CLS™
Commercial Level Simulations

F-117A STEALTH FIGHTER

For FS2004

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Please note that the sections on pages 3 to 6 are details of the real world aircraft, upon which the FS2004 aircraft is modeled. The pictures on pages 3, 4, 5, 6 (top) and 13 are of the FS2004 model. After reading about the real world aircraft, be sure to read the remainder of this document for important information regarding the FS2004 model. The section 'Flight and Operation Details' lists the other documents and further sources of information. I hope you enjoy flying your F-117A.

BACKGROUND

The F-117A Nighthawk Stealth Fighter Attack Aircraft was developed by Lockheed Martin following work on stealth technology carried out in secret from 1975. Development of the F-117A began in 1978 and first flew in 1981. It was not until 1988 that its existence was publicly announced. The Nighthawk is the world's first operational stealth aircraft. The purpose of the aircraft is to penetrate dense threat environments and attack high value targets with high accuracy. F-117's were in operational service during Operation Desert Storm.

DESIGN

The surfaces and edge profiles were designed to reflect hostile radar into narrow beam signals directed away from the enemy radar detector. All doors and opening panels on the aircraft have triangular toothed forward and trailing edges to reflect this radar. The aircraft is mainly constructed of aluminium. Titanium is used for areas of the engine and exhaust systems. The surface of the aircraft is coated with a radar absorbent material (RAM). The radar cross-section (RCS) of the F-117 has been estimated at between 10 and 100 square cm which is two or three orders of magnitude less than the RCS of a conventional fighter aircraft.
The V-shaped tail rudders control the yaw. Each complete surface acts as a flight control surface. The aircraft has four elevons on the inboard and outboard trailing

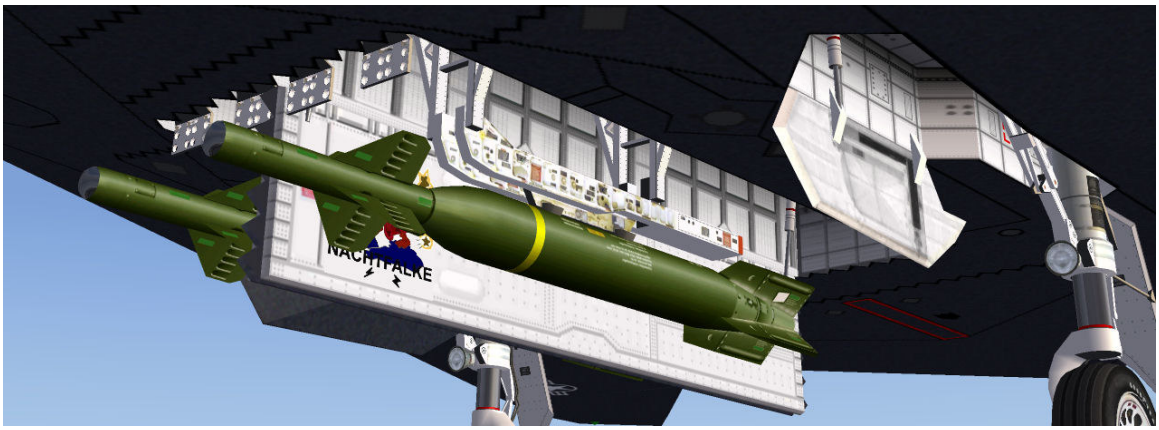
edge of the wings. The elevons do not act as flaps that would reduce the rate of descent for touchdown. Speed brakes are also not fitted. A drag parachute is used to assist in landing speed control. The landing speed is high, being in the region of 180 or 190 miles per hour.

COCKPIT

The cockpit is equipped with an ACES II zero/zero ejection seat manufactured by Boeing. It is also equipped with a head up display (HUD) and the panel is equipped with a video monitor displaying infrared imagery from the aircraft's onboard sensors. The cockpit has a colour moving map. The fly-by-wire system is utilized. The canopy' serrated edge reduce the radar returns from the join between the canopy and the fuselage. The canopy glass is coated in gold to make the panel appear to be a continuous part of the fuselage surface to radar.

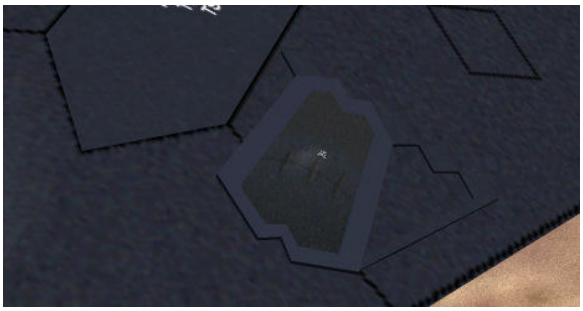
WEAPONS

Model fitted with The Guided Bomb Unit-27 (GBU-27)



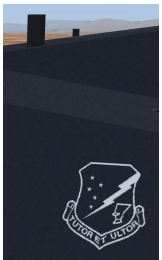
The aircraft can carry a range of tactical fighter ordnance in the weapons bay, including BLU-109B low level laser guided bomb, GBU-10 and GBU-27 laser guided bomb units, Raytheon AGM-65 Maverick and Raytheon AGM-88 HARM air-to-surface missiles.

SENSORS



For stealth purposes, the F-117A does not use radar for navigation or targeting. For this, the aircraft is equipped with a forward looking infrared (FLIR) and a downward looking infrared (DLIR) with laser target designator. The FLIR and DLIR are covered by radar absorbing screen grids. The pilot can see the target on the monitor display. The weapon delivery and impact is recorded on an internally mounted video system which provides real time damage assessment. The aircraft has multi-channel pitot static tubes installed in the nose. Each heated tube is facetted to match the angles of the surfaces of the aircraft to reduce the radar returns. Multiple ports along the length of the tubes provide differential pressure readings. The F-117 is deliberately unstable aerodynamically in order to have a high level of maneuverability. The aircraft's orientation is monitored continuously in flight and the on-board computers execute hundreds of small electro-hydraulic adjustments to keep the aircraft flying smoothly.

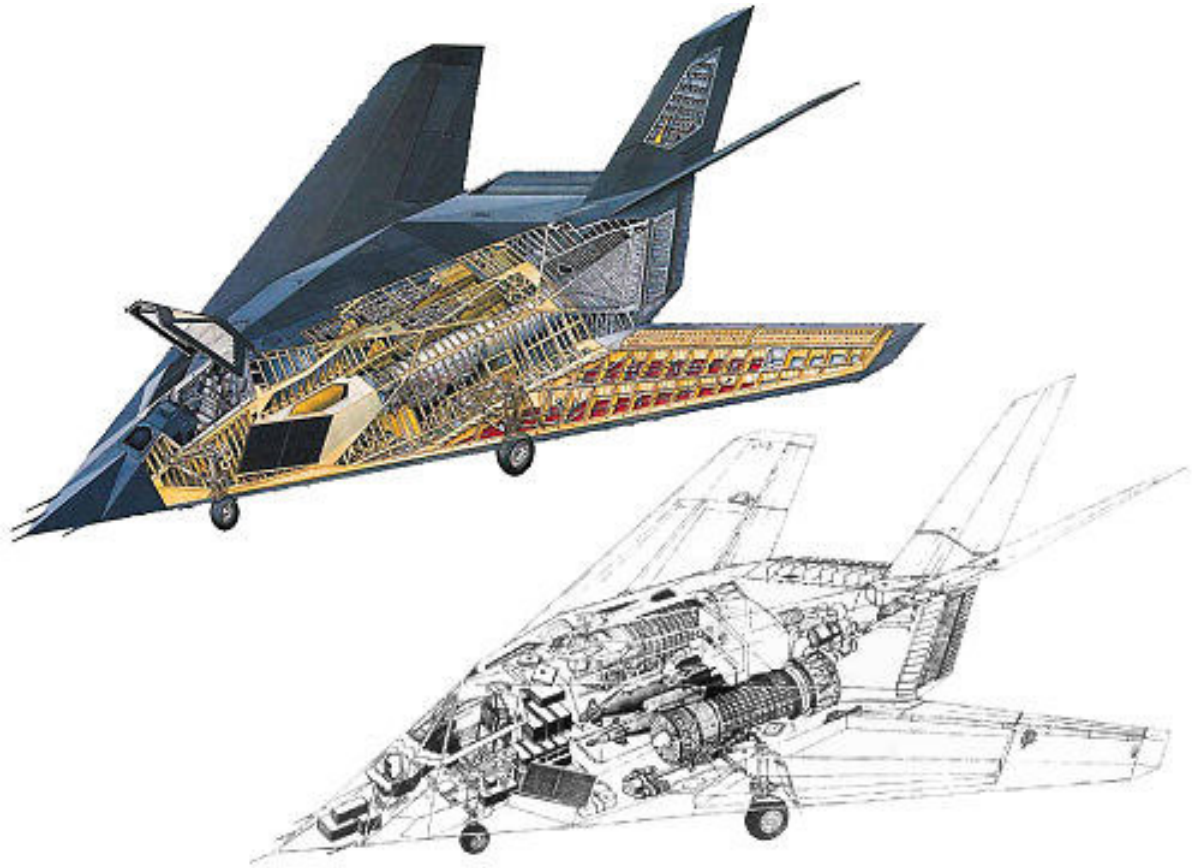
COMMUNICATIONS



The communications antennae are retractable when the radio is not in use. They are fitted on the upper and lower fuselage and behind the cockpit. The aircraft normally flies missions in conditions of radio silence.

ENGINES

The F-117A is powered by two low bypass F404-GE-F1D2 turbofan engines from General Electric. The engines are non-afterburning and do not have thrust reverser capability. The rectangular air intakes on both sides of the fuselage are covered by gratings which are coated with radar absorbent material. The wide and flat structure of the engine exhaust area reduces the infrared and radar detection of the aft section of the engine. The two large tail fins slant outwards to provide an obstruction to the infrared and radar returns from the engine exhaust area.



THE FS2004 MODEL

The above is a general description of the real-world aircraft. Many of the features mentioned are incorporated in this FS2004 model. However, certain features were omitted if FS2004 does not incorporate them, or to provide a more practical model for simulation.

FLIGHT AND OPERATION DETAILS

See the manuals

LOADING THE AIRCRAFT

In the Select Aircraft menu under manufacturer, find ‘Commercial Level Simulations’.

ALWAYS START THE AIRCRAFT IN COCKPIT VIEW

This runs all the gauges for the first time, and sets everything correctly. For example, if starting in spot (outside) view and hitting the 'L' key, this turns on all the lights AND special effects like the rain spray and wing plumes, and surrounds the aircraft with a fog. In fact, switch the lights from the panel.

MODEL VISUAL DETAILS

The liveries were researched and our current at the date of this document.
The aircraft markings are those of the 7th Fighter Squadron, the "Screaming Demons", the 8th FS, the "Black Sheep", the 9th FS, the "Flying Knights" and the 49th OG, all of the 49th Fighter Wing based at Holloman AFB, NM. The 49th OG livery is that of the commandant's aircraft and uses the "Flying Knights" insignia and has all Squadrons insignia on the tail fin. Additionally, there is a texture set for the US Flag Scheme that was painted onto only one aircraft for an air show for military dignitaries and carried this livery for about 3 months.

49th Fighter Wing Insignia

I Protect and Avenge

Screaming Demons

Black Sheep

Flying Knights

These badges appear on the visual model.

GENERAL FS2004 MODEL DETAILS

1) Accurate 3D model.
2) Flight Dynamics based on over 50 hours in the real flight simulator
3) Five texture sets are available showing the latest livery, and includes the famous US flag scheme. Correct pilot arm badges according to unit.
4) All external markings and badges are based on the actual current aircraft and are all readable.
5) The airframe surface has been given a realistic reflective sheen. The finish has a mottled effect to model the RAM (radar-absorbent material) coating.
6) The 'teeth' components around the canopy have been 3D modeled and not textured.
7) The canopy glass has a gold coloured finish to represent the gold film applied to the glass.
8) Authentic 'nose art' painted on the port bomb bay door as seen during Operation Desert Storm. They have since been removed from the real aircraft, but are included in this model as 'the legends live on'.
9) Rotating 3D wheels, full suspension, steering, gear locks and gear door connection rods. Main wheel ventilation holes showing brake texture behind. Gear modeled to real aircraft components producing authentic mechanism with correct animations. In VC view, transparent plastic gear knob with integral light illuminating red during gear transit.
10) Animated flight control surfaces including split differential working elevons and all moving V configuration rudders.
11) Opening canopy (rate varies with lift). As the canopy opens in VC and spot views, the panel/gauge shade flaps fold forward. The hydraulic lifting struts are animated. 'Frame' disappears in 2D view with canopy open
12) The bomb doors open and the armament 'swings' down in a realistic manner. Only the doors open in flight, and fully extend on the ground as the real aircraft. Bomb bay spoilers added with turbulence inducing holes. All doors have hinges and door rams.
13) The radio antennas extend or retract according to the radio operation. 2on top, 2 below and a dipole type behind the cockpit.
14) The black drag chute can be set to open automatically on landing. This occurs when the chute handle is turned through 90° and the nose wheel rotates on ground contact. The chute is technically recognized by FS2004 as flaps and drag is generated to assist with speed reduction. The chute is deployed at around 80 knots and jettisoned at around 30 knots. The chute automatically resets and repacks into its locker. The repacking process has been hidden so the observer will not see an unrealistic reversal of the chute's operation. Chute cords tie down to one attachment cord (as real aircraft), with single cord through rudders to stop fouling of chute cords with rudders
15) The IRADS (the radar spheres in front of the canopy and under the aircraft, forward starboard side) animate to keep on target.

16) The engine blow-in doors on top of the engine fairings open automatically for speeds below 160 knots. These assist for low speed flying and maneuvers (i.e. taxi speeds) because the engine grills are a restriction at these conditions.
17) Refueling port revolves to open and is illuminated. Fuel levels auto set back to 100%. The ice-lights on the engine intake grills also illuminate with the refuel port.
18) Navigation lights hard coded. Flashing beacon light with rotation effect reflections.
19) Gear lights with reflections. Landing and taxi lights with reflective lenses. All three lights illuminate when switched to 'Landing' and front gear only when switched to 'Taxi'
20) The panel was painstakingly researched and is as true a representation as possible.
21) 3D VC panel. Elements including 3D AP assembly (includes Spatial Disorientation button). AP and HUD frame have authentic positioning.
22) All gauges were purpose built for this aircraft using the FS2004 coding, XML.
23) The vast majority of the switches, buttons and controls are functional. In cases where the control functions were unknown or not supported by FS2004, realistic alternatives were employed. Note that little information is available for the F-117 panel. However, all the regular analogue gauges that can be seen on released photographs have normal operation and allow full functionality with FS2004.
24) PFD and MFD completely reworked to the latest gauge specification and colours. PFD contains an additional page displaying a nearest airport table. When scrolled the appropriate frequency table is generated for ease of obtaining radio information, including ILS frequency. This was introduced to provide a simple method of obtaining required frequencies, and simpler to use than the default GPS gauge or default map view. Weapon type is shown on the PFD.
25) The gauges are self illuminated by using the panel light switch only, including the HUD (2 glass pieces with illuminating HUD projector lenses) with transparent background and bright detail illumination (also with night dimming), and do not rely on a general background light. Cockpit lighting is available. In the 2D view, the CRT gauges can be switched between 'bright' and 'green luminous'. All gauges have high quality graphics and can all be zoomed to improve their reading. Lighting colours (including the blue CRT buttons) are to the current aircraft specification.
26) Target panel gauge shows ‘camera’ views in 2D view. In VC view shows FLIR views. All views in this gauge are now green with panel light switch on.
27) Adjustable Head Latency gauge introduced for VC view. Added head turn switching for taxi speeds.
28) Pilot fully animated for joystick, throttles and head. The head appears to move the 'wrong' way. When climbing the head looks down, or turning looks the other way. This is because the pilot is keeping his eye on the target. Correct barrel style throttle controls with drag and lock available in the VC view.
29) Rudder pedal mechanism added behind radio panel and can be viewed through the pedal cut-out areas.
30) Recessed canopy handle on cockpit side. Manual canopy manual handle rotates when engine 1 speed is near or at zero (that is, the engine is off).

31) The ejection seat is fully labeled. These labels are readable, especially in the virtual cockpit view.
32) Engine exhaust shimmer and smoke turn on according to engines speed. Smoke effects can be turned off on the panel.
33) With the engines off and the parking brake on, ground services appear, being Mj-1 bomb truck with illuminating spot light (cabin light switch), pilot goes walkabout, heat seek and fin boxes, pilots steps, chocks and 'remove' tapes that move in the breeze. The elevons sink down and the rudders 'hang' (spread to align with the aircrafts fore/aft axis) due to zero hydraulic pressure and move with reducing engine speed.
34) Wing vortex and wing vapour according to G force.
35) Wheel spray if raining or snowing.
36) Runway tyre marks have been customized for this aircraft.
37) Full Stereo Sound set included.
38) Fly with or without the virtual cockpit to suit computer specification.

NOTE: There are no spoilers or flaps on this or the real world aircraft.
Please read the other included documentation for full details on the aircraft and panel operation. This aircraft can be flown 'simply' or use most of the functions available to FS2004.

MODEL TECHNICAL DETAILS

All gauges were produced using XML. FSUIPC, a popular add-on, is not required. If FSUIPC is installed, it will not interfere with this aircraft's operation.
Frame rates were enhanced by a low polygon count when building the airframe. This can be seen in the size of the mdl file. At under 2 MB, this is typically smaller than competitor's aircraft of similar complexity. This was achieved partially by the design concept of the F-117. The airframe is a collection of flat surfaces. Therefore the model was constructed using a collection of 3, 4 or 5 sided flat polygons. These were put together like a 3D jigsaw puzzle. Therefore, the number of vertices per polygon, and the total number of polygons was very low. However, the VC in the VC version tends to lower frame rates.

LEGALITIES and COPYRIGHT

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