 and C-17, and tankers, such as the KC-10 and KC-135.
Contractor: Raytheon Aircraft Company.
Power Plant: two Pratt & Whitney Canada JT15D-5B turbofans; each 2,900 lb thrust.
Accommodation: two side by side and one to the rear; rails are fitted to accommodate an extra four seats to permit transport of maintenance teams.
Dimensions (400A): span 43 ft 6 in, length 48 ft 5 in, height 13 ft 11 in.
Weights: empty 5,200 lb, gross (400A) 16,100 lb.
Performance: max speed at 27,000 ft 538 mph, max operating altitude 41,000 ft, range 2,222 miles.

T-3A Firefly

Selected in April 1992 to replace the T-41 Mescalero, the fully aerobatic T-3A has been used since March 1994 by AETC's 3d FTS at Hondo Airport, Tex., and since January 1995 by the 557th FTS at the US Air Force Academy to screen prospective pilots prior to SUPT. The basic airframe is the Slingsby T67M260 Firefly built in the UK; Northrop Worldwide Aircraft Services is responsible for final assembly, test, delivery, and logistical support. Delivery of 113 T-3As was completed in January 1996, with 57 aircraft for the 3d FTS and 56 for the 557th FTS.
Contractors: Slingsby Aviation Limited; Northrop Worldwide Aircraft Services Inc.
Power Plant: Textron Lycoming AEIO-540-D4A5 engine; 260 hp.
Accommodation: two, side by side.

Dimensions: span 34 ft 9 in, length 24 ft 10 in, height 7 ft 9 in.
Weights: empty 1,780 lb, gross 2,525 lb.
Performance: max level speed 175 mph, ceiling 19,000 ft, range with max fuel, 65 percent power at 8,000 ft 469 miles.

T-37B Tweet

USAF's first purpose-built jet trainer, the T-37 is currently AETC's standard two-seat primary trainer. The original T-37A was superseded in November 1959 by the T-37B; all A models were later converted to B standard. A contract for the T-37B SLEP was awarded to Sabreliner Corp. in August 1989. This covers the design, testing, and production of kits to be installed by USAF, to modify or replace critical structural components of the entire fleet, thereby extending the capability of the T-37 into the next century. Almost 1,000 T-37s were built, and more than 450 remain in USAF's active inventory, including a number with ACC and AMC. A distinctive dark blue and white finish is intended to help formation training and ease maintenance.

AETC plans to replace the T-37B with the new Joint Primary Aircraft Training System (JPATS), to be produced by Raytheon (see below) and delivered from FY 1999.

Contractor: Cessna Aircraft Company.
Power Plant: two Continental J69-T-25 turbojets; each 1,025 lb thrust.
Accommodation: two, side by side, on ejection seats.
Dimensions: span 33 ft 9¼ in, length 29 ft 3 in, height 9 ft 2¾ in.
Weights: empty 3,870 lb, gross 6,575 lb.
Performance: max speed at 25,000 ft 426 mph, ceiling 35,100 ft, range at 360 mph with standard tankage 870 miles.

T-38A and AT-38B Talon

Almost identical in structure to the F-5A export tactical fighter, the **T-38A** was the world's first supersonic trainer aircraft. First flown in April 1959, it was in continuous production from 1956 to 1972 and entered operational service in March 1961. Of 1,187 T-38s built, more than 1,100 were delivered to USAF, and more than 400 remain in service throughout the Air Force. Most are used by AETC for advanced pilot training. A slightly different version, designated **AT-38B,** with a gunsight and practice bomb dispenser, is used by AETC for Introduction to Fighter Fundamentals (IFF).

An ongoing program called Pacer Classic (the T-38 SLEP) is integrating 10 modifications, including major structural renewal, into one program, and a full avionics upgrade is planned. As a result, coupled with the reduction of the T-38's work load through introduction of the T-1A, the service life of the T-38s should extend to 2020.

Contractor: Northrop Corporation.
Power Plant: two General Electric J85-GE-5A turbojets; each 2,680 lb thrust dry, 3,850 lb thrust with afterburning.
Accommodation: student and instructor, in tandem, on ejection seats.
Dimensions: span 25 ft 3 in, length 46 ft 4½ in, height 12 ft 10½ in.
Weights: empty 7,164 lb, gross 12,093 lb.
Performance: max level speed at 36,000 ft more than Mach 1.23 (812 mph), ceiling above 55,000 ft, range, with reserves, 1,093 miles.

T-43A and CT-43

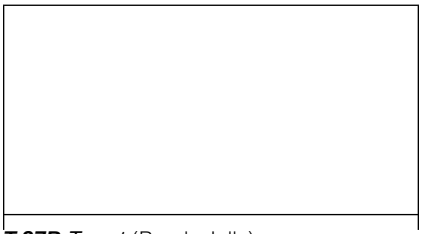
A navigation trainer first flown in April 1973, the **T-43A** was derived from the commercial Boeing Model 737-200 and was equipped with the same on-board avionics as the most advanced USAF operational aircraft of that time, including celestial, radar, and inertial navigation systems, a Long-Range Aid to Navigation (Loran) system, and other radio systems. Deliveries of the 19 aircraft ordered for ATC (now AETC) were completed in July 1974. Most remaining aircraft are in the AETC inventory; two others are assigned to the ANG; and one, with VIP interior, is assigned to the 310th AS at Howard AFB, Panama (as **CT-43**).

Contractor: Boeing Aerospace Company.
Power Plant: two Pratt & Whitney JT8D-9 turbofans; each 14,500 lb thrust.
Accommodation: crew of two, 12 students, five advanced students, and three instructors.
Dimensions: span 93 ft 0 in, length 100 ft 0 in, height 37 ft 0 in.
Weight: gross 115,500 lb.
Performance: econ cruising speed at 35,000 ft Mach 0.7, operational range 2,995 miles.

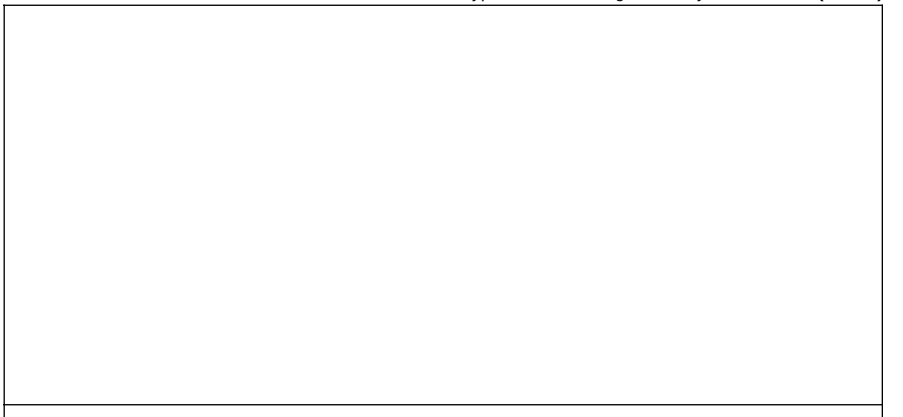
Joint Primary Aircraft Training System (JPATS)

The Joint Primary Aircraft Training System (JPATS) contract was awarded to the Raytheon Aircraft Company in February 1996. Its not-yet-designated Beech/Pilatus PC-9 Mk II is based on the Swiss Pilatus PC-9 aircraft, modified to include a strengthened fuselage, upgraded engine, more fuel, pressurized cockpit, larger, bird-resistant canopy, and new digital avionics. The new aircraft will replace USAF's T-37Bs and USN's T-34Cs in training entry-level pilots, as well as supporting undergraduate naval flight officer and USAF navigator training. Delivery of a planned 372 operational aircraft for the Air Force is scheduled to begin in 1999 at Randolph AFB, Tex., followed by Laughlin AFB, Tex., Vance AFB, Okla., and Columbus AFB, Miss. IOC for the Air Force is expected in August 2001; IOC for the Navy's 339 aircraft is expected in 2002.

Contractor: Raytheon Aircraft Company.
Power Plant: one Pratt & Whitney Canada PT6A-68 turboprop; 1,708 shp.
Accommodation: student and instructor, in tandem, on zero/zero ejection seats.
Dimensions: span 33 ft 5¼ in, length 33 ft 4¾ in, height 10 ft 8⅓ in.
Weight: empty (approx) 4,415 lb.
Performance: max speed 368 mph.

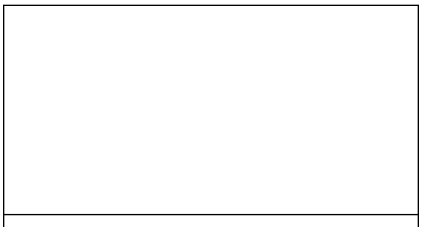


***T-37B** Tweet* (Randy Jolly)



***AT-38** Talon* (Nate Leong)

T-43 (Randy Jolly)



Joint Primary Aircraft Training System (JPATS)

UV-18B Twin Otter

The UV-18B is a military version of the DHC-6 Twin Otter STOL utility transport. Two were procured in FY 1977 for use as parachute jump training aircraft at the US Air Force Academy.

Contractor: The de Havilland Aircraft of Canada Ltd.
Power Plant: two Pratt & Whitney Canada PT6A-27 turboprops; each 620 ehp.
Accommodation: crew of two and up to 20 passengers.
Dimensions: span 65 ft 0 in, length 51 ft 9 in, height 19 ft 6 in.
Weight: gross 12,500 lb.
Performance: max cruising speed 210 mph, ceiling 26,700 ft, range with 2,500 lb payload 806 miles.

The US Air Force Academy also lists the following types in its training inventory: **SGS 1-26E (TG-3A)** sailplane, **SGS 2-33A (TG-4A)** glider, **SGM 237 (TG-7A)** motorized glider, **ASK-21 (TG-9A)** sailplane, and **Stemme S-10 (TG-11A)** motorized glider.

Strategic Missiles

LGM-30G Minuteman

Maintaining a key role in the US strategic deterrent posture, Minuteman is a three-stage, solid-propellant ICBM, housed in underground silos for which an upgrade program was completed in 1980 to provide increased launch-facility protection. The only version now in service, LGM-30G Minuteman III, became operational in 1970, providing improved range over earlier versions, rapid retargeting, and the capability to place three multiple independently targetable reentry vehicles (MIRVs) on three targets with a high degree of accuracy. A single reentry vehicle configuration has been demonstrated, and planned for, in accordance with strategic arms control negotiations. A total of 500 Minuteman IIIs will be based at Minot AFB, N. D.; F. E. Warren AFB, Wyo.; and Malmstrom AFB, Mont., when START II is ratified. The Air Force is currently consolidating the Minuteman III fleet by removing the 150 missiles at Grand Forks AFB and emplacing them in converted Minuteman II launchers at Malmstrom AFB. This project, called Rivet Add, began in October 1995 and will be completed by October 1997.

Enhancements and modifications under way will maintain the viability of the Minuteman III force through 2020. On the missile itself, all three stages will be remanufactured. A guidance replacement program will ensure long-term supportability of the aging guidance system's electronic components. A depot-level maintenance refurbishment, known as Rivet Mile, has been in progress to correct existing, and retard future, age-related deterioration of facilities in Minuteman silos and launch control centers. Modification of the launch centers, begun in 1989 under the Rapid Execution and Combat Targeting program, has been completed, ensuring real-time status information on the weapons and communications nets, improving responsiveness to launch directives, and improving rapid retargeting capability. The possibility of deploying 20 modified Minuteman III missiles, armed with defensive kinetic-kill vehicles, to meet the requirement for an emergency response national missile defense system is under consideration.

Assembly and Checkout: Boeing Aerospace Company.
Power Plant: first stage: Thiokol M-55 solid-propellant

motor, 210,000 lb thrust; second stage: Aerojet-General SR19-AJ-1 solid-propellant motor, 60,300 lb thrust; third stage: Thiokol SR73-AJ-1 solid-propellant motor, 34,400 lb thrust.
Guidance: Autonetics Division of Rockwell International inertial guidance system.
Warheads: three Mk 12/12A MIRVs.
Dimensions: length 59 ft 10 in, diameter of first stage 5 ft 6 in.
Weight: launch weight (approx) 78,000 lb.
Performance: speed at burnout more than 15,000 mph, highest point of trajectory approx 700 miles, range with max operational load more than 7,000 miles.

LGM-118A Peacekeeper

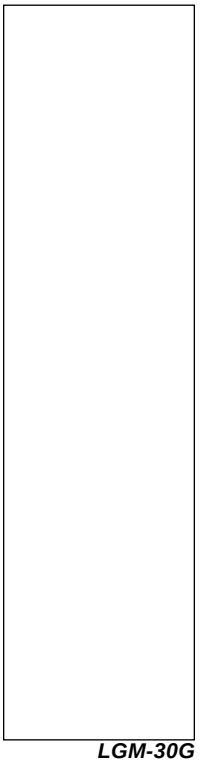
Deployed initially in response to an increased Soviet strategic threat, the Peacekeeper missile marked 10 years of alert duty on October 10, 1996. Emplacement of Peacekeepers in existing Minuteman III silos near F. E. Warren AFB, Wyo., began in June 1986, reaching FOC with 50 missiles in December 1988. However, the changing international political climate led to a statutory cap on deployment of only 50 (of a funded 114) of these missiles in the FY 1990 budget, and development of a rail-garrison mode of Peacekeeper deployment was terminated.

Peacekeeper is a four-stage ICBM that carries up to 10 independently targetable reentry vehicles. It has many advantages over other strategic missile systems. In particular, it is more accurate, carries more warheads, and has greater range than the Minuteman III. Its greater resistance to nuclear effects and its more capable guidance system provide Peacekeeper with a greatly improved ability to destroy very hard targets. These attributes, combined with its prompt response, provide a decisive deterrent. Peacekeeper will be scheduled for retirement under the provisions of the START II treaty, already ratified by the US Senate but not by the Russian Duma, and no retirement action will occur until its terms come into force.
Basing: Boeing Aerospace and Electronics.
Assembly and Test: Martin Marietta, Denver Aerospace.
Power Plant: first three stages solid-propellant, fourth stage storable liquid; by Thiokol, Aerojet, Hercules, and Rocketdyne, respectively.
Guidance: inertial; integration by Rockwell, inertial measurement unit by Northrop and Rockwell.
Warheads: 10 Avco Mk 21 MIRVs.
Dimensions: length 71 ft 0 in, diameter 7 ft 8 in.
Weight: approx 195,000 lb.

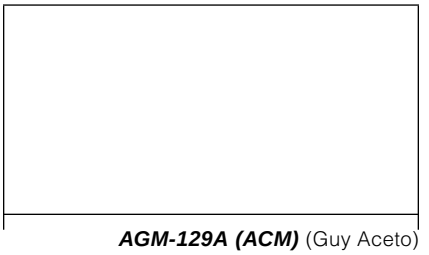
AGM-86B/C ALCM/CALCM

Programmed for precision attack on surface targets, the **AGM-86B** Air-Launched Cruise Missile (ALCM) is a small, subsonic, unmanned, winged air vehicle, currently deployed on B-52H aircraft. When launched in large numbers, its ability to dilute enemy defenses improves the capability of manned aircraft to penetrate to major targets. Small radar signature and low-level flight capability enhance the missile's effectiveness. The last of 1,715 production models was delivered in October 1986. ALCM-equipped units are at Barksdale AFB, La., and Minot AFB, N. D.

First used operationally during the Persian Gulf War, the **AGM-86C** is a conventionally armed version (CALCM), development of which began in 1986. One was recently tested with an improved GPS. It flew for five hours before precisely impacting the target in a new steep terminal dive maneuver devised for delivering penetrator warheads. *(Data for AGM-86B, except where indicated.)*
Contractor: Boeing Aerospace Company.



LGM-30G ***LGM-118A***



AGM-129A (ACM) (Guy Aceto)

Power Plant: Williams International Corporation/Teledyne CAE F107-WR-100 turbofan; 600 lb thrust.
Guidance: AGM-86B: inertial plus TERCOM, by Litton; AGM-86C: inertial plus GPS, by Litton.
Warhead: AGM-86B: W80-1 nuclear; AGM-86C: blast/fragmentation conventional.
Dimensions: length 20 ft 9 in, body diameter 2 ft 0½ in, wingspan 12 ft 0 in.
Weight: 3,200 lb.
Performance (approx): speed 500 mph, range 1,555 miles.

***AIM-9** Sidewinder (top), **AGM-88 HARM** (bottom)* (Guy Aceto)

AGM-129A (ACM)

Embodying low-observable technology, the AGM-129A Advanced Cruise Missile has improved range, accuracy, survivability, and targeting flexibility compared with the AGM-86B. Developed by General Dynamics, the ACM first flew in July 1985; in November 1987, McDonnell Douglas was awarded a contract for technology transfer leading to second-source capability for this advanced system, which is deployed on B-52H aircraft. Delivery of production AGM-129As began in June 1990, the 410th BW at K. I. Sawyer AFB, Mich. (now closed), being the first operational unit; final delivery was in August 1993. Total acquisition of the ACM was 461 missiles.
Contractor: General Dynamics (Convair)/McDonnell Douglas Missile Systems.
Power Plant: Williams International F112-WR-100 turbofan.
Guidance: inertial, with TERCOM update.
Warhead: W80-1 nuclear.
Dimensions: length 20 ft 10 in, body width 2 ft 3¾ in, wingspan 10 ft 2 in.
Weight: 3,709 lb.
Performance (approx): range 1,865 miles.

Airborne Tactical and Defense Missiles

AIM-7 Sparrow

Sparrow is a radar-guided air-to-air missile with all-weather, all-altitude, and all-aspect capability. It entered service in 1958, and approximately 34,000 AIM-7C, D, and E versions were produced. The later, advanced solid-state **AIM-7F,** introduced from 1975, has a larger motor, Doppler guidance, improved ECM, and better capability over both medium and "dogfight" ranges. Approximately 5,400 were produced.

A monopulse version of Sparrow, designated **AIM-7M,** aimed at reducing cost and improving performance in the ECM and look-down clutter regions, began operational service during FY 1983; this version equips USAF and USN F-14, F-15, F-16 (ADF), and F/A-18 aircraft. **AIM-7P/RIM-7P,** in service since 1992, has improvements to the fuze and electronics, aimed at increasing lethality against sea-skimming antiship missiles and cruise missiles. AIM-7s equipped with telemetry packages in place of warheads are used in a pro-gram initiated by the USAF Air Warfare Center and linked with industry, to develop passive missile-warning systems for USAF tactical aircraft. The **AIM-7R,** or missile homing improvement program, is designed to improve the missile's performance against sophisticated ECM by means of a new IR seeker added to the guidance and control section, incorporated within a multimode seeker assembly. Entry into service is planned this year. *(Data for AIM-7F.)*
Contractors: Raytheon Company/Hughes Missile Systems Company.
Power Plant: Hercules Mk 58 Mod 0 boost-sustain rocket motor.
Guidance: Raytheon semiactive Doppler radar homing system.
Warhead: high-explosive, blast fragmentation, weighing 86 lb.
Dimensions: length 11 ft 10 in, body diameter 8 in, wingspan 3 ft 4 in.
Weight: launch weight 504 lb.
Performance (estimated): max speed more than Mach 3.5; range more than 25 miles.

AIM-9 Sidewinder

The AIM-9 Sidewinder is a close-range, air-to-air missile using IR guidance. Versions currently in the USAF inventory:

AIM-9M: improved version of third-generation AIM-9L Sidewinder with all-aspect intercept capability. This version has increased infrared counter-countermeasures (IRCCM) capability, improved background discrimination, and reduced-smoke rocket motor. Full production began in FY 1981 with an order for approximately 1,280 missiles.

AIM-9M-9: modification to improve IRCCM capability of early missiles.

Development of the next-generation replacement for the AIM-9M continues, with the award on December 13, 1996, of a $169 million contract to Hughes for the engineering/manufacturing phase of its **Evolved Sidewinder,** derived from an **AIM-9X** demonstration/validation contract funded jointly by the Navy and the Air Force from 1994. Evolved Sidewinder is an off-boresight missile that will be used, most probably, in association with a helmet-mounted sight to enhance target acquisition and tracking. It incorporates airframe improvements and thrust vector control, and combines a high- performance focal plane array sensor and a

Texas Instruments advanced tracker with the existing AIM-9M rocket motor, warhead, and fuze.

AIM-9 missiles, equipped with telemetry packages in place of warheads, are being used by the Air Warfare Center in an industry-linked program to develop passive missile warning systems for USAF's tactical aircraft. *(Data for AIM-9M.)*

Contractor: Raytheon Company/Loral Aeronutronics.
Power Plant: Thiokol Mk 36 Mod 11 solid-propellant rocket motor.
Guidance: solid-state IR homing guidance.
Warhead: high-explosive, weighing 20.8 lb.
Dimensions: length 9 ft 5 in, body diameter 5 in, finspan 2 ft 1 in.
Weight: launch weight 191 lb.
Performance: max speed above Mach 2; range more than 10 miles.

AIM-120A (AMRAAM)

Intended as a replacement for the AIM-7 Sparrow, the AIM-120A Advanced Medium-Range Air-to-Air Missile (AMRAAM) provides an all-weather, all-environment capability for USAF's F-15, F-16, and F-22 and the Navy's F-14 and F/A-18 fighters. Inertial midcourse guidance and active radar terminal homing provide launch-and-maneuver capability. Significant improvements in operational effectiveness over the AIM-7 include increased average velocity, reduced miss distance, improved fuzing, increased warhead lethality, multiple target engagement capability, improved clutter rejection in low-altitude environments, improved ECCM capability, increased maximum launch range, reduced-smoke motor, and improved maintenance and handling.

A leader/follower program has been under way (Hughes/Raytheon), with the preproduction effort (producibility and qualification) in FY 1986 and low-rate initial production in FY 1987 (180 missiles). Subsequent lots have been competed for and, up to and including Lot 9, have been awarded to Hughes and Raytheon.

The first production **AIM-120A** was delivered by Hughes in 1988, when the 33d TFW at Eglin AFB, Fla., became the first operational unit to receive AMRAAMs. The **AIM-120B** and **AIM-120C** versions are currently in production, the latter with smaller control surfaces to permit increased internal carriage capability in the F-22. The 200,000-hour captive-carry mark was passed in November 1994 due to the frequency of air patrols over Bosnia and Iraq where the missile was combat-proven. A Preplanned Product Improvement (P^3I) program seeks to develop AMRAAM improvements, including software reprogrammability, advanced counter-countermeasures, and options for improved propulsion. The missile is in full-rate production. Funding has been approved for procurement of well over half of a proposed final total in excess of 12,000 AMRAAMs for USAF and USN.

Contractors: Hughes Missile Systems Company/Raytheon Company.
Power Plant: Gencorp Aerojet two-stage solid-propellant rocket motor.
Guidance: inertial midcourse, with active radar terminal homing.
Warhead: high-explosive directed fragmentation weighing 48 lb.
Dimensions: length 12 ft 0 in, body diameter 7 in, span of tail control fins 2 ft 1 in.
Weight: 345 lb.
Performance: cruising speed approx Mach 4, range approx 30 miles.

AGM-65 Maverick

The basic **AGM-65A** Maverick is a launch-and-leave, TV-guided, air-to-surface missile that enables the pilot of the launch aircraft to seek other targets or leave the target area once the missile has been launched. Production was initiated in 1971, following successful test launches over distances ranging from a few thousand feet to many miles and from high altitudes to treetop level.

AGM-65B: has a "scene magnification" TV seeker that enables the pilot to identify and lock on to smaller or more distant targets. Orders for AGM-65A/Bs totaled 19,000.

AGM-65D: developed to overcome limitations of the TV Maverick, which can be used only in daylight clear-weather conditions, this version has an imaging-infrared (IIR) seeker as well as a lower-smoke motor. The Air Force Operational Test and Evaluation Center and TAC (now ACC) conducted operational flight testing with 25 live launches from A-7, A-10, F-4E, F-4G, and F-16 aircraft at Nellis AFB, Nev., in September 1986, resulting in 24 direct hits on a variety of vehicles. IIR Maverick became operational on A-10s in February 1986.

AGM-65G: uses the IIR seeker with an alternate 298- lb blast fragmentation warhead for use against hardened targets. Software has been modified to include options for targeting ships and large land targets as well as mobile armor. This version also has a digital autopilot and a pneumatic, rather than hydraulic, actuation system. First successful launch took place in November 1987.

AGM-65H: upgraded TV Maverick with significant reliability, maintainability, and performance improvements over the AGM-65B.

A total of 25,397 AGM-65D/Gs were ordered for USAF through FY 1991, with the final order awarded to Raytheon in 1991.

Maverick missiles were first employed by USAF in Vietnam and were used extensively during the Persian Gulf War. They currently equip the A-10, F-15E, and F-16, singly or in three-round clusters, for use against such pinpoint targets as tanks and columns of vehicles, and in the SEAD role. *(Data for AGM-65A/B.)*

Contractor: Hughes Missile Systems Company/Raytheon Company.
Power Plant: Thiokol TX-481 solid-propellant rocket motor.
Guidance: self-homing, EO guidance system (IIR on D and G models).
Warhead: high-explosive, shaped charge.
Dimensions: length 8 ft 2 in, body diameter 1 ft 0 in, wingspan 2 ft 4½ in.
Weight: launch weight (AGM-65A) 462 lb, (AGM-65G) 662 lb.
Performance: range 0.6 to 14 miles.

AIM-120 *(AMRAAM)*

AGM-65 *Maverick* (Guy Aceto)

GBU-15

AGM-130

AGM-84A Harpoon

Originally acquired, under a cooperative memorandum of understanding with USN, to equip two squadrons of now-retired B-52G aircraft for maritime antisurface warfare operations, the Harpoon all-weather antiship missile now arms conventional-mission B-52Hs.

Contractor: McDonnell Douglas Missile Systems Company.
Power Plant: Teledyne CAE J402-CA-400 turbojet; 660 lb thrust.
Guidance: sea-skimming cruise monitored by radar altimeter, active radar terminal homing.
Warhead: penetration high-explosive blast type, weighing 488 lb.
Dimensions: length 12 ft 7½ in, body diameter 1 ft 1½ in, wingspan 3 ft 0 in.
Weight: 1,145 lb.
Performance: speed high subsonic, range more than 57 miles.

AGM-88 HARM

High speed, coupled with the ability to cover a wide range of frequency spectrums through the use of programmable digital processors in both the carrier air-craft's avionics equipment and the missile, gives this second-generation antiradiation missile greatly improved capability over first-generation Shrikes and Standards. Equipping recently retired F-4G "Wild Weasel" aircraft, the AGM-88 High-Speed Antiradiation Missile (HARM) proved highly effective against enemy ground radar during the Persian Gulf War. HARMs now equip F-16s dedicated to the SEAD mission and have been used operationally against Iraqi defenses as part of Operation Southern Watch.

Current production version is the **AGM-88C,** with a more lethal warhead, containing tungsten alloy cubes rather than steel, and the enhanced-capability Texas Instruments AGM-88C-1 guidance head. USAF is updating older AGM-88Bs with the new guidance seeker. Erasable Electronically Programmable Read-Only Memory has been retrofitted on USAFE, PACAF, and ACC HARMs, permitting changes to missile memory in the field. Production of all versions was expected to total around 21,000 by this year. *(Data for AGM-88A.)*

Contractor: Texas Instruments, Inc.
Power Plant: Thiokol smokeless, dual-thrust, solid-propellant rocket motor.
Guidance: passive homing guidance system, using seeker head that homes on enemy radar emissions.
Warhead: high-explosive fragmentation, weighing 145 lb.
Dimensions: length 13 ft 8½ in, body diameter 10 in, wingspan 3 ft 8½ in.
Weight: 807 lb.
Performance: cruising speed supersonic, altitude limits S/L to 40,000 ft, range more than 10 miles.

GBU-15 and AGM-130A/C

The **GBU-15** is an air-launched, cruciform-wing, glide bomb fitted with a guidance system designed to give it pinpoint accuracy from low or medium altitudes over short standoff ranges. Development began in 1974, based on experience gained in Vietnam with the earlier Pave Strike GBU-8 HOBO modular weapon program. The GBU-15 is intended for tactical use to suppress enemy defenses and to destroy heavily defended targets. The target-detecting device is carried on the front of the warhead. The control module, with autopilot and data link module, attaches to the rear.

The weapon offers two modes of attack. In direct attack, the weapon is locked on to the target before launch and flies a near line-of-sight profile to impact. In the indirect mode, the seeker can be locked on to the target after launch, or the operator can fly the weapon manually to impact, using guidance updates provided through the data link. This profile uses a midcourse glide phase and extends standoff range. A "buddy" system may be operated whereby the weapon is launched from one aircraft and controlled by another. The GBU-15 is currently deployed with F-15E aircraft. Versions include: GBU-15(V)1/B TV-guided variant, qualified for operational service in 1983 (production complete); GBU-15(V)2/B IIR version, which entered service in 1987; GBU-15(V)3/B with a CBU-75 warhead and DME transponder guidance system; and GBU-15-I, combining the accuracy of the GBU-15 with the penetration capability of the improved 2,000-lb BLU-109/B iron bomb.

The AGM-130 is a product improvement to the GBU-15, adding a rocket motor, a radar altimeter, and a digital control system. These improvements triple the standoff range of the GBU-15. Both the **AGM-130A** (with a Mk 84 warhead) and the **AGM-130C** (with the BLU-109/B penetrating warhead) are currently in production. Upgrades include a new solid-state TV seeker, an improved IR seeker, and INS/GPS guidance that permit operation in adverse weather and improve target acquisition. Deliveries to USAF began in November 1992. The AGM-130 is certified for use with the F-15E. *(Data for GBU-15.)*

Contractor: Rockwell International Corporation.
Guidance: TV or IIR seeker, or DME transponder.
Warhead: Mk 84 bomb (2,000-lb unitary), BLU-109, or CBU-75.
Dimensions: length 12 ft 10½ in, body diameter 1 ft 6 in, wingspan 4 ft 11 in.
Weight: 2,450 lb.
Performance: cruising speed subsonic.

GBU-24A/B

The GBU-24A/B is a third-generation laser-guided bomb guidance kit, called Paveway III, integrated with a BLU-109 penetrating warhead. The kit consists of an advanced guidance section and high-lift airframe. It is extremely precise and highly effective against a broad range of high-value hard targets. The system can be employed from low, medium, and high altitudes, providing operational flexibility through the use of an adaptive digital autopilot and large field-of-regard, highly sensitive scanning seeker. The GBU-24A/B adapts to conditions of release, flies an appropriate midcourse, and provides trajectory shaping for enhanced warhead effectiveness. The weapon is deployed on the F-15E and F-16. The GBU-24A/B was highly successful in the Persian Gulf War and is in production.
Contractor: Texas Instruments, Inc.
Guidance: semiactive laser.
Dimension: length 14 ft 2 in.
Weight: 2,350 lb.

GBU-24 (Guy Aceto)

GBU-27

To meet the unique requirements of the F-117A, the GBU-24A/B was adapted to GBU-27 standard, incorporating specific guidance features to accomplish this mission. The GBU-27 is extremely precise and was used to great effect in the Persian Gulf War. It is in production.
Contractor: Texas Instruments, Inc.
Guidance: semiactive laser.
Dimension: length 13 ft 11 in.
Weight: 2,170 lb.

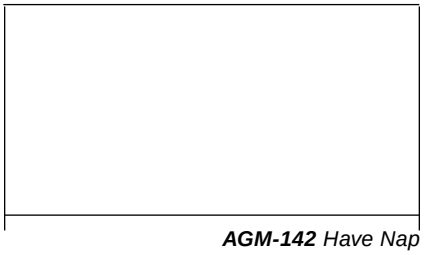
GBU-28

Under USAF's rapid-response program, a new bunker-busting weapon was developed for Operation Desert Storm, for use against deeply buried, hardened command-and-control facilities. Four of the laser-guided GBU-28 4,700-lb weapons were used in the war: two for testing and two by F-111Fs against a bunker complex on February 27, 1991. The body design is based on the BLU-109/B penetrator, extended by 54 in to 152 in, and doubling the wall thickness to 2¼ in. Guidance is by a modified GBU-27 system. Flight tested on the F-15E and F-111F, the GBU-28 demonstrated the capability to penetrate more than 100 ft of dirt or 20 ft of concrete. To date, 125 have been built, with funds for an additional 160 requested in the FY 1997 budget. All are to be upgraded with an improved fuze and guidance system. Advanced hard target munition concepts are being assessed under an ongoing concept exploration study leading to a follow-on to the GBU-28.
Contractor: National Forge and Texas Instruments.

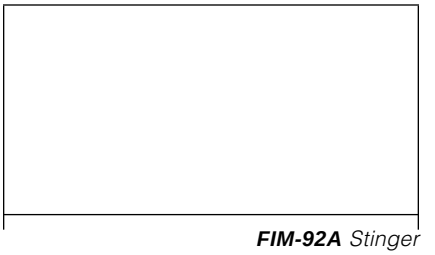
Joint Direct Attack Munition (JDAM) GBU-31/32 and GPS-Aided Munition (GAM)

JDAM is currently being developed to meet USAF and USN requirements for highly accurate, autonomous, all-weather, conventional bombing capability. In **GBU-31** form it adds an INS/GPS guidance kit to the 2,000-lb general-purpose Mk 84 bomb or the 2,000-lb BLU-109 penetrator; the **GBU-32** is built around the general-purpose 1,000-lb Mk 83. While still aboard the launch aircraft, JDAM can be continually updated with target information through the aircraft's avionics system. Once released, the inertial guidance kit will take over and, with periodic GPS updates, will guide the weapon to its target. Initial fielding is expected in 1997–98. JDAM is intended for use on a variety of aircraft, including the B-1, B-2, B-52, F-15E, F-16, F-22, F-117A, and F/A-18.

The B-2 bomber is currently equipped with a small inventory of **GPS-Aided Munitions (GAMs),** providing an interim weapon until JDAM becomes available. GAM is a Mk 84 2,000-lb conventional bomb with a GPS/inertial guidance-and-control tailkit, for exclusive deployment with the B-2. In a B-2 firepower demonstration, 16 GAMs destroyed all 16 targets.



AGM-142 *Have Nap*



FIM-92A *Stinger*

AGM-142 Have Nap

USAF is acquiring this medium-range standoff missile derived from the Israeli-built Popeye. Initial operational test and evaluation launches were completed in May 1990, and a coproduction agreement was entered into between Rafael and Martin Marietta (now Lockheed Martin).

The purpose of Have Nap is to provide long-range bombers with a conventional precision strike capability in support of worldwide theater commanders. Primary carrier aircraft are conventional-mission B-52Hs.
Contractor: Rafael Armament Development Authority.
Power Plant: solid-propellant rocket motor.
Guidance: inertial, with data link, TV, or IIR homing.
Warhead: high-explosive, 750-lb-class blast/fragmentation or penetrator.
Dimensions: length 15 ft 11 in, body diameter 1 ft 9 in, wingspan 5 ft 9 in.
Weight: 3,005 lb.
Performance: range 50 miles.

AGM-154A Joint Standoff Weapon (JSOW)

First in a USN/USAF family of low-cost, highly lethal glide weapons with a standoff capability, the AGM-154A Joint Standoff Weapon (JSOW) allows for the integration of several different submunition and unitary warheads, nonlethal payloads, various terminal sensors, and different modes of propulsion. The services are integrating JSOW with BLU-97 combined effects bomblets and BLU-108 Sensor-Fuzed Weapon submunitions for area and armored targets.

Development, under USN lead, began in 1992 on the baseline BLU-97 variant, which flew for the first time on December 13, 1994. The BLU-108 variant, under USAF lead, has undergone demonstration/validation and entered EMD in 1995. The third variant, JSOW/Unitary, also under USN lead, entered EMD in the middle of 1995 and integrates an IIR terminal seeker, the AWW-13 data link, and a 500–800-lb unitary warhead. Texas Instruments has also proposed and demonstrated a powered variant of the unitary version with an 800-lb warhead.

Testing completed to date includes F/A-18 jettison test series to the limits of the carriage envelope, free flight and live-fire dispense tests of BLU-97, captive dispense tests of BLU-108, free flight and in-flight destruct (range safety), environmental flight tests on F-15E and F-16, and fit checks on F-15E, F-16, F-117A, F/A-18, A-6E, AV-8B, B-1, B-52, Tornado, and Jaguar. IOC is planned for 1998.
Contractor: Texas Instruments.
Guidance: AGM-154A and JSOW/BLU-108 tightly coupled INS/GPS; JSOW/Unitary tightly coupled INS/GPS midcourse, IIR terminal with data link.
Dimensions: length 13 ft 4 in.
Weight: 1,065–1,500 lb.
Performance: range: low-altitude launch 17 miles, high-altitude launch 46 miles.

Joint Air-to-Surface Standoff Missile (JASSM)

Under development as a replacement for the canceled AGM-137 TSSAM, the Joint Air-to-Surface Standoff Missile (JASSM) is intended to be a precision, long-range weapon to hold high-value targets at risk. Lockheed Martin and McDonnell Douglas were selected in June 1996 to compete in a two-year definition and risk reduction phase. Anticipated Air Force purchase is 2,400 missiles.

Wind-Corrected Munition Dispenser (WCMD)

USAF plans to modify 40,000 standard tactical munition dispensers with guidance kits to compensate for wind drift on downward flight from high altitudes. WCMD kits will each have an INS guidance unit, movable tailfins that pop out in flight, and a signal processor. With a range of about eight miles, a WCMD will carry mines, cluster bomblets, or antiarmor submunitions. Successful flight testing began in February 1996. Carrier aircraft are expected to include B-1s, B-52Hs, F-15Es, F-16s, F-117s, and F-22s.

Rapier

Under a decision confirmed by an initial contract for 32 fire units in February 1981, British-built Rapier missile systems were deployed at seven USAF bases then in the UK to protect Air Force installations. The last unit became operational in July 1986. Manned by RAF regiment personnel, the USAF version of Rapier is intended primarily for defense against fast (Mach 1+), maneuvering, low-flying targets by day and night. The four-round fire unit, Blindfire radar, and a trailer of reload missiles are towed by Land Rovers loaded with support equipment.

Under a similar agreement, the government of Turkey operates 14 US-owned fire units for the defense of US air bases in that country.
Contractor: British Aerospace plc, Dynamics Division.
Power Plant: IMI two-stage solid-propellant rocket motor.
Guidance: surveillance radar and command to line-of-sight guidance. Optional Marconi DN181 Blindfire radar or optical target tracking, depending on conditions.
Warhead: semi-armor-piercing, with impact fuze.
Dimensions: length 7 ft 4 in, body diameter 5 in, wingspan 1 ft 3 in.
Weight: approx 94 lb.
Performance: max speed more than Mach 2, range 4 miles.

FIM-92A Stinger

First developed as a man-portable, tube-launched, surface-to-air missile for the US Army, Stinger has been employed since 1984 by air personnel in South Korea to provide base defense against high-speed,

low-level, ground-attack aircraft.
Contractor: Hughes Missile Systems Company/ Raytheon Company.
Power Plant: solid-propellant rocket motor.
Guidance: IR homing guidance.
Warhead: high-explosive blast fragmentation, weighing 6.6 lb.
Dimensions: length 5 ft 0 in, body diameter 2¾ in, wingspan 5½ in.
Weight: launch weight 35.3 lb.
Performance: range 1.85 miles.

Launch Vehicles

Atlas II

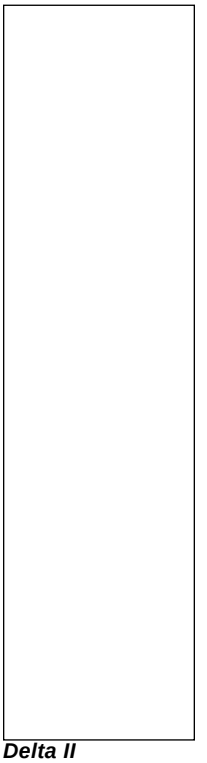
April 1996 saw the 100th launch of an Atlas/Centaur vehicle. The upgraded Atlas II version has been developed to meet USAF's continuing medium-launch vehicle (MLV II) requirement. The familiar "stage-and-a-half" configuration of the original ICBM is retained for the basic Atlas. Changes include lower-cost advanced avionics, an improved flight computer, booster engines with greater thrust, and longer propellant tanks. The engine and tank changes have been made to both the Atlas and Centaur stages. A new Atlas IIAR, with a Russian-designed RD-180 engine, will be used starting in 1998, enhancing payload capacity to 8,400 lb to GTO. A total of nine Atlas II vehicles are to be procured. Primary DoD payload is the Defense Satellite Communications System (DSCS). The first Atlas II/DSCS launch took place from Cape Canaveral AFS, Fla., in February 1992; first Atlas II–Centaur configuration launched in January 1995.
Prime Contractor: Lockheed Martin Corporation.
Power Plant: uprated Boeing North American MA-5 propulsion system in Atlas stage, comprising central sustainer motor and two boosters; total thrust 488,000 lb. Latest Atlas IIAS adds four Thiokol Castor IVA solid rocket motors.
Dimensions (Atlas stage): length 81 ft 7 in, max body diameter 10 ft 0 in.
Launch Weight: 416,000 lb.
Performance: in latest Atlas IIAS configuration, capable of putting 19,050 lb into a low-Earth orbit (LEO) from Cape Canaveral AS, Fla. Range of payloads Atlas II through Atlas IIAS can lift into geosynchronous transfer orbit (GTO) from Cape Canaveral is 4,900–8,150 lb, and 13,650–15,900 lb to LEO from Vandenberg AFB, Calif.

Titan II

Fourteen Titan II ICBMs have been refurbished and modified to provide expendable space-launch capability. Five successful launches have included the launch of the space probe Clementine I toward the Moon in January 1994, marking the first US lunar mission since Apollo 17 in December 1972. Remaining refurbished Titan IIs are assigned exclusively to place Defense Meteorological Satellite Program (DMSP) and National Oceanic and Atmospheric Administration (NOAA) satellites into polar orbit through the turn of the century.
Prime Contractor: Lockheed Martin Corporation.
Power Plant: first and second stages: Aerojet liquid hypergolic propellant rocket engines; first stage 430,000 lb thrust; second stage 100,000 lb thrust. Strap-on solid rocket motors can be added to the first stage to increase payload capability.
Guidance: Delco inertial guidance system.
Dimensions: first and second stages: height 110 ft 0 in, diameter 10 ft 0 in; payload fairing heights 20, 25, and 30 ft, diameter 10 ft 0 in.
Launch Weight: 408,000 lb.
Performance: more than 4,200 lb to low-Earth polar orbit.

Titan IV

USAF's primary heavy-lift launcher, Titan IV was selected originally in 1985 to augment the space shuttle and is used to launch critical military payloads, including the Defense Support Program (DSP) and Milstar satellites. It is a growth version of the earlier Titan 34D, with stretched first and second stages, seven-segment solid boosters, and a 16 ft 8½ in diameter payload fairing. **Titan IVA** is capable of placing a 32,000-lb payload into low polar orbit and 39,000 lb into LEO. With a modified Centaur G-prime upper stage, it can place 10,200 lb into geosynchronous Earth orbit (GEO). With an alternative Inertial Upper Stage (IUS), it can place 5,200 lb into GEO. First launch took place from Cape Canaveral, Fla., in June 1989. The latest **Titan IVB** version has mission-unique kits, providing a standard interface for payloads to permit launch-site processing, a new electrical system on the booster core, a new ground system, and upgraded solid-rocket motors with 25 percent improved performance. First launch from Cape Canaveral was made successfully on February 22, 1997; the first from Vandenberg AFB, Calif., will be in 1999. Forty-one Titan IVs have been ordered, and a follow-on buy of no more than six vehicles is planned. *(Data for Titan IVA.)*
Prime Contractor: Lockheed Martin Corporation.
Power Plant: Aerojet liquid hypergolic propellant rocket engines; first stage, two engines 551,200 lb thrust each; second stage 106,150 lb thrust; initially two United Technologies solid rocket boosters, each 1,400,000 lb peak thrust; later two Alliant (formerly Hercules) solid rocket boosters, each 1,800,000 lb peak thrust.
Guidance: Delco inertial guidance system, to be replaced by Honeywell digital avionics system on twenty-fourth vehicle and later.
Dimensions: first and second stages: height 119 ft 2½ in, diameter 10 ft 0 in.
Launch Weight: 1,900,000 lb.
Performance: see above.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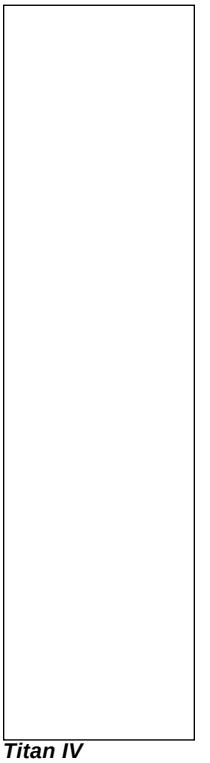

Titan IV


Pegasus

Centaur

Centaur was the first US high-energy upper stage and the first to use liquid hydrogen as a propellant. Its multiburn and extended coast capability were first used operationally during the 1977 Mariner Jupiter/Saturn missions. The D-1A version used with the Atlas demonstrated wide-ranging applications and capabilities. The nose section of Atlas was modified to a constant 10 ft diameter to accommodate the Centaur, which, in turn, provided most of the electronic command-and-control systems for the launch vehicle. A 10-ft-diameter fairing protected payloads for Centaur D-1A.

The **D-2A,** used with the current Atlas II, has been stretched three feet to include more propellant and thus has increased thrust. Payload fairings of either 11-ft or 14-ft diameter can be used.

The modified **Centaur G-prime** upper stage, with high-energy cryogenic propellants and multiple restart capability, is used with the Titan IVA, creating the greatest weight-to-altitude capability of any US launch vehicle by placing a 10,200-lb payload into GEO. *(Data for Centaur D-1A and G-prime, except where indicated.)*
Prime Contractor: Lockheed Martin Corporation.
Power Plant: two Pratt & Whitney liquid oxygen/liquid hydrogen rocket engines; D-1A: RL10A-4 engines, each with 20,500 lb thrust; G-prime: RL10A-3-3A engines, each with 16,500 lb thrust.
Guidance: inertial guidance system.
Dimensions: D-2A: length 33 ft 0 in, diameter 10 ft 0 in; G-prime: length 29 ft 0 in, diameter 14 ft 2½ in.
Launch Weight: D-2A (approx) 45,000 lb; G-prime-mod (approx) 53,000 lb.

Inertial Upper Stage (IUS)

Serving as an upper stage for the Titan IV for DoD, as well as with the shuttle for NASA, the highly reliable IUS was used for the first time in October 1982. Consisting of an aft skirt, an aft-stage solid rocket motor, an interstage, a forward-stage solid rocket motor, and an equipment support structure, it has the capability of boosting 5,200 lb into GEO when used on Titan IVA or 5,350 lb with the Titan IVB.
Prime Contractor: Boeing Defense and Space Group.
Power Plant: aft-stage solid rocket motor 59,000 lb thrust, forward-stage solid rocket motor 25,000 lb thrust.
Guidance: inertial.
Dimensions: length 17 ft 0 in, diameter 9 ft 6 in.
Launch Weight: 32,600 lb.

Delta II

Selected by the Air Force in 1987 to launch the Navstar GPS satellites, the Delta II is slightly larger than McDonnell Douglas's earlier Delta rocket to satisfy USAF's medium-payload requirement. The first launch took place in February 1989, and, to date, 25 operational GPS satellites have been launched successfully.

Delta II is a three-stage booster surrounded by nine solid-propellant, graphite epoxy motors. For low-Earth orbit missions, the third stage is typically not used. In December 1995, a newly assigned vehicle, complete with new avionics, an increased expansion ratio on three of the graphite epoxy motors (GEMs), and a new launch control system, successfully placed a NASA payload into orbit. Delta II will continue to support GPS into the next century by replenishing aging satellites as they fail and is supporting other DoD payloads.
Prime Contractor: McDonnell Douglas Aerospace Company.
Power Plant: first stage: Boeing North American RS-27A liquid-propellant engine, 237,000 lb thrust; second stage: Aerojet AJ10-118K engine, 9,750 lb thrust; third stage: Thiokol STAR-48B solid-propellant motor, 14,920 lb thrust; strap-on GEM solid rocket motors, 100,270 lb thrust (sea level).
Dimensions: length 130 ft 0 in, diameter 8 ft 0 in; bulbous payload fairing, max diameter 10 ft 0 in.
Launch Weight: 511,190 lb.
Performance: 11,100 lb to low-Earth orbit, 4,010 lb to geosynchronous transfer orbit.

Pegasus

USAF's smallest launcher, this three-stage, solid-propellant winged vehicle is air-launched from a B-52 and is designed for maximum operational flexibility in delivering 850–1,050-lb payloads to LEO. Conceived in 1987, Pegasus was developed jointly by Orbital Sciences Corp. and Hercules Aerospace Co. as a private venture. The vehicle was under contract to the Defense Advanced Research Projects Agency for its initial two flights, the first of which took place in 1990 from Vandenberg AFB, Calif. In July 1991, it successfully placed seven minisatellites in orbit. Now managed by the Air Force, it will support the USAF space test program and the Ballistic Missile Defense Organization. The enhanced-performance Pegasus XL successfully launched a DoD payload into polar orbit on March 8, 1996, following two earlier, unsuccessful launch attempts. *(Data for basic Pegasus vehicle.)*
Prime Contractor: Orbital Sciences Corporation and Hercules Aerospace Company/Alliant Techsystems.
Power Plant: three solid-propellant motors developing 109,400 lb, 27,600 lb, and 7,800 lb thrust, respectively.
Guidance: inertial guidance.
Dimensions: length 49 ft 0 in, wingspan 22 ft 0 in, diameter 4 ft 2 in.
Launch Weight: 42,000 lb.

Taurus

A more powerful version of the Pegasus space-launch vehicle, using an LGM-118 Peacekeeper missile first-stage addition and with the Pegasus wings removed. Taurus is ground-launched from regular launch complexes and will be used to test

a quick-readiness, mobile launch facility. The first launch, on March 14, 1994, put two USAF and ARPA satellites into a 340-mile polar orbit. Capable of lifting 3,200 lb to LEO and 1,130 lb to GTO using a Star 37 perigee kick motor.

Evolved Expendable Launch Vehicle (EELV)

Program aimed at fostering the evolution of a current launcher into a family of rockets, with reduced launch costs, to replace current DoD medium and heavy launchers. The requirement is to place payloads of 2,500 to 45,000 lb into low-Earth orbit. Four contracts were awarded in August 1995, to Alliant Techsystems Inc., Boeing Defense and Space Group, Lockheed Martin Technologies Inc., and McDonnell Douglas Aerospace, covering the 15-month low-cost concept validation phase. On December 20, 1996, Lockheed Martin and McDonnell Douglas were each awarded a $60 million 17-month pre-engineering and manufacturing development contract. *[See "EELV Enters New Phase," February 1997 "Aerospace World," p. 9.]* IOC for the medium-lift version is planned for 2001 and 2002, respectively, from Vandenberg AFB, Calif., and Cape Canaveral AS, Fla.; planned IOC for the heavy-lift EELV is 2005 at Vandenberg, and 2006 at Cape Canaveral.

Unmanned Aerial Vehicles

Tier II Predator

Delivery of Tier II Predator medium-altitude endurance vehicles has begun to the 11th RS at Indian Springs, Nev., the unit that officially took over Predator operations from the US Army on September 3, 1996. This UAV has already demonstrated its capability during continuous 16-hour surveillance missions over Bosnia for US European Command. Although fully autonomous, it is capable of midflight reprogramming or remote piloting. Navigation is by GPS/INS. Equipped with 450-lb Versatron TV, IR, and SAR sensors package, with Loral Ku-band satellite data link allowing real-time transmissions of video or SAR images to a ground station. Planned enhancements include a sigint package and laser designator.

Contractor: General Atomics.
Power Plant: one Rotax 912 engine; 85 hp.
Dimensions: length 26 ft 8 in, height 7ft 3 in, span 48 ft 8½ in.
Weights: empty 773 lb, gross 1,874 lb.
Performance: 24 hr loiter on station 575 miles from base at altitude of up to 25,000 ft, ceiling 23,000 ft, cruise speed 80 mph.

Tier II Plus Global Hawk

This high-altitude endurance UAV is scheduled to be flown for the first time in spring this year. A 2,000-lb payload, incorporating a TV, IR, and SAR sensors package under development by Hughes, will permit ground commanders to switch among radar, IR, and visible wavelengths as required. Global Hawk will be capable of flying up to 40 hours at a cruise speed of nearly 400 mph and at an altitude of 65,000 ft and will loiter on station 3,450 miles from base for 24 hours. The prototype was rolled out on February 20, 1997.

Contractor: Teledyne Ryan Aeronautical.
Power Plant: one Allison AE 3007H turbofan; 7,200 lb thrust.
Dimensions: length 44 ft 4¾ in, height 15 ft 2½ in, span 116 ft 2½ in.
Weights: empty 7,648 lb, gross 25,600 lb.

Tier III Minus DarkStar

Designed to complement Global Hawk, DarkStar is a low-observable UAV, intended to operate in high-threat environments at altitudes in excess of 45,000 ft for at least eight hours, 575 miles from its base. It will be capable of monitoring a mission area of 18,500 square miles, using a recon/optical TV camera or a Westinghouse SAR, transmitting primarily fixed-frame images while in flight. Following the loss of the prototype, flight testing will resume with DarkStar 2 at Edwards AFB, Calif., this summer.

Contractor: Boeing/Lockheed Martin.
Power Plant: one Williams International F129 (FJ44) turbofan; 1,900 lb thrust.
Dimensions: length 15 ft 0 in, height 5 ft 0 in, span 69 ft 0 in.
Weight: gross 8,600 lb.
Payload: 1,000 lb.
Performance (estimated): cruise speed 345 mph, flight endurance 12 hr.

Tier II *Predator*

Tier II Plus *Global Hawk*

Tier III Minus *DarkStar*

MQM-107D *Streaker* (Guy Aceto)

BQM-34A *Firebee* (Guy Aceto)

Aerial Targets and Decoys

MQM-107D Streaker

Third-generation version of the MQM-107 Streaker, the current MQM-107D model has been in service since 1987. It is a recoverable, variable-speed target drone used at Tyndall AFB, Fla., for research, development, test, and evaluation (RDT&E) and the Weapon System Evaluation Program.

Contractor: Raytheon Aircraft Company.
Power Plant: initially one Teledyne CAE 373-8 engine; 960 lb thrust; MQM-107Ds delivered since 1989 have 1,060 lb thrust TRI 60-5 turbojets.
Guidance and Control: analog or digital, for both ground control and preprogrammed flight. High-*g* autopilot provisions.
Dimensions: length 18 ft 1 in, body diameter 1 ft 3 in, span 9 ft 10 in.
Weight: max launch weight (excl booster) 1,460 lb.
Performance: operating speed 230–594 mph, operating height 50–40,000 ft, endurance 2 hr 15 min.

MQM-107E Streaker

Improved performance follow-on to the MQM-107D, the E model will be the Air Force's standard subscale target. It will be operational at Tyndall AFB, Fla., by February 1998.

Contractor: Tracor Flight Systems Inc.
Power Plant: Microturbo TRI 60-5 engine; 1,061 lb thrust or TCAE 373-8B.
Guidance and Control: Digital autopilot and remote control by the Gulf Range Drone Control Upgrade System (GRDCUS), a multifunction command-and-control multilateration system.
Dimensions: as D model.
Weight: as D model.
Performance: operating speed 207–631 mph, operating height 50–40,000 ft, endurance 2 hr 15 min.

BQM-34A Firebee

More than 1,800 of these jet target vehicles have been delivered to USAF since initial development of the BQM-34A in the late 1950s.

Current BQM-34As with uprated General Electric J85-100 engine provide a thrust-to-weight ratio of one to one, enabling this version to offer higher climb rates and 6*g* maneuvering capability. A new microprocessor flight-control system provides a prelaunch and in-flight self-test capability. Since 1989, these targets have been used for weapon system evaluation at Tyndall AFB, Fla.

Contractor: Teledyne Ryan Aeronautical.
Power Plant: one General Electric J85-GE-100 turbojet; 2,850 lb thrust.
Guidance and Control: remote-control methods incl choice of radar, radio, active seeker, and automatic navigator developed by Teledyne Ryan; the current model of the BQM-34A is configured to accommodate the GRDCUS, which allows multiple targets to be flown simultaneously.
Dimensions: length 22 ft 10¾ in, body diameter 3 ft 1¼ in, span 12 ft 10¾ in.
Weight: launch weight 2,500 lb.
Performance: max level speed at 6,500 ft 690 mph, operating height range 20 ft to more than 60,000 ft, max range 796 miles, endurance (typical configuration) 30 min.

QF-4

Replacing the QF-106 as a joint-service full-scale aerial target (FSAT), the QF-4 has an improved flight-control system and greater payload compared with the earlier drone. Approximately 300 F-4s will be converted to FSATs.

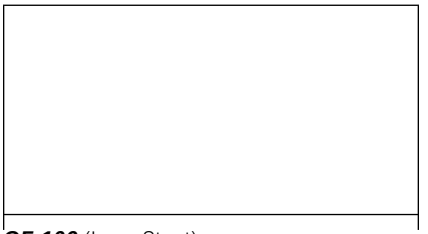
Contractor: Tracor Inc.
Power Plant: two Pratt & Whitney J79-GE-17 turbojets; each with approx 17,000 lb thrust with afterburning.
Guidance and Control: remote-control methods incl the GRDCUS and the Drone Formation and Control System and will also accommodate the triservice Next-Generation Target Control System currently under development.
Dimensions: length 63 ft 0 in, height 16 ft 5 in, wingspan 38 ft 5 in.
Weight: mission operational weight 49,500 lb.
Performance: max speed Mach 2, ceiling 55,000 ft, range (approx) 500 miles.

QF-106

Approximately 194 F-106s were converted to FSATs, replacing the QF-100 in USAF service from late 1991. Advantages of the QF-106 over the QF-100 include higher supersonic speeds while under remote control and increased maneuverability. Last target delivered in December 1994. QF-106s will be operational through FY 1997.

Contractor: Honeywell Inc.
Power Plant: one Pratt & Whitney J75-P-17 turbojet; 24,500 lb thrust with afterburning.
Guidance and Control: remote-control methods

include the GRDCUS and, for Holloman AFB, N. M., operations, both the Drone Formation and Control System (the US Army's predecessor to the GRDCUS) and the Drone Tracking and Control System (a microwave command guidance system scheduled for phaseout).
Dimensions: length 70 ft 8¾ in, height 20 ft 8½ in, wingspan 38 ft 3½ in.
Weight: mission operational weight 40,500 lb.
Performance: max speed Mach 2, ceiling 50–55,000 ft, typical radius 575 miles.



QF-106 (Lans Stout)

Satellite Systems

Defense Support Program

Defense Support Program (DSP) satellites, a key part of North America's early warning system, detect missile launches, space launches, and nuclear detonations. Operated by AFSPC, the satellites feed warning data to NORAD and US Space Command early warning centers at Cheyenne Mountain AS, Colo.

The first launch of a DSP satellite took place in the early 1970s, and, since that time, the satellites have provided an uninterrupted early warning capability to the US. Though not designed to spot and track smaller missiles, the system's capability was demonstrated during the Persian Gulf War, when the satellites provided warnings of Iraqi Scud attacks. A total of 17 DSP satellites were launched by USAF. Procurement will end with Number 23, canceling the further satellites originally planned.

An advanced satellite constellation known as the Spacebased Infrared (SBIR) system is being developed to replace the DSP satellites, employing satellites in two orbits. The contract for the demonstration/validation phase of the low-orbit component was awarded to Rockwell (now Boeing North American)/Lockheed Martin in October 1996; a Lockheed Martin team including Aerojet, Honeywell, and Northrop Grumman received the contract for development and delivery of seven "high" satellites a month later. *[Data for DSP.]*
Prime Contractors: TRW and Aerojet.
Power Plant: solar arrays generating 1,485 watts.
Dimensions: diameter 22 ft 0 in, height 32 ft 8 in, with solar paddles deployed.
Weight: 5,000 lb (approx).
Performance: orbits at approx 22,000 miles altitude in geosynchronous orbit; uses IR sensors to sense heat from missile and booster plumes against Earth's background.

Defense Meteorological Satellite Program

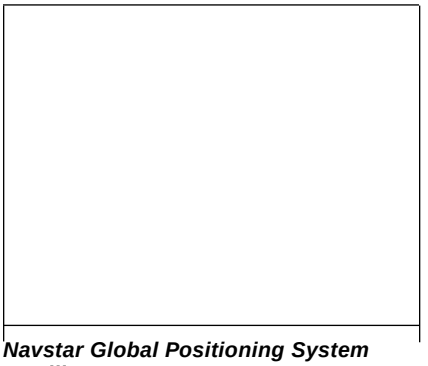
Defense Meteorological Satellite Program (DMSP) space vehicles, operated by AFSPC's 50th Space Wing, Falcon AFB, Colo., have been collecting weather data for US military operations for about two decades. Two operational DMSP Block 5D-2 satellites survey the entire Earth four times a day, using their primary sensor, the Operational Linescan System, to take visual and IR imagery of cloud cover. Military weather forecasters use this imagery to detect developing weather patterns anywhere in the world, helping to identify, locate, and determine the severity of thunderstorms, hurricanes, and typhoons.

DMSP satellites also have sensors that measure atmospheric moisture and temperature levels, X rays, and electrons that cause auroras. The satellites can locate and determine the intensity of auroras—electromagnetic phenomena that can interfere with radar operations and long-range communications. This information aids military commanders in making decisions. Satellite weather systems operated by DoD, NASA, and NOAA are to be merged and managed by NOAA.
Prime Contractor: Lockheed Martin Corporation.
Power Plant: solar arrays generating 1,000 watts.
Dimensions: height 11 ft 6 in, width 4 ft 9 in, length 19 ft 3 in.
Weight: 1,750 lb.
Performance: DMSP satellites orbit Earth at about 500 miles altitude and scan an area 1,800 miles wide. Each system covers the Earth in about 12 hr.

Defense Satellite Communications System

Defense Satellite Communications System (DSCS) satellites provide worldwide secure voice high-data-rate transmission, operating in superhigh frequency. The system is used for high-priority communications, such as the exchange of wartime information between defense officials and battlefield commanders. The military also uses the DSCS to transmit data on space operations and early warning to various systems and users. A program has been funded to allow more tactical users access to the DSCS.

The Air Force began launching the DSCS Phase II satellites in 1971. These are equipped with antennas capable of providing low-gain, Earth-field-of-view coverage and steerable, high-gain area coverage. The first launch of the more advanced Phase III satellites was in 1982. These satellites are nuclear hardened and can resist jamming. Phase III spacecraft are capable of providing flexible coverage and nulling in addition to the Phase II's capabilities. They are operated by the 50th Space Wing.
Prime Contractor: Phase II, TRW; Phase III, Lockheed Martin Corporation.
Power Plant: Phase II: solar arrays generating 531 watts, decreasing to 418 watts after five years; Phase III: solar arrays generating 1,240 watts, decreasing to 980 watts after 10 years.
Dimensions: Phase II: cylindrical body 9 ft 0 in diameter, 6 ft high (13 ft with antennas deployed); Phase III: rectangular body 6 ft x 6 ft x 7 ft; 38-ft span with solar arrays deployed.
Weight: Phase II 1,350 lb, Phase III 2,550 lb.
Performance: two Phase II and nine Phase III DSCS satellites are currently in geosynchronous orbit.

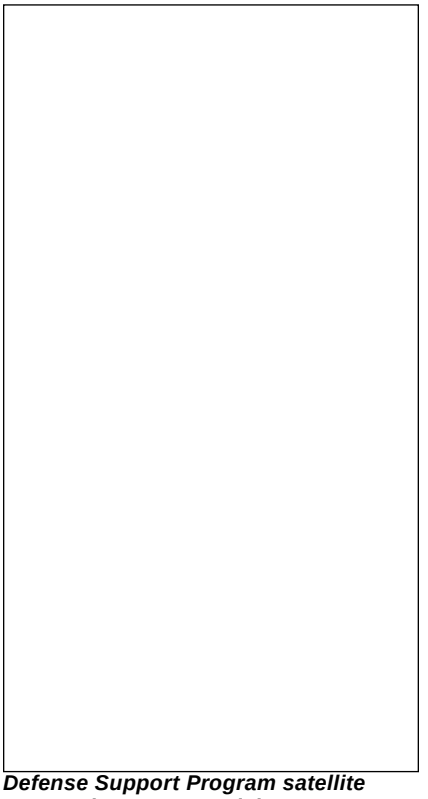


Navstar Global Positioning System satellite

Navstar Global Positioning System

The Navstar Global Positioning System (GPS) is a constellation of orbiting satellites providing navigation data to military and civilian users around the world. Operated by the 50th Space Wing, Falcon AFB, Colo., the constellation achieved FOC with 24 Block II/IIA satellites in July 1995. The twenty-fifth, a replenishment satellite, was launched in March 1996. The 24 satellites provide 24-hour navigation services, including accurate, three-dimensional (latitude, longitude, and altitude) velocity and precise time; passive, all-weather operation; continuous real-time information; support to an unlimited number of users and areas; and support to civilian users currently at a slightly less accurate level. Concern over potential enemy use of GPS is being addressed under the NAVWARS initiative.

Also benefiting from the GPS are such functions as mapping, aerial refueling and rendezvous, geodetic surveys, and search-and-rescue operations. Replenishment by Block IIR satellites is scheduled to begin early this year.
Prime Contractors: Boeing North American, Lockheed Martin Corporation, and Loral Fairchild Systems.
Power Plant: solar arrays generating 700 watts.
Dimensions: width 5 ft 0 in, length 17 ft 6 in, incl solar array.
Weight: 1,860 lb in orbit.
Performance: GPS satellites orbit the Earth every 12 hr, emitting continuous navigation signals. The signals are so accurate that time can be figured to within one-millionth of a second, velocity within a fraction of a mile per hour, and location to within a few feet. Receivers are used in aircraft, ships, and land vehicles and can also be handheld.



Defense Support Program satellite mounted atop an Inertial Upper Stage booster.

Milstar Satellite Communications System

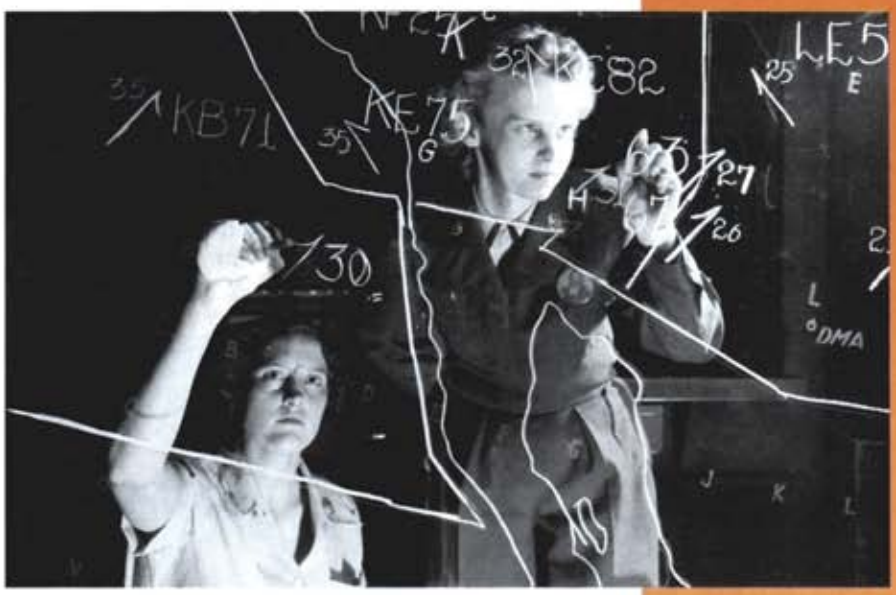
Milstar is a joint-service communications system that provides secure, jam-resistant EHF communications for all US armed services. Operated by the 50th Space Wing, the constellation will link command authorities with a wide variety of resources including ships, submarines, aircraft, and ground stations. The first Milstar satellite was launched in February 1994 and is fully operational. The second satellite was launched in November 1995. Currently serving tactical as well as strategic forces, the last Milstars (to be launched between 1999 and 2002) will include medium-data-rate payloads able to transmit larger amounts of data.
Prime Contractor: Lockheed Martin Corporation.
Power Plant: solar arrays generating 7,000 watts.
Dimensions: 52 ft x 116 ft (with full solar array extension).
Weight: 10,000 lb.
Performance: The constellation will consist of four satellites in geosynchronous orbit at 4° inclination. The spacecraft are three-axis stabilized, with design lifetime of 10 years.

Fleet Satellite Communications

A constellation of five satellites used by the Air Force and Navy, as well as the Presidential command network. Each satellite has 23 channels (12 for Air Force, 10 for Navy, one reserved for the national command authorities). Operational since 1978 in geostationary orbit, the FLTSATCOM system carries a secure link among the three, providing UHF (and on the last two satellites EHF) communications.

UHF Follow-On Satellites

New generation of satellites with 39 channels, providing UHF communications to replace FLTSATCOM satellites. Compatible with the terminals used by the earlier systems. UFO-4 was the first in the series to include an EHF communications package, constituting an additional 11 channels, with enhanced antijam telemetry, command, broadcast, and fleet interconnectivity. Ten were ordered, six of which have been launched. ■



Today they would use computers, but in the 1950s, Plexiglas and grease pencils had to suffice, even for the men and women of North American Air Defense Command (as it was known then). NORAD, which then as now was charged with defending the continent's borders, would not change "air" to "aerospace" until 1981.

In the 1960s, Titan II underground missile complexes were enormous compared to the Peacekeeper and Minuteman capsules of today. Once the order was given, launch of the nation's nuclear deterrent would have been in the hands of lieutenants and captains, just as it is today. But back then, noncommissioned officers like these were also part of the launch crews.

The launch of Sputnik in 1957 shocked the US into realizing it was behind in the "space race" with the USSR. Determined to catch up, the US redoubled its efforts in both manned and unmanned spaceflight. After some initial setbacks, the US began to overtake the Russians. One of the early triumphs was the successful spacewalk by USAF Maj. Edward H. White on the Gemini 4 mission in June 1965. Colonel White was later tragically killed with Lt. Cmdr. Roger B. Chaffee and Lt. Col. Virgil I. "Gus" Grissom in the Apollo 1 capsule fire in 1967. ■