CHAPTER 4

Operating Limitations

4.1 AIRCRAFT

4.1.1 Engine Limitations

4.1.1.1 RPM

Compressor (N_2)

1. The maximum rpm is 102% .

2. Ground idle is:

F404-GE-400	F404-GE-402
61 to 72%	63 to 70%

3. Flight idle is 68 to 73% .

4. Maximum fluctuation at stabilized power is ±1% .

Fan (N_1)

5. The maximum rpm is:

F404-GE-400	F404-GE-402
106%	108%

6. Maximum fluctuation at stabilized power is ±0.5% .

4.1.1.2 EGT

1. Maximum steady-state is:

	F404-GE-400	F404-GE-402
MIL	830° C	880° C
MAX	830° C	920° C

2. Maximum transient is:

	F404-GE-400	F404-GE-402
Start	815° C	815° C
MIL	852° C	902° C
MAX	852° C	942° C

3. Maximum fluctuation at stabilized power is ±8° C.

4.1.1.3 Nozzles

Maximum fluctuation is ±3% .

4.1.1.4 Oil Pressure

NOTE

For fuel temperatures in excess of 38° C, the lower oil pressure limit can decrease as much as 10 psi.

Ground

1. For ambient temperatures above -18° C (0° F), oil pressure must peak below 180 psi and start to decrease within 30 seconds after reaching idle rpm and continue to decrease to steady state limits.

2. For ambient temperatures below -18° C (0° F), maximum oil pressure 2½ minutes after start is 180 psi.

3. Steady state ground idle oil pressure (warm oil) limit is 45 to 110 psi.

Inflight

During steady state flight, oil pressure limits are as follows:

IDLE	55 to 110 psi
MIL	95 to 180 psi

4.1.2 Airspeed Limitations. The approximate maximum permissible airspeeds in smooth or moderately turbulent air with the arresting hook and landing gear retracted, flaps in AUTO, and any combination of air-to-air missiles are shown in figure 4-1. For exact airspeed limitations, refer to the Tactical Manual, A1-F18AC-TAC-020 (NWP 55-5-F/A18 Vol IV). Refer to Systems Limitations, figure 4-2, for additional airspeed limitations.

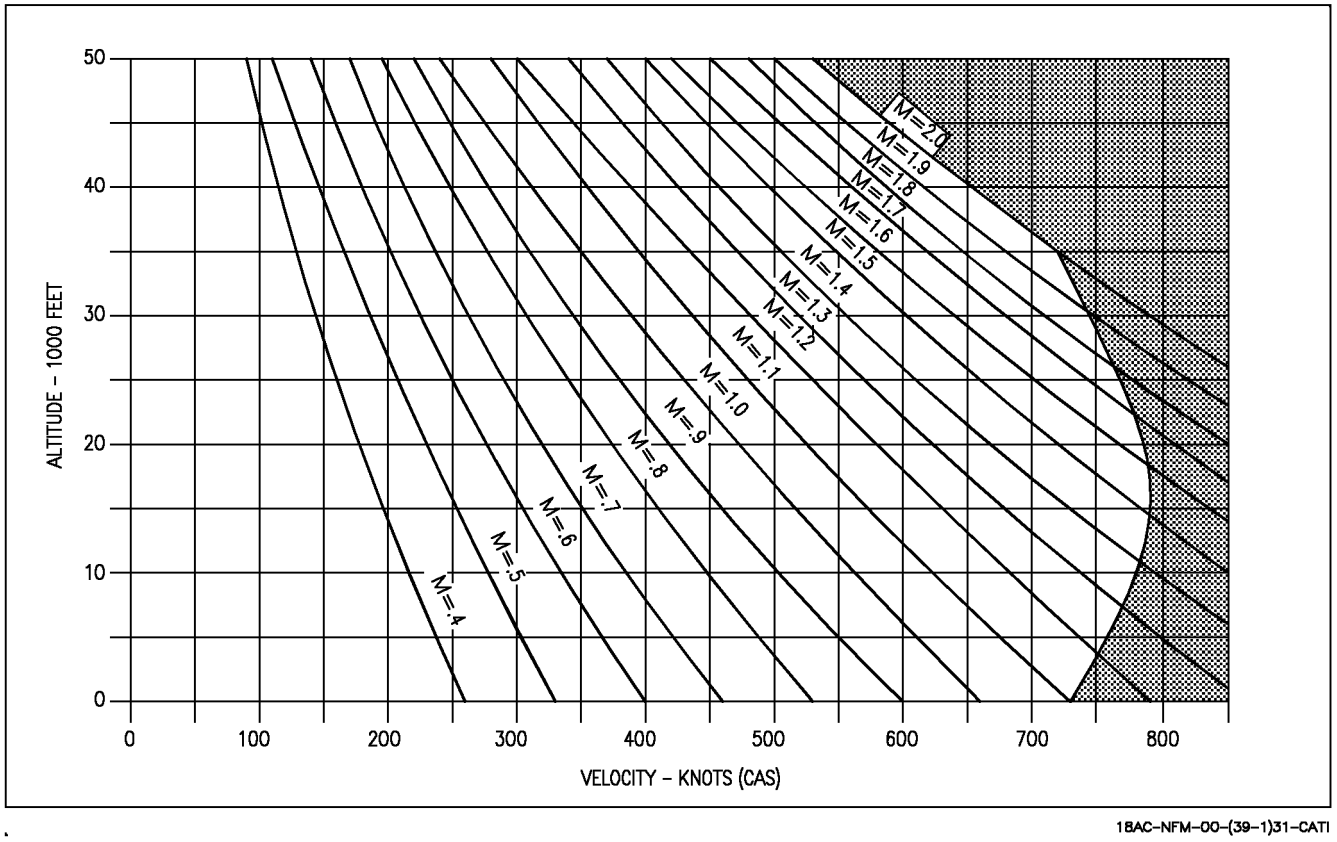


Figure 4-1. Airspeed Limitations

REFUELING PROBE	Extension-Retraction	300 Knots
	Extended	400 Knots
LANDING GEAR	Extension-Retraction	250 Knots
TIRES	Nose Gear	190 Knots groundspeed
	Main gear	210 Knots groundspeed
TRAILING EDGE FLAPS	HALF-FULL	250 Knots
CANOPY	Open	60 Knots

Figure 4-2. System Limitations

4.1.3 Prohibited Maneuvers

4.1.3.1 General

1. Takeoff with any CAS axis failed.
2. Zero airspeed tailslide.
3. Intentional departures/spins.
4. Flight in lightning or thunderstorms.
5. Yaw rates over 25°/second (yaw tone).
6. Full or partial stick aileron roll over 360° bank angle change.
7. Dive over 45° with less than 1,900 pounds fuel.
8. Zero g except transient.
9. Negative g for more than 5 seconds for aircraft 161353 THRU 161924 BEFORE AFC 053 (10 seconds for other aircraft.)
10. Negative g
    a. Roll maneuvers over 180° bank angle change.
    b. Over 1/2 lateral stick above 635 KCAS below 20,000 feet MSL.
11. For aircraft 161353 THRU 161924 BEFORE AFC 018 and 053, less than 1 minute between negative g maneuvers (10 seconds for all other aircraft).
12. For aircraft 161353 THRU 161924, afterburner operation at less than +0.1 g.
13. Pulling any FCS circuit breaker in flight except as directed in NATOPS.
14. Selection of gain ORIDE above 350 knots/ Mach 1.0 or above 10° AOA.
15. Inflight selection of RCVY on the spin recovery switch except for actual spin recovery or as directed in NATOPS.
16. Flight without LAU-7A wing tip launcher rails (with power supply and nitrogen bottle installed).
17. Takeoff or flared landing with 90° crosswind component over 30 knots. Normal or section landing with 90° crosswind component over 15 knots.
18. Section takeoff with any of the following conditions:
    a. Crosswind over 15 knots.
    b. Asymmetric load over 9,000 foot-pounds not including missiles or pods on stations 1 or 9.
    c. Dissimilar loading except VERS, MERS, TERS, pylons, FLIR, LDT, fuselage AIM-7s/ AIM-120s or wing tip mounted stores.
19. Landing with autopilot engaged except for Mode 1 ACL.
20. Use of RALT mode below 500 feet AGL.
21. Negative 1g above 700 KIAS and below 10,000 feet MSL.
22. Supersonic Flight
    a. At or above 1.4 Mach
        (1) Roll maneuvers exceeding
            (a) 2 g load factor, or
            (b) 1/2 lateral stick, or
            (c) 180° bank angle
        (2) Throttles during Dive Pull
            (a) not over MIL
    b. Single seat
        (1) Above 1.8 Mach with a centerline tank and no external wing tanks
        (2) Above 1.6 Mach/635 KCAS with an external wing tank

c. Two seat

(1) Above 1.8 Mach without external tanks

(2) Above 1.6 Mach with a centerline tank and no external tanks

(3) Above 1.6 Mach/635 KCAS with an external wing tank

4.1.3.2 Flaps Half or Full

1. Bank angle -

a. FE configuration - over 90°

b. FE configuration with centerline tank/ stores - over 60°

c. All other configurations - over 45°

2. Cross control inputs above 150 knots with flaps FULL.

4.1.4 CG Limitations

1. The forward CG limit is 17% MAC.

NOTE

Maximum thrust field takeoffs are permissible at CG location forward to 16% subject to air density restrictions.

2. Aft CG limit -

a. FE configuration: 28% MAC

b. All other configurations: 27-28% MAC (Refer to AOA limitations)

4.1.5 Lateral Weight Asymmetry Limitations

1. For field takeoff, the maximum asymmetric load is 22,000 ft-lbs.

2. For catapult launches, with a weight board of 36,000 lbs and below, the maximum asymmetric load is 6,000 ft-lbs. For catapult launches, with a weight board of 37,000 lbs and above, the maximum asymmetric load is 22,000 ft-lbs. Pilots are responsible for ensuring that asymmetry is within allowable limits for their aircraft gross weight.

3. For inflight conditions, the maximum authorized asymmetric load is 26,000 ft-lbs.

NOTE

The maximum authorized lateral weight asymmetry is 26,000 foot-pounds. Asymmetric jettison/normal release of a store from station 2 or 8 that weighs in excess of 2330 pounds (i.e., GBU-24, MK-60, MK-65, Walleye II ER/DL) exceeds the lateral weight asymmetry limitation and is prohibited (even if this is the normal SMS release sequence, except in an emergency).

4. For FCLP or carrier landings, the maximum asymmetric load (including wingtip AIM-9 and wing fuel) is 17,000 ft-lbs for gross weights of 33,000 lbs or less.

For carrier landings, the maximum asymmetric load (including wingtip AIM-9 and wing fuel) is 14,500 ft-lbs for gross weights greater than 33,000 lbs.

5. For field landing (flared), with sink rate at touchdown up to 500 fpm, the maximum asymmetric load is 26,000 ft-lbs.

NOTE

For landing only: Due to the landing gear structural limitations, internal wing fuel and tip missile lateral asymmetry must be used to calculate total lateral weight asymmetry.

4.1.6 Angle-of-Attack (AOA) Limitations

4.1.6.1 Flaps Auto. With the flaps AUTO, AOA limits depend upon aircraft store configuration, CG, lateral asymmetry and, for F/A-18B/D aircraft, Mach number. A lateral asymmetry of 0 to 6,000 foot-pounds (excluding

weight of asymmetric tip missile and/or asymmetric internal wing fuel) is considered a symmetric configuration. In any case where more than one symmetric or asymmetric limit may be considered applicable, or if any AOA limit is conflicting, the most restrictive limit shall be used.

For all aircraft not otherwise restricted, the following tables are the symmetric AOA limits for aircraft in the Fighter Escort (FE) configuration (F/A-18 with/without: missiles on store stations 1 and/or 9, missiles on store 4 and/or 6,

NATOPS FLIGHT MANUAL

NAVY MODEL

F/A-18A/B/C/D 161353 AND UP AIRCRAFT

and FLIR, LDT, or for empty suspension equipment such as pylons and racks on stations 2, 3, 5, 7 and 8, or in the FE configuration with combinations of centerline, inboard, and/or outboard stores.

CONFIGURATION	AOA LIMIT (°)	CG (% MAC)
FE	Unrestricted -6° to +25°	17 to 25% 25 to 28%
FE plus centerline tanks/ stores	Unrestricted -6° to +25°	17 to 23.5% 23.5 to 28%
FE plus inboard tanks/ stores (with centerline tank/stores)	-6° to +25°	17 to 27.5%
FE plus inboard tanks/ stores (without centerline tank/stores)	-6° to +35° -6° to +25°	17 to 24% 24 to 27.5%
FE plus outboard tanks/ stores (centerline tank/ stores optional)	-6° to +25°	17 to 27.5%
FE plus inboard and outboard tanks/stores (centerline tank/stores optional)	-6° to +20°	17 to 27%

4.1.6.1.1 Lateral Weight Asymmetry AOA Limitations. For all aircraft, the weight of an asymmetric tip missile and/or internal wing fuel asymmetry should not be used in calculating total weight asymmetry except for landing. Due to the landing gear structural limitations, internal wing fuel and/ or tip missile lateral asymmetry must be used to calculate total weight asymmetry. For the F/A-18B/D, some AOA limits due to Mach number may take precedence over lateral weight asymmetry limits.

NOTE

The maximum authorized lateral weight asymmetry is 26,000 foot-pounds. Asymmetric jettison of any store weighing in excess of approximately 2,330 pounds exceeds the 26,000 foot-pound asymmetry limit and is prohibited, except in an emergency, even if this is in the normal SMS release sequence.

1. With a lateral weight asymmetry between 6,000 and 12,000 foot-pounds, the AOA limits are –6° to +20°.

2. With a lateral weight asymmetry between 12,000 and 26,000 foot-pounds, the AOA limits are –6° to +12°.

3. For lateral weight asymmetries between 22,000 and 26,000 ft-lbs:

a. Abrupt lateral stick inputs are prohibited.

b. Smooth inputs up to 1/2 stick for rolling maneuvers up to a maximum of 180° bank angle change are authorized.

c. Rudder pedal inputs are authorized only as required to maintain balanced flight (Slip indicator ball centered).

4.1.6.1.2 AOA Limits Due to Mach Number (F/A-18B/D). The F/A-18B/D aircraft have increased departure susceptibility at high subsonic Mach numbers and require additional AOA limitations as a function of Mach. Lateral weight asymmetry AOA limits may take precedence over some Mach/AOA limits.

MACH NUMBER	AOA LIMIT
0.7 to 0.8 Mach	—6° to +20°
0.8 to 0.9 Mach	—6° to +15°
above 0.9 Mach	—6° to +12°

4.1.6.2 Flaps Half or Full. The AOA limit is 0° to +15°.

WARNING

During single engine operations at MIL or MAX, loss of lateral and directional control may occur above the following AOAs:
Flaps FULL - 10° AOA
Flaps HALF - 12° AOA

4.1.7 Weight Limitations. The maximum allowable gross weights are:

Location	Pounds
Field	
Takeoff	51,900
Landing (Flared)	39,000
FCLP/Touch-and-go/Baricade	
Before AFC 029	30,700
After AFC 029	33,000
Carrier	
Catapult	51,900
Landing	
Unrestricted	33,000
Restricted	34,000

Arrestments above 33,000 pounds are subject to the following restrictions:

(1) Arresting gear - MK 7 MOD 3 Only
(2) Glideslope - 3.5° Maximum
(3) Recovery Head Wind (RHW) -
(a) 40 knots Minimum - Half flaps allowed
(b) Less than 40 knots - Full flaps only
(4) Lateral Weight Asymmetry -
14,500 ft-lb Maximum (External pylon stores, AIM-9 Wing tips, and wing fuel)
(5) No MOVLAS recovery

NOTE

The combination of arresting gear, glide slope, RHW, and the asymmetry limits listed above ensure landing stresses remain within tested landing gear strength safety margins.

4.1.8 Acceleration Limitations

1. The permissible accelerations during landing gear extension or retraction and/or with the flaps HALF or FULL are +0.5 g to +2.0 g symmetrical, +0.5 g to +1.5 g unsymmetrical.

2. The maximum permissible accelerations in smooth air with the flaps AUTO are shown in figure 4-3. Avoid buffet at limit g when possible. In moderate turbulence, reduce deliberate accelerations 2.0 g below that shown in figure 4-3. Additional acceleration limits when carrying external stores are shown in the External Stores Limitation chart, figure 4-4, and in the Tactical Manual, A1-F18AC-TAC-020 (NWP 55-5-F/A18 Vol IV).

4.2 EXTERNAL STORES

4.2.1 Limitations. Only the external stores shown in the External Stores Limitations chart, figure 4-4, and the External Stores Limitations chart in the Tactical Manual, A1-F18AC-TAC-020 (NWP 55-5-F/A18 Vol. IV) may be carried and released.

4.2.2 Banner Towing Limitations

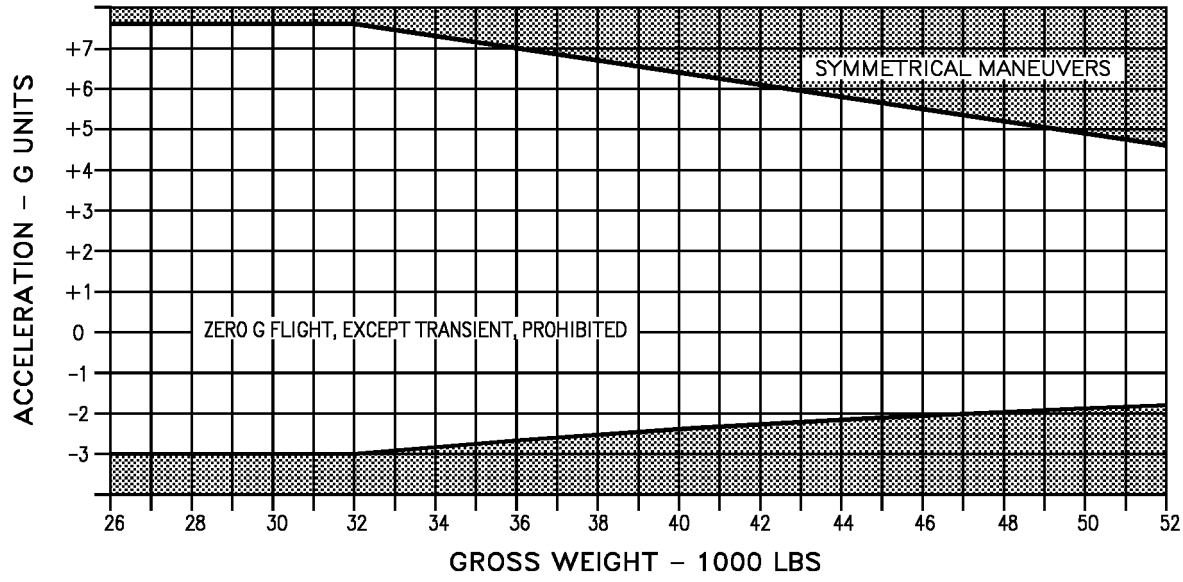
Airspeed	220 Knots maximum
Maximum bank angle	40°
Use of speed brake	No restrictions

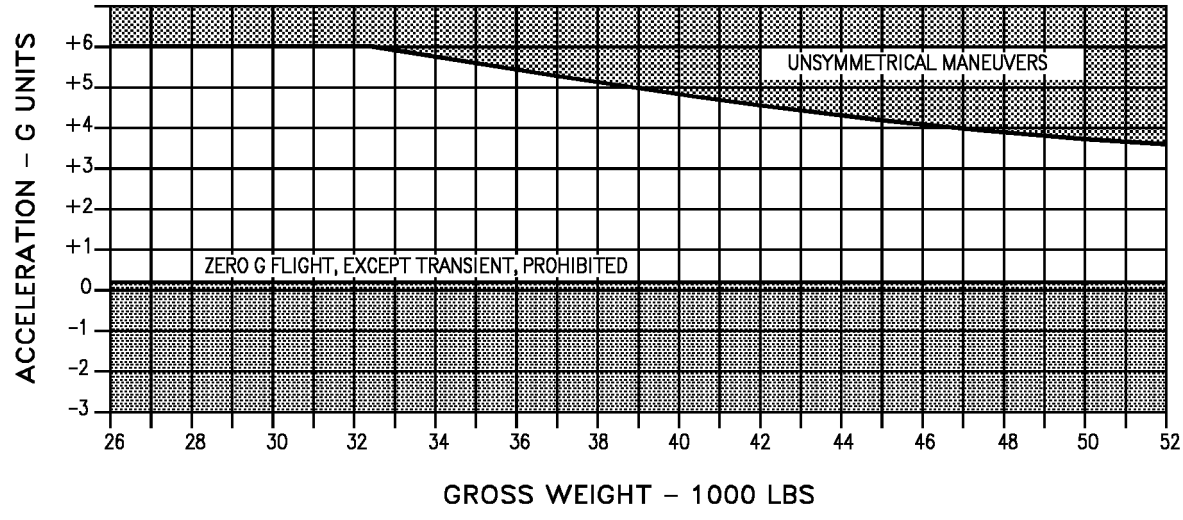
4.2.3 Tow Banner Adapter Limitations

Airspeed	400 Knots maximum
Acceleration	4 G maximum

AIRCRAFT THRU 161924

BASIC AIRCRAFT WITH OR WITHOUT AIM-7 AND/OR AIM-9





NOTES

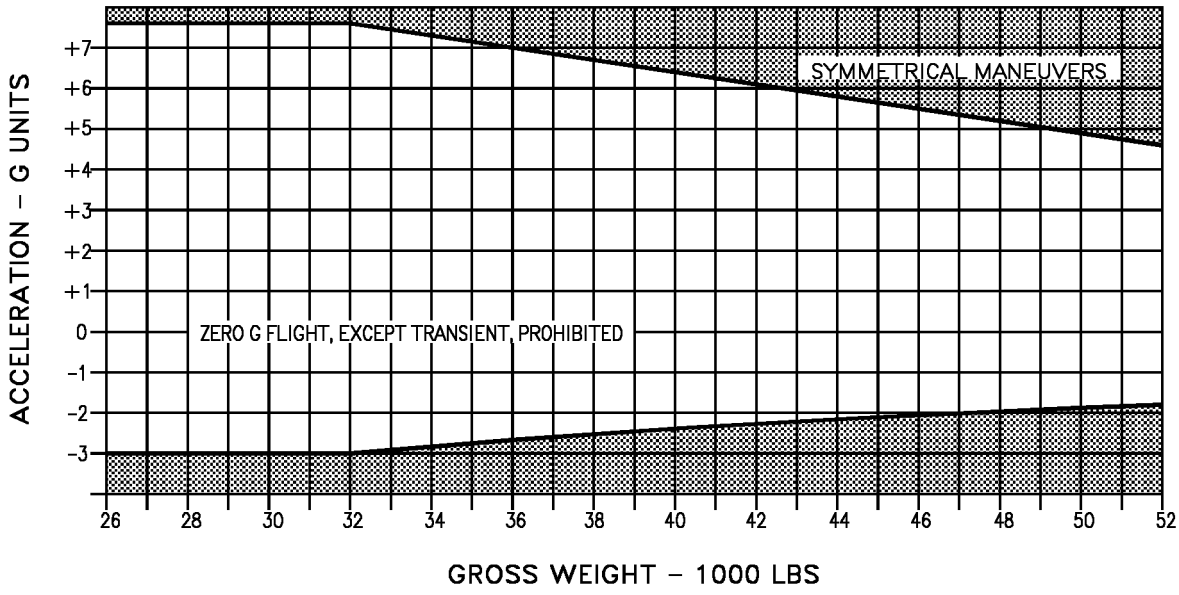
- See External Stores limitations for additional G limitations
- With the G limiter operating normally (no G-LIM 7.5 G caution) the unsymmetrical maneuvers limit shown here is valid only for full lateral stick displacement.
- For aircraft with G limiter, G limiter overshoots up to 8.0 G (permitted by G limiter) do not constitute an overstress. Overstress inspection is not required unless MMP code 811 is set.

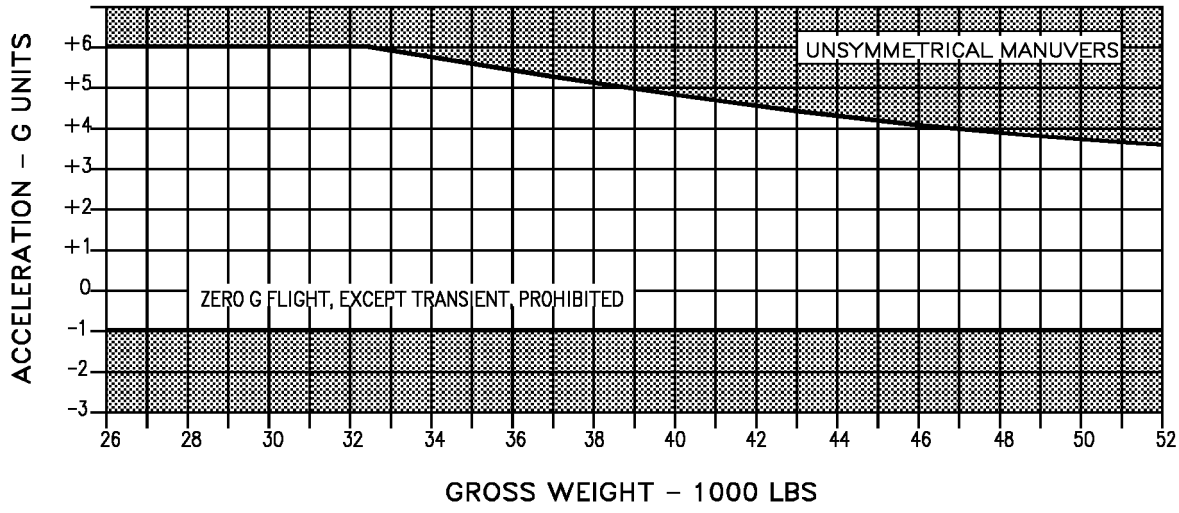
18AC-NFM-00-(40-1)31-CATI

Figure 4-3. Acceleration Limitations (Sheet 1 of 2)

AIRCRAFT 161925 AND UP

BASIC AIRCRAFT WITH OR WITHOUT AIM-7 AND/OR AIM-9



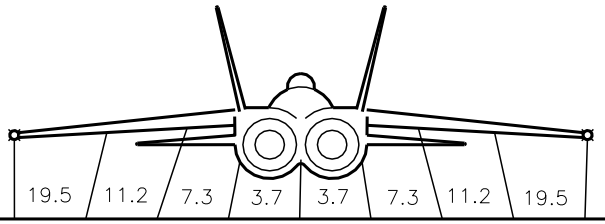


NOTES

- See External Stores Limitatons for additional G limitations.
- With the G limiter operating normally (no G-LIM 7.5 G caution), the unsymmetrical maneuvers limit shown here is valid only for full lateral stick displacement.
- For aircraft with G limiter, G limiter overshoots up to 8.0 G (permitted by G limiter) do not constitute an overstress. Overstress inspection is not required unless MMP code 811 is set.

18AC-NFM-00-(40-2)31-CATI

Figure 4-3. Acceleration Limitations (Sheet 2 of 2)



LBA – LIMIT BASIC AIRCRAFT

STORE	LINE NUMBER	DISTANCE FROM AIRCRAFT CENTERLINE–FT. STATION LOADING AND SUSPENSION 1	2	3	4	5	6	7	8	9	MAXIMUM KCAS OR IMN WHICHEVER IS LESS CARRIAGE	JETTISON EJECTED	JETTISON AUX RELEASE	ACCELERATION – G CARRIAGE SYM	CARRIAGE UNSYM	JETTISON EJECTED	JETTISON AUX RELEASE	ANGLE OF ATTACK LIMITS	CG LIMITS	CONFIGURATION WEIGHTS (LBS)	APPLICABLE NOTES
315/330 Gal. Fuel Tank	1					●					1.6	575/ 0.95	575/ 0.95	LBA	LBA	+1.0 TO +2.0	1.0 LEVEL	-6°/ +25°	23.5 /28	E454/429 F2596/2673	1,2, 5
																		UNRES-TRICTED	17/ 23.5		
	2			●				●			635/ 1.6							-6°/ +25°	24/ 27.5	E1194/1144 F5478/5632	3,4
																		-6°/ +35°	17/ 24		
	3			●		●		●										-6°/ +25°	17/ 27.5	E1648/1573 F8074/8305	1,2, 3,4

NOTES

1. Carrier landing is permitted with fuel in the centerline tank providing tank is not more than 1/4 full.
2. Carriage of cylindrical tank on the centerline station is prohibited aboard carriers with non-flush deck catapults.
3. Carrier takeoff with asymmetric loading in excess of 22,000 foot-pounds and carrier landing with asymmetric loading in excess of 17,000 foot-pounds are prohibited.
4. Carrier landing is authorized with full or partially full external wing tanks provided the 17,000 foot-pound asymmetry limit is not exceeded.
5. Single seat aircraft carriage limit with a centerline tank and no external wing tanks is 1.8 M.

Figure 4-4. External Stores Limitations

18AC-NFM-00-(42-1)33-CATI