# FlightGear 2020.3

Enhanced by Jimmy "Lx" Biles

Original design by Richard Harrison

80-0060 Block 27 Wind tunnel aerodynamics: ref: AFIT/GAE/ENY/90D-16

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Tweaked by Cromha

# Cromha's F-15C/E

# Flight Manual

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# INTRODUCTION

# F-15C INTRODUCTION

The McDonnell Douglas (now Boeing) F-15 Eagle is an American twin-engine, all-weather tactical fighter designed by McDonnell Douglas to gain and maintain air superiority in aerial combat during the Cold War. Following reviews of proposals, the USAF selected McDonnell Douglas's design in 1967 to meet the service's ned for a dedicated air superiority fighter. The Eagle first flew in July 1972, and entered service in 1976.

The F-15 Eagle boasts an all-service kill ratio of 140:0 (104 kills for 0 deaths). The F-15 downed the majority of Iraqi aircraft during the Gulf War of 1991, and the same in the Balkan conflict of 1999.

The F-15 was originally envisioned as a pure air superiority aircraft. Its design included a secondary ground-attack capability that was largely unused in the C and D variants. For this reason only air to air missiles are currently supported.

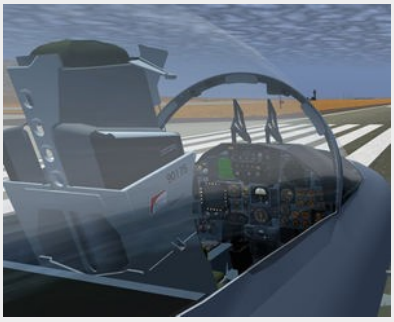
The design proved flexible enough that an all-weather strike derivative, the F-15E Strike Eagle, was later developed, entering service in 1989. The F-15 Eagle is expected to be in service with the U.S. Air Force past 2025. The F-15 production line was initially set to end in 2019, 47 years after the type's first flight.

The currently modeled variants of the F-15 in this FlightGear Addon are the F-15C, the F-15D (two-seater variant) and the F-15E.

# FGADDON'S OVERVIEW

FGAddon

External view



Cockpit view

- **Type**: All-weather tactical interceptor fighter
- **Propulsion**: Twin jet-engine
- **Manufacturer**: McDonnell Douglas, Boeing
- **Author(s)**: Richard Harrison, Enrique Laso, Gene Buckle, Jimmy L. Miles (Cromha)
- **FDM**: JSBSim
- **--aircraft=** f15c f15d f15dbs f15e
- **Status**: Advanced production
  - **FMD**: 5/5
  - **Systems**: 5/5
  - **Cockpit**: 5/5
  - **Model**: 5/5
  - **Supports**: Dual Control, Aerial Refueling, Rebrandt-compatible, Canvas
- **Development**
  - **Repository**: https://github.com/OcelotWalrus/F-15
  - **License**: GPLv2+

## Features

- F-15C, D and E variants
- Realistic FDM based on windtunnel-derived aerodynamic data found in (AFIT/GAE/ENY/90D-16)
- Photorealistic 3D cockpit with real cockpit textures provided by Gene Buckle from his unique F-15C Eagle Flight Simulator Project (the modeled F-15E uses the F-15C's cockpit)
- Operational weapons and radar.
- Full range of sound simulation (buffet, gear, engines, etc.). Cockpit aural warnings including voice.
- Canvas radar and HUD, VSD, TEWS, and MPCD.
- Refuelling and stores.
- In-cockpit engine start (including JFS).
- Modelled hydraulic and electrical systems.
- ALS afterburner flames. These flames are Rembrandt-compatible and adjust to take into account ambient lighting.
- External and internal Rembrandt-compatible lighting.
- Modelled ECS, including pressurisation, windscreen temperature, and frosting.
- Control actuator system.
- Overload Warning System.
- Caution/warning system.

## Simulation Fidelity and Limitations

- The windtunnel data is valid for a clean configuration at Mach 0.6. The aerodynamic model has been adapted to the entire range of the aircraft, Mach 0 to Mach 2.5.
- Forces and moments for flaps, gear, stores, have been added based on parameter estimation and by using data from other reports. These been validated by comparison with plots from various reports and results are within a tolerance that is acceptable for a desktop simulation.
- ECS, HYDS and Electrics systems models are simplified and do not accurately follow the schematics for the aircraft.
- Timings for gear, cockpit opening are based on observation of video evidence.
- The MPCD is restricted to only implement a few pages, notable PACS
- I have not attempted to accurately model in any way the TEWS system, as all details on it are restricted by security classification.
- Missile dynamics and tracking simulation is simplistic (based on the work by xiii, and Shinobi), AIM-9 is most accurate, with AIM-7 and AIM-120 being not quite so realistic
- Flight controls and the CAS system are reasonably well modelled; but again accurate data isn't readily available so this is based largely on a published article and knowledge gained from technical reports.

# Cromha's Enhancements

- Now, let's take a look at what Cromha (Jimmy L. Miles) has added and enhanced in this updated F-15 model:
- Added new liveries:
  - 162nd Fighter Wing [fictional]
  - 162nd Fighter Wing (Black) [fictional]
  - 162nd Fighter Wing (Zebra) [fictional]
  - 75th Anniversary
  - 65Th Flanker
  - JASDF 305th Nyutabaru Air Show
  - 55 23rd Flying Tigers [fictional]
- Added the F-100-PW-229 engines to the F-15E variant, other variants keep the older F-100-PW-220
- Added mach cone, strake and G vortex vapor effects
- Updated the flares' effect
- Added more preview screenshots
- Made the CFTs a parameter instead of it being controlled by the selected livery
- Added the ability to change the smoke generator's color and added a keybind to toggle it outside the ground services dialog
- Fixed the gun smoke's offset (was in the nose of the plane, and not actually where the gatling gun is)
- Modified the "reload gun" button in fuel and storage to make it also reload flares and chaffs
- Made the release flare/chaff keybind toggle release instead of just releasing once
- Display the amount of gun rounds and countermeasures in the fuel and payload dialog
- Added a gun out-of-ammo sound effect
- Replaced the sound effects for the flare, so it's no longer a voice saying "flare", and reused the gun out-of-ammo sound effect for the flare out-of-ammo sound effect
- On the HUD, cross the selected armament if it's out of ammo
- Added the F-15E variant
- Modified the HUD to contain airpseed in kts and G force
- Added an AIM-120D missile available for all variants (higher range and capabilities than the AIM-120, but can't be used in close range fight due to its 10nm minimal range)
- Updated the HUD to display a cannon crosshair
- Allowed the possibility to set custom load for gun, flares and chaffs, using slides
- Implemented simulation of `MINIMAL`, `FLARES` and `CHAFFS` red signal near already-working `CANOPY` signal. `MINIMAL` will set on when either flares of chaffs each own level is lower than 35 (max is 120 each). `FLARES` will set on when flares are getting dumped, as well as `CHAFFS` but for chaffs
- You can now customize the fuel and payload directly in the F-15 fuel and stores menu, instead of having to go to the fuel and payload in equipment tab
- Fixed liveries whose nose deprecated
- Upgraded the fuel and payload panel by renaming it to F-15 Eagle Configuration Panel and merging ground services into it, as well as lighting config
- Renamed the AIM-120 to AIM-120C as it's actually the C variant
- Changed some missiles' weight and other statistics to be more realistic
- Allowed MK-84s to be installed on the conformal body stations (only for the F-15E variant)

# FLIGHT CONTROLS

## ARI

The ARI is a system that automatically applies rudder based on aileron movement (designed to work as an aid as it's what a good pilot should do anyway). The schedule adjusts based on configuration and airspeed. The system is disabled above Mach 0.9 or whenever the landing gear is deployed.

## CAS

The CAS system is a three channel system (Yaw, Pitch, Roll). The YAW channel is basically a yaw damper, the pitch channel is basically a pitch damper and the roll channel is a roll rate limiter. It is not recommended to fly with the YAW CAS channel disabled and is liable to result in serious yaw oscillation at higher mach. If any of these systems are disabled (or inoperative) a warning light will be visible on the caution / warning panel.

## Pitch Ratio & Roll Ratio

The CADC adjusts the amount of surface movement of the elevator, ailerons and differential elevator per inch of stick movement based on the airspeed to improve the controllability at higher speeds. Both of these systems can be turned off at the roll ratio is on the MISC panel on the left console, the pitch ratio switch is on the centre panel next to the landing gauge. There is also a gauge on this panel which indicates the current pitch ratio either .5 in the emergency mode or the value determined by the CADC.

# AURAL WARNINGS

The following audio warnings are given:

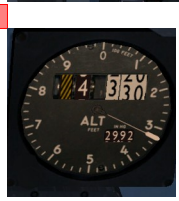
- AOA > 25 (900hz beep beep pause)
- AOA > 30 and gear down (1,600hz beeping)
- 85% to 91% of maximum G loading reached (900hz 4 times per second)
- 92% to 95% of maximum G loading (900hz 10 times per second)
- 96% to 100% of maximum G loading (continuous 900hz tone)
- Gear not down when below 200 kts. (900hz beeping)
- Voice warnings for:
  - Whenever the Master Caution light illuminates (CAUTION)
  - Bingo Fuel
  - More than 100% of maximum G loading (OVER-G)

The OWS calculates the maximum permissible G loading based upon the current configuration.

# COCKPIT INSTRUMENTS

# MAIN CENTER PANEL


## 1 Altimeter



The Altimeter shows the barometric pressure altitude and is displayed in units of 20 feet.

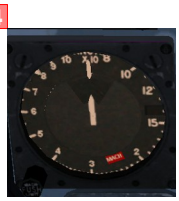
## 2 Acceleration (G)

The Accelerometer shows the current values of positive and negative G loads. The display of maximum +G and –G is not simulated.

## 3 Angle of Attack (AOA)

The AoA indicator is positioned on the instrument panel under the IAS and Mach meter. It is used for indicating the current AOA value within the limits of 0 to 45 units. The AOA indicated values do not correspond to actual degrees. In the area of the landing AOA (20–22 units) there is a corresponding index on the indicator.

## 4 Airspeed Indicator (IAS)



The IAS and Mach meter is positioned to the right of MPCD. It shows the indicated airspeed and the Mach number. The fixed scale of the indicated airspeed is graduated within the limits of 50 to 1,000 kts. The moving scale of the Mach number shows the value of Mach number within the limits of the operating altitudes and speeds. Mach numbers are shown starting from the indicated speed value of 200 kts.

## 5 Fire Supression Panel

There is no simulation of the fire suppression system. The only functional parts of this panel are the burn thru lights that indicate that the temperature of the area surrounding the engines is too high. If these lights light the correct procedure is to reduce augmentation and engine power until the temperature returns to an acceptable range.

## 6 Flaps Panel

The flaps panel contains the hook control for the emergency hook. This is intended for use in wire arrested emergency airfield landings and is not strong enough for carrier landings; however in this model these limits are not simulated so it is possible to land the aircraft on a carrier. There is an indicator for the status of the flaps. The top light will indicate in amber when the flaps are in transit, and the green light below is when the flaps are locked in the open position.

## 7 Landing Gear Panel


The landing gear panel contains a handle that controls the position of the landing gear. Landing gear can be deployed or retracted by clicking on the handle (or by using g/G). When the gear is in transit a red lamp will illuminate the handle. When on the ground the handle will move but the gear will not. There is a landing gear warning horn that will sound when below 200kts and descending; this can be silenced by pushing the silence button.

Next to the landing gear is the pitch ratio panel. The primary flight control effectivity is adjusted following a schedule to produce about the same acceleration (G) per inch of stick movement. The gauge indicates the current ratio, and the emergency pitch ratio switch will lock this at 0.5 in the event of system failure. When the landing gear is down the pitch ratio is locked at 1.0

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## Emerg Jett Panel

The Emerg Jett button will, when fully depressed, result in the jettison of pylons, whether it's armament or fuel tanks.

The Emergency Jettison panel also contains a selector for the Steer Mode which is primarily used to control the flight director bars on the ADI.

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## Red Warnings Panel

This panel contains several warning indicators:

- "Canopy Unlocked": on when the canopy is fully open
- "Program": not simulated
- "Minimum": on when either flare or chaff level is below 36 to indicate the level is low
- "Chaff": on when chaffs are being released
- "Flares": on when flares are being released

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## ARM Modes Panel

This selects the primary arm mode. For normal air-to-air operations, all modes require to be offline. For air-to-ground operations, A/G mode needs to be online. Other modes are not simulated.

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## Lower Center Panel

On the top center, you have the Attitude Direction Indicator, providing a 3D flight trajectory cue to maintain the desired path. The cue takes form of V steering bars. Below the that, you have the Horizontal Situation Indicator, combining a heading indicator with a VHF omnidirectional range-instrument landing system display. With the "heading set" switch you can set the heading and with the "course set" switch you can set the course.
You also find the emergency jett panel on the right and the master arm modes on the left.

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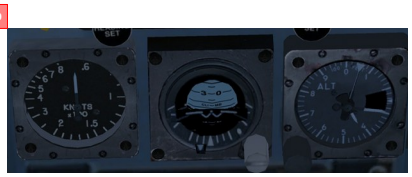

## Standby Instruments

There are standby instruments for the following:

- ADI
- Airspeed
- Altitude

These will operate when no electrical power is available or in the event of Avionics failure. The lighting for these is controlled by the switch "STBY INST" on the lighting panel.

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## Vertical Velocity Indicator (VVI)

The VVI is used for indicating the vertical aircraft speed, i.e. the climb and sink rate in thousands feet per minute. When the indicator arrow moves in a clockwise direction, it indicates that the aircraft is increasing its flight altitude. When the indicator arrow moves in a counter-clockwise direction, it indicates that the aircraft is descending.

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## Cabin Pressure and JFS

Providing that the ECS is receiving sufficient bleed air the cabin pressure will be maintained according to the correct schedule.

To start JFS first use the Engines Master Panel in the right hand console to switch the JFS on and then pull the lever. Providing that there is sufficient hydraulic pressure in the Util system JFS will start. If there is insufficient pressure you must use the Quickstart button from the menu as there is no way to recharge this system without engines or external electrical power.

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## Caution Panel

This panel contains warning lights that indicate problems with the aircraft. The Emergency Vent lever will rapidly depressurize the cabin in case of emergency.

Each different warning will not be listed and explained in this manual.