

F-15 Global Strike Eagle

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Paths to the Present
FLASHBACK

The concept of air launching vehicles from carrier aircraft is a concept that has been around for decades. From launching small missiles, parasite fighter aircraft, or manned, hypersonic vehicles, air-launch is a proven technology. In the mid 1980's, the Air Force tested the capability of air launching a multistage, anti-satellite ASM-135 missile from beneath an F-15 Eagle in a successful attempt to destroy an orbiting satellite.

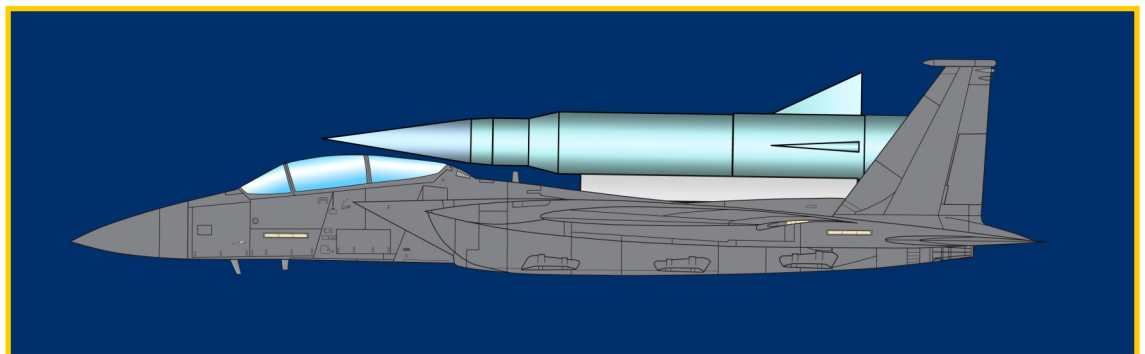


A Ling Temco Vought ASM-135 ASAT missile beneath F-15A Eagle, 76-0086 during a test flight out of Edwards AFB, CA.

In 2006, Boeing proposed a similar concept for missile launch, this time using an unmanned variant of the F-15E Strike Eagle with the launch vehicle mounted dorsally instead of ventrally. Boeing designated this variant as the F-15 Global Strike Eagle (GSE). The

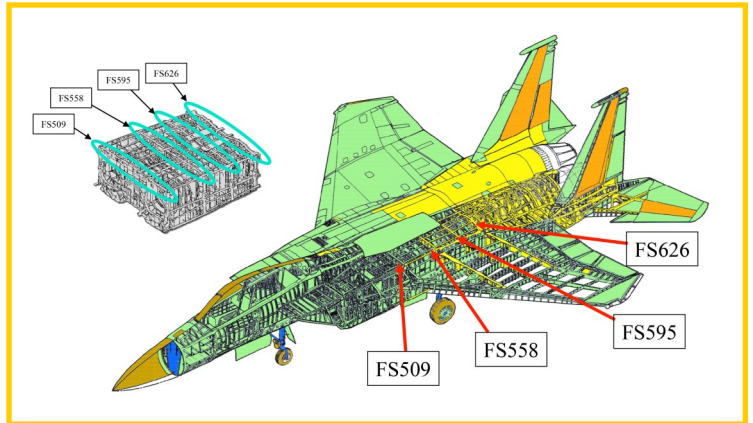
concept proposed the F-15 GSE as a low-cost demonstration of global strike capability utilizing a variety of munitions including the little-known Common Aero Vehicle (CAV). Defined as a maneuverable, hypersonic reentry vehicle that has the capability of dispensing a variety of payloads inside the atmosphere, the CAV concept eventually merged with the Air Force/DARPA Falcon project. Providing a Low Earth Orbit (LEO) launch capability for micro satellites, or micro-sats, was another mission possibility for the F-15 GSE and, with future upgrades, delivering heavier ballistic and orbital payloads.

Initial studies using the more conventional method of a wing-mounted, or center-mounted payload limited the F-15E to approximately 220 pounds (100 kg) while con-



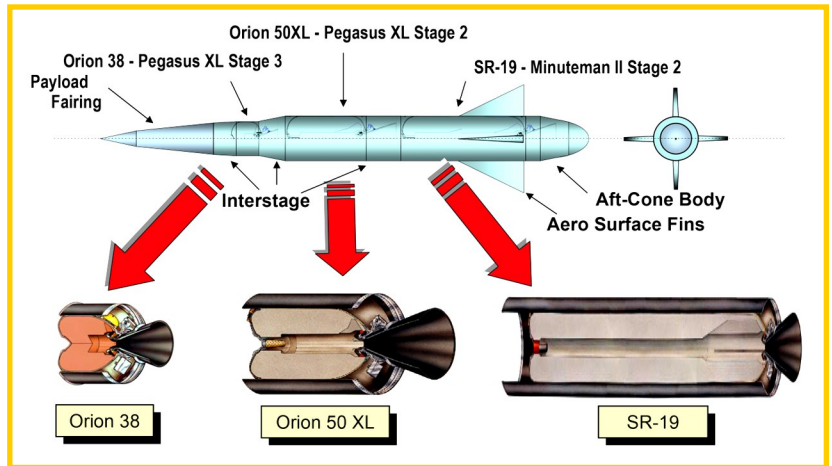
Side view profile showing the revised canopy on the F-15E Global Strike Eagle with one possible launch vehicle payload configuration.

trolling the diameter and length of the Launch Vehicle (LV). Moving the LV to the top of the F-15E allowed for greater flexibility and larger payload capacity. As proposed, the F-15E GSE required only minimal modifications to strengthen the upper fuselage structure for the top-mounted missile pylon, upgraded Pratt & Whitney F100-229 engines and lower aft canopy profile. For safety the Air Force would perform the air-launch mission unmanned, but the aircraft retained a manned capability for ferry missions.



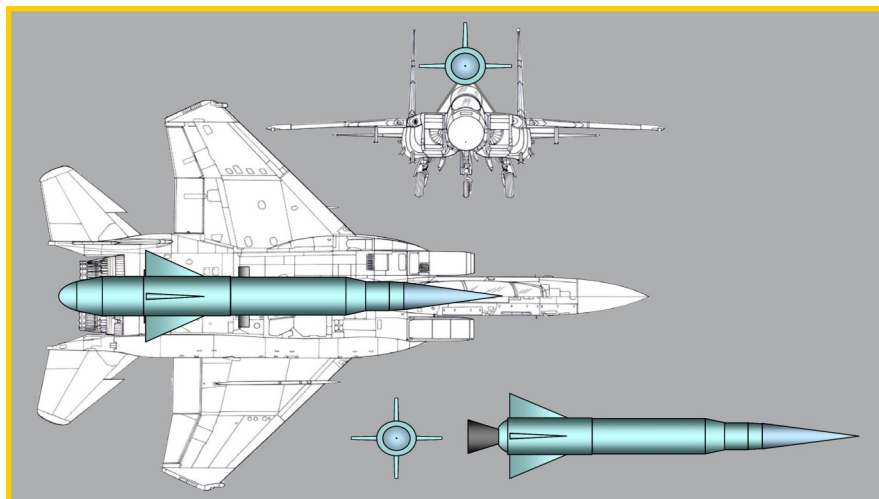
Four primary bulkheads of the fuselage structure provide the 8 mount points required for launch pylon attachment.

The F-15 GSE concept made use of off-the-shelf solid rocket motors (SRM), or government furnished SRM's to reduce cost, time and complexity. Contained between the booster stages were the avionics control and communication packages, electro-mechanical actuation system, batteries, sure-separation system and flight termination system. Aerodynamic control surfaces added boost phase control and an aft cone fairing added to reduce drag during the F-15 boost phase which ejected shortly after LV separation.



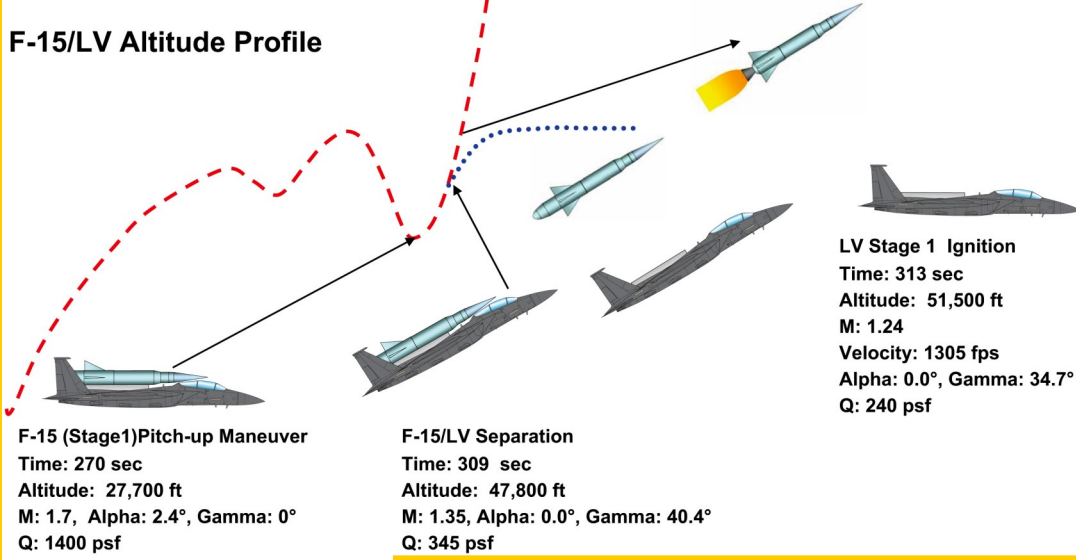
The major components of the F-15 Global Strike Eagle launch vehicle are shown in great detail.

The proposed launch vehicle consisted of off-the-shelf components such as the SR-19, Minutemen II second stage used as the first stage of the launch vehicle. The LV second stage would have used the Orion 50XL, while the third stage used the Orion 38, both from the Pegasus XL launch system. The large LV system would have impaired pilot ejection capability and therefore required an unmanned mission. Existing flight control software from the latest Unmanned Air Vehicle (UAV) systems would be used to allow unmanned operations.



Benefits of the F-15 GSE system stated an operationally responsive space and

F-15/LV Altitude Profile



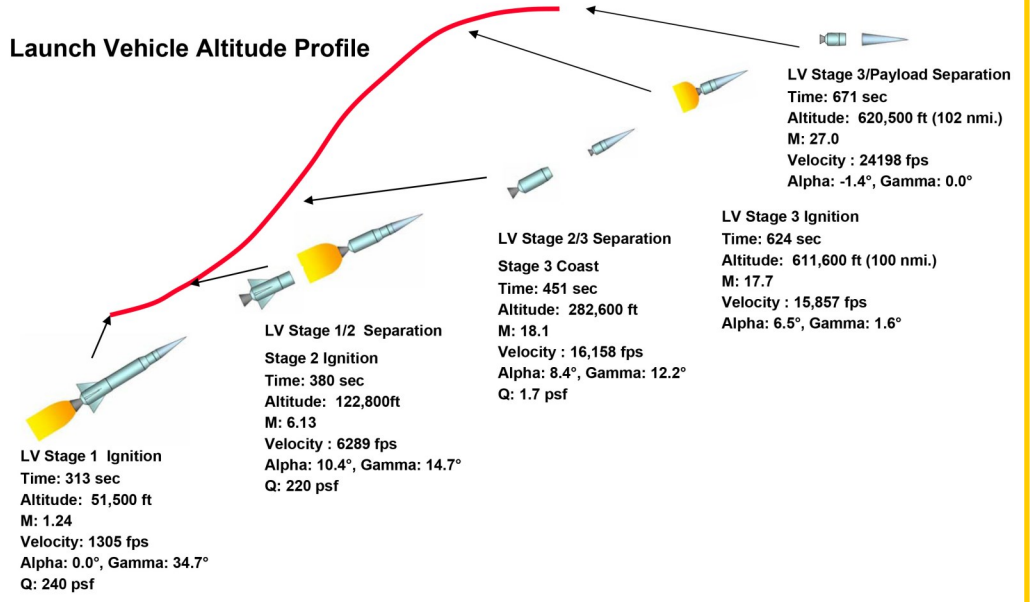
The F-15E GSE begins its launch profile pitch-up maneuver at a speed of Mach 1.7 at 27,000 feet and levels out after launch flying at Mach 1.24 and 51,500 feet.

F-15 (Stage1) Pitch-up Maneuver
 Time: 270 sec
 Altitude: 27,700 ft
 M: 1.7, Alpha: 2.4°, Gamma: 0°
 Q: 1400 psf

F-15/LV Separation
 Time: 309 sec
 Altitude: 47,800 ft
 M: 1.35, Alpha: 0.0°, Gamma: 40.4°
 Q: 345 psf

LV Stage 1 Ignition
 Time: 313 sec
 Altitude: 51,500 ft
 M: 1.24
 Velocity: 1305 fps
 Alpha: 0.0°, Gamma: 34.7°
 Q: 240 psf

Launch Vehicle Altitude Profile



Launch vehicle profile graphic showing stage 1 ignition just 5 minutes into the flight at Mach 1.24 at 51,500 feet altitude and payload separation approximately 6 minutes later near Mach 27 at 620,500 feet.

LV Stage 1 Ignition
 Time: 313 sec
 Altitude: 51,500 ft
 M: 1.24
 Velocity: 1305 fps
 Alpha: 0.0°, Gamma: 34.7°
 Q: 240 psf

LV Stage 1/2 Separation
 Stage 2 Ignition
 Time: 380 sec
 Altitude: 122,800ft
 M: 6.13
 Velocity : 6289 fps
 Alpha: 10.4°, Gamma: 14.7°
 Q: 220 psf

LV Stage 2/3 Separation
 Stage 3 Coast
 Time: 451 sec
 Altitude: 282,600 ft
 M: 18.1
 Velocity : 16,158 fps
 Alpha: 8.4°, Gamma: 12.2°
 Q: 1.7 psf

LV Stage 3 Ignition
 Time: 624 sec
 Altitude: 611,600 ft (100 nmi.)
 M: 17.7
 Velocity : 15,857 fps
 Alpha: 6.5°, Gamma: 1.6°

LV Stage 3/Payload Separation
 Time: 671 sec
 Altitude: 620,500 ft (102 nmi.)
 M: 27.0
 Velocity : 24198 fps
 Alpha: -1.4°, Gamma: 0.0°

munitions launch capability, low profile mission (looks like other F-15's), low system development cost, mission flexibility by use of forward basing options and recall capability, and fully upgradable system capabilities.

In the end, the Air Force chose not to pursue this unique air-launched concept, instead the service continues to rely on the use of the venerable Boeing B-52 Stratofortress and B-1B Lancer for near-term hypersonic vehicle air-launch capabilities.

For further reading, see: Chen, Timothy T., Ferguson, Preston W., Deamer, David A., and Hensley, John; "Responsive Air Launch Using F-15 Global Strike Eagle"; AIAA-RS4 2006-2001.



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