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From A to F: The F/A-18 Hornet

F/A-18 Breaking the Sound Barrier. Source: www.boeing.com

By: Kevin Waclawicz

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F/A-18 Hornet Development

Some History

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On January 6, 1972, the USAF issued a request for proposals for a lightweight fighter (LWF). Doubts were beginning to surface as to whether the expensive but capable Grumman F-14 Tomcat and the McDonnell Douglas F-15 Eagle were the right way to go. The USAF felt it was time for a light cheap multirole fighter. After receiving proposals from Boeing, Ling-Temco-Vought, General Dynamics and Northrop, the field narrowed it down to two companies to build prototypes.

- General Dynamics – YF-16
- Northrop – YF-17

Navy Picks the Loser

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Just three years later, on January, 13 1975, the decision was made after a fly off. The USAF decided that the new air combat fighter would be developed from the General Dynamics YF-16. Five months later, the Navy made the decision to chose the loser of the LWF flyoff, the Northrop YF-17, as their new multirole fighter. Congress subsequently criticized the Navy's choice and the aircraft's ability. The Navy, however had their reasons for their choice.

- Twin engine (carrier recovery performance)
- More multi-mission potential (capable of carrying the Sparrow)

The YF-17

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Cutouts in LEX:

Designed to draw off the Stagnant Fuselage Boundary Layer air before it could be ingested by the engines, and expel it into the low pressure area above the wing roots.

F/A-18 Hornet Development

The Great Book of Modern Warplanes, Bill Sweetman, Micahael J. Gething, Doug Richardson, Mike Spick & Bill

The YF-17 versus F/A-18 A/B

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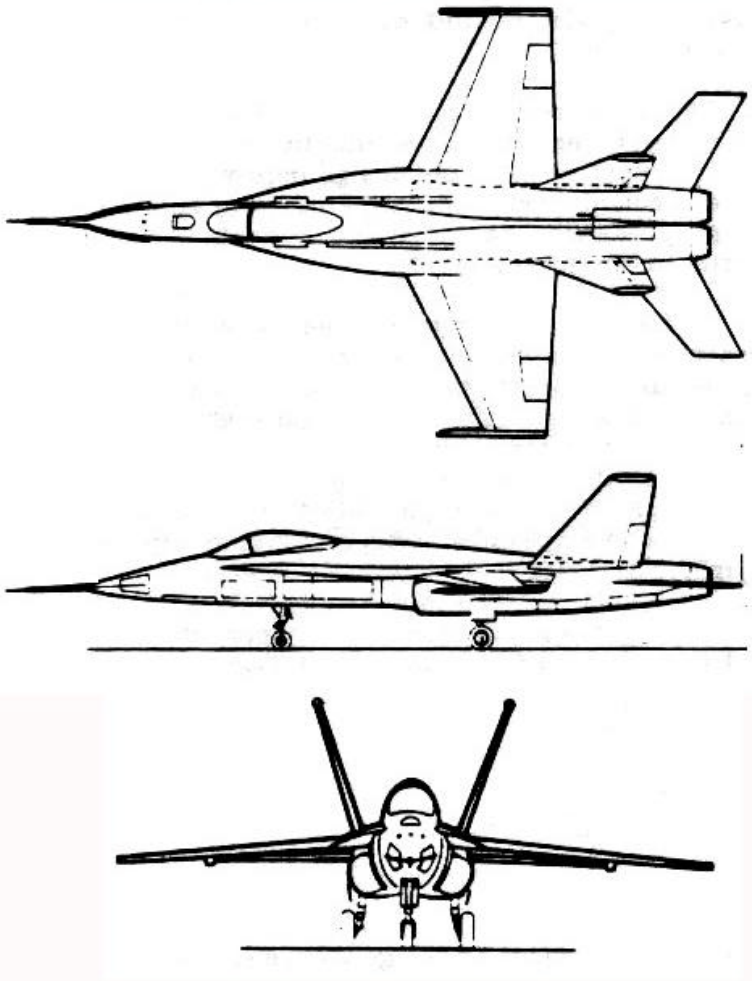
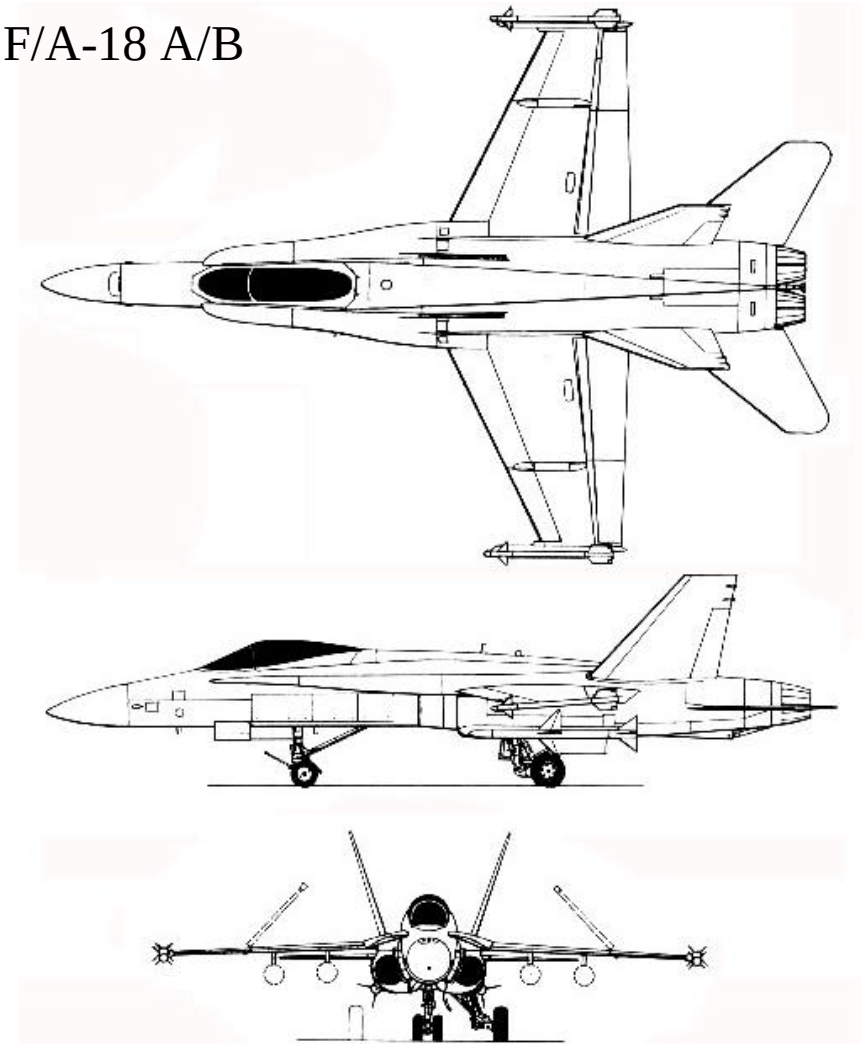
YF-17



AIAA-74-941, "Development and Flight Test Progress of the YF-17", Joe B. Jordan

F/A-18 A/B



F/A-18 Hornet Development

Jane's All the World's Aircraft 1982/83, Jane's Publishing Company

F/A-18 C/D versus the E/F

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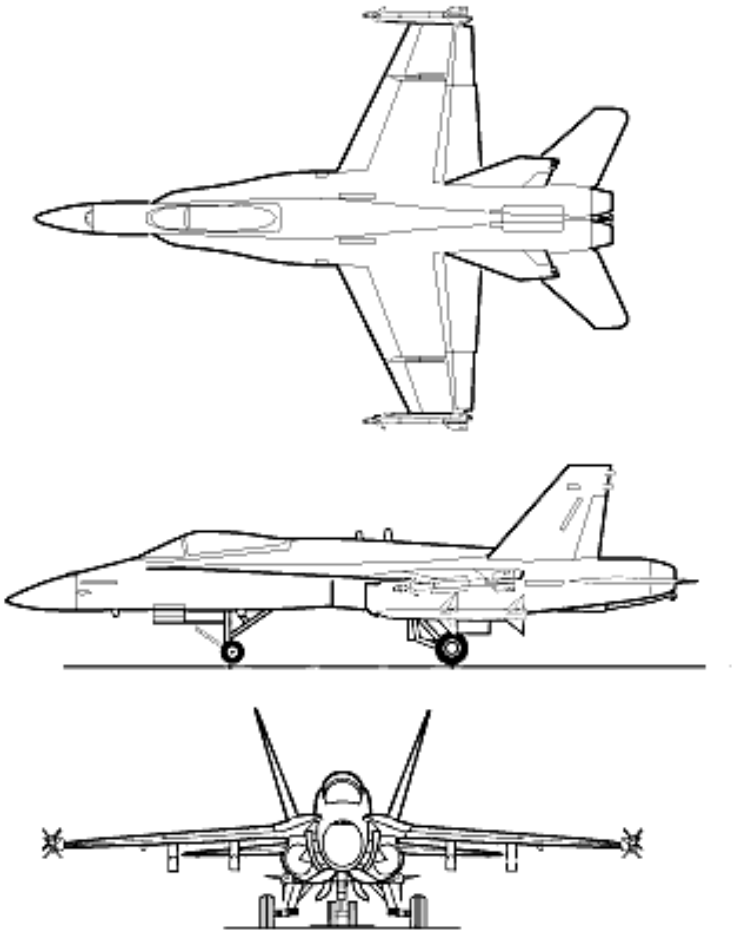
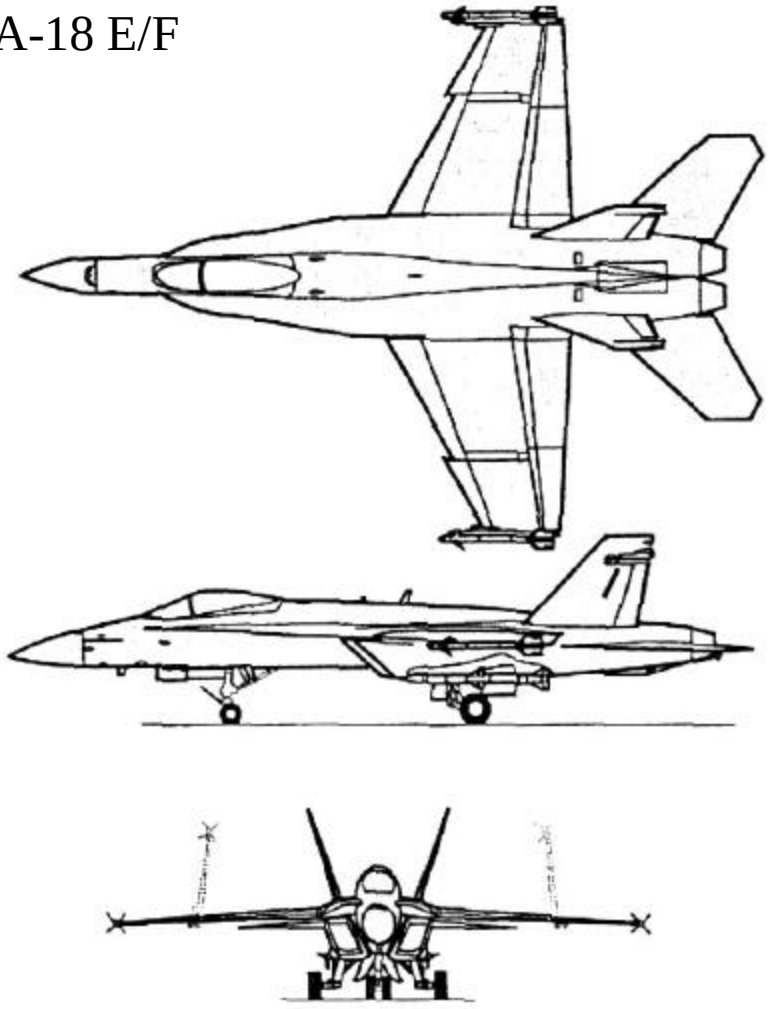
F/A-18 C/D



F/A-18 E/F



http://www.boeing.com

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"F/A-18E/F Design Approach Addressing Development Risk", *Aviation Week*, Stanley W. Kandebo

Evolution from the YF-17 to the F/A-18

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	YF-17	F/A-18 A/B	F/A-18 C/D	F/A-18 E/F
AR	3.5	3.52	4	4
S (ft^2)	350	400	400	500
b (ft)	35	37.5	40.42	44.7
l (ft)	55.5	56	56	60.1
h (ft)	14.5	15.29	15.33	15.8
Λ (deg)	27.5*	27.7*	26.7	29.4
λ	0.42*	0.5*	0.45*	0.45*
t/c (%chord) root/tip	5/3.5	5/3.5	5/3.5	6.2/4.3
T/W (@T-O)	0.6522	0.6632	0.6821	0.6667
W/S (lb/ft^2)	63.36	93.63~	96	99
TOGW (fighter)	23000	33585	36123	45900
(attack)	23000	48253	51900	65918
Ferry Range (miles)	2990	2303	2350	2937
Max Speed (Mach)	1.95	1.7	1.7	1.7
High Lift		L.E. Flap	L.E. Flap	L.E. Flap
	L.E. Nose Droop	Single Slotted	Single Slotted	Single Slotted
	T.E. Flap	T.E. Flap	T.E. Flap	T.E. Flap

•Indicates geometry found manually
~ Calculated assuming 40% of fuel has been consumed

All other data obtained from cited references

F/A-18 Hornet Development

The F/A-18 E/F Super Hornet

First Flight: November 29,1995

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Primary Changes

- Increased wing area by 25%
- A snag on the Leading Edge
- Enlarged LEX by 34%
- Increased wing t/c
- Enlarged inlets
- 34 inch center fuselage plug
- 15% larger vertical tail
- 36% larger horizontal tail
- Sweep increase of 3 deg
- No twist!

http://www.boeing.com

Interesting Aero Tidbits on the E/F

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Added Controls:

- LEX spoilers – multifunction surfaces located on the upper surface on each LEX which acts primarily as a speedbrake
- LEX vents – located at the junction of the LEX and the leading-edge flaps that open automatically at high AOA to allow energy air to flow over the wing-fuselage blend. These vents control the LEX vortices and takes the place of LEX fences.

  (fin-root cracking fix)

Control Problems:

- Wing drop: periodic lateral-directional motions that are dominated by oscillatory rolling motions. ie. Loss of aero damping in roll when the wing stalls.

  → Fixed by rescheduling of the leading- and trailing-edge flaps along with a porous hinge cap. The porous hinge cap reduces the growth of the pressure gradient on the wing.*

*The higher pressure behind the shock towards the T.E. creates a downward pressure into the chamber, with an increase in upward pressure toward the wing's forward edge. This increase in pressure in a low pressure area thickens the B.L and works as a mechanical fence.

Fighter Comparison

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	F-14 Tomcat	F-15 Eagle	F-16 Falcon	F/A-18 E/F Super Hornet
AR	7.28	3.01	3.59	4
S (ft^2)	565	608	300	500
b (ft)	64.12/38.21/33.29	42.81	32.83	44.7
l (ft)	62.67	63.75	49.49	60.1
h (ft)	16	18.46	16.71	15.8
Λ (deg)	20/68/75	39	40	29.4
λ	-	0.36	0.48	0.45*
t/c (%chord) root/tip	5 to 9	5.9/3	4	6.2/4.3
T/W (@T-O)	0.7	1.07	1.05	0.6667
W/S (lb/ft^2)	92.45~	64.55~	70.07~	99
TOGW (fighter)	59714	44630	23810	45900
(attack)	-	-	-	65918
Ferry Range (miles)	2000	2878	2415	2937
Max Speed (Mach)	2.34	2.5	2+	1.7
High Lift	L.E. Slats T.E. Flaps	L.E. Flaps T.E. Flaps Conical Camber	L.E. Flaps Flaperons	L.E. Flap Single Slotted T.E. Flap

•Indicates geometry found manually
~ Calculated assuming 40% of fuel has been consumed

All other data obtained from cited references

F/A-18 Hornet Development

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