PART 2

LIMITATIONS

Chapter 1

AIRFRAME LIMITATIONS

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1. General. The following take-off configurations for the Lightning F. Mk. 53 have been cleared for use. In normal circumstances no other configurations are permitted, however in extreme necessity the aircraft can take off with asymmetric configurations of those weapons. When the terms '2-inch rocket pack' and 'MATRA launchers' are used, they can mean full or empty. The 1000 lb. bombs mentioned are Mk. 10 or Mk. 13-19 series with Type 114 ballistic tails. Red Top acquisition and drill rounds may be carried with or without wings, but the carriage of a single Red Top missile without wings is not permitted (refer to Part 2, Chap. 2). Where a limit is quoted in the form 'X/Y', e.g. 650 kts/1.2M, then the limit that is to be observed is the lesser of the two unless specified otherwise.

a. Interceptor role

(i) Aircraft with missile pack without missiles, or 2-inch rocket pack with launchers closed.

(ii) Aircraft with two Firestreak missiles.

(iii) Aircraft with two Red Top missiles.

(iv) Aircraft with two Firestreak missiles and gun pack.

(v) Aircraft with 2-inch rocket pack and gun pack.

(vi) Aircraft with two Red Top missiles and gun pack.

b. Ground attack role

(i) Aircraft with 2-inch rocket pack and two 1,000 lb bombs.

(ii) Aircraft with 2-inch rocket pack and underwing pylons only.

(iii) Aircraft with 2-inch rocket pack, two 1,000 lb bombs and gun pack.

(iv) Aircraft with 2-inch rocket pack, underwing pylons and gun pack.

(v) Aircraft with 2-inch rocket pack and two Matra launchers.

(vi) Aircraft with 2-inch rocket pack, two Matra launchers and gun pack.

c. Reconnaissance role only or reconnaissance role plus interceptor or ground attack role

(i) Aircraft with reconnaissance pack.

(ii) Aircraft with reconnaissance pack and gun pack.

(iii) Aircraft with reconnaissance pack and underwing pylons only.

(iv) Aircraft with reconnaissance pack, underwing pylons and gun pack.

(v) Aircraft with reconnaissance pack and two 1,000 lb bombs.

(vi) Aircraft with reconnaissance pack, two 1,000 lb bombs and gun pack.

(vii) Aircraft with reconnaissance pack and two Matra launchers.

(viii) Aircraft with reconnaissance pack, two Matra launchers and gun pack.

(ix) Aircraft with two Red Top missiles without wings.

2. Weight limitations

Max. take-off weight	42,000 lb
Max. normal landing weight	34,500 lb
Max. emergency landing weight	39,000 lb

3. CG limits

The take-off CG limits are contained in the Lightning Mk. 53 Servicing Manual (BAC 53(SA)-1), Book 1, Section 2, Chap 3A.

4. Maximum speeds

a.	All configurations without missiles or underwing pylons	The lesser of 650 kt/2.0 M (700 kt operational necessity only)
b.	With Red Top missiles:	
	(i) Operational missiles:	
	below 10,000 ft	550 kt
	10,000 ft and above	The lesser of 650 kt/2.0 M (700 kt operational necessity only)
	(ii) Acquisition missiles:	
	below 10,000 ft	550 kt
	10,000 ft and above	The lesser of 650 kt/2.0 M
	(iii) Drill missiles	The lesser of 650 kt/2.0 M
c.	With Firestreak missiles:	
	(i) Operational missiles	The lesser of 650 kt/2.0 M (700 kt operational necessity only)
	(ii) Acquisition or drill missiles	The lesser of 650 kt/2.0 M
d.	With underwing pylons (no stores)	0.9 M (The lesser of 650 kt/1.8 M operational necessity only provided that above 0.9 M, 2″ rocket launchers remain closed, normal acceleration does not exceed 4g, and rolling is confined to normal course changing manoeuvres only)
e.	With 1,000 lb bombs	0.9 M
f.	With Matra launchers:	
	(i) With practice SNEB rockets	The lesser of 450 kt/0.9 M
	(ii) With HC or HE SNEB rockets with diaphragms and nose cones fitted	The lesser of 520 kt/0.9 M
g.	For the operation of services:	
	(i) With two-inch rocket launchers extended	The lesser of 650 kt/1.7 M
	(ii) With airbrakes extended	The lesser of 650 kt/1.3 M
	(iii) During flap extension and retraction and with flaps down	250 kt
	(iv) During undercarriage extension and retraction	250 kt
	(v) With undercarriage locked down	280 kt

(vi) For brake parachute stream . . . 170 kt (normal)
190 kt (emergency)

(vii) During taxying with the canopy open . 65 kt (taxy speed plus wind component)

5. Minimum speeds

Flaps and undercarriage up . . . . . 180 kts

Flaps and undercarriage down . . . . . 140 kts

Add 5 kts per 2000 lb weight increase above 36,000 lb AUW. In all configurations higher minimum speeds must be maintained with g applied.

6. G limitations

a. Positive. The maximum positive 'g' in each configuration is given in Table 1; lower limits apply whilst weapons are being fired (refer to Chap. 2, para. 2 of this Part).

TABLE 1 – G LIMITATIONS

Speed/configuration	Wing fuel		
	Less than 5000 lb (total)	Full	Full
	Ventral fuel		
	Empty	Up to 1000 lb	More than 1000 lb
Without pylons (with missiles, 2″ rockets or reconnaissance pack)			
Up to 0.9 M – with/without gun pack and with/without rocket launchers extended	6 g	6 g	5.5 g (5 g with over 3500 lb in ventral/ launchers extended)
0.9 to 1.7 M – with rocket launchers extended	3 g	3 g	3 g
0.9 to 1.8 M – without gun pack	6 g	5.5 g	5 g
– with gun pack	5.5 g	5 g	4.5 g
Above 1.8 M or with a single missile	4 g maximum		
With pylons (with 2-inch rockets)			
Up to 0.9 M – with/without stores (including single underwing store) and with/without gun pack and with/without launchers extended	5.5 g	5.5 g	5 g
0.9 to 1.8 M – no stores, operational necessity	4 g maximum		

b. Negative

(i) The maximum permissible negative normal acceleration is minus 3 g indicated.

(ii) Negative g must not be applied for longer than 15 seconds at any one time and a period of 1 minute should be allowed to elapse between successive applications.

7. Altitude limitations

Normal operating limit . . . . . 50,000 ft

NOTE . . .

Refer to Pt. 1, Chap. 11, para. 18 for the pilot's personal equipment limitations.

8. Stalling and spinning. Intentional stalling and spinning are prohibited. The action to be taken in the event of an inadvertent spin is given in Part 3, Chap. 3.

9. Rolling manoeuvres

a. General restrictions. The following restrictions are to be observed in conjunction with those given at sub-para's. 9 (b), (c) and (d):

(i) Before rolling, care should be taken to minimize sideslip by appropriate use of rudder trim; this is particularly important in an asymmetric configuration (i.e. with a single missile or underwing store).

(ii) Airbrake position must not be varied during rapid rolling.

(iii) Within the hatched area of Fig. 6, Part 3, Chap. 3, coarse use of aileron must be limited so that rapid rolling is avoided in the presence of moderate buffet. Failure to observe this limitation would result in excessive fin loads.

(iv) In the presence of moderate buffet or other signs of approach to the stall, coarse use of aileron should be avoided, particularly at high subsonic speeds above 10,000 ft. Failure to observe this limitation could lead to a spin.

(v) With accelerometer readings less than 1 g (0 g in the ground attack role) the use of aileron should be kept to a minimum but the transient use of aileron for target tracking at less than 1 g is permitted.

(vi) Co-ordinated turns using low rates of roll only are permitted above 650 kts/2.0 M or with accelerometer readings greater than 4 g.

(vii) Rapid rolling with rocket launchers extended is prohibited.

(viii) When asymmetric stores are carried or fuel remains in the ventral tank, full aileron rolls are permitted up to 90° only, provided the speed does not exceed 0.9 M and the 'g' is in the range 0 to 4 g or the onset of moderate buffet.

(ix) At supersonic speeds, in the reconnaissance role, when 'g' is more than 3, or when carrying empty underwing pylons, rolling is confined to normal course changing manoeuvres only.

b. Rolls up to 180°

(i) In a symmetric missile configuration (two or no missiles) or with 2-inch rocket launchers closed, rapid rolling through not more than 180° using up to full aileron is permitted up to 650 kts/2.0 M within the range 1 to 4 g or the onset of moderate buffet.

(ii) With symmetric or no underwing stores, rapid rolling up to 180° is permitted provided there is no fuel in the ventral tank and the speed does not exceed 0.9 M within the range 1 to 4 g (rolls up to 90° are permitted up to the same speed in the range 0 to 1 g).

c. Rolls up to 360°. Rolls up to 360° are only permitted in a symmetric missile configuration (two or no missiles) or with rocket launchers closed. They must be executed smoothly from the upright attitude using low rates of roll in 1 g flight, and must be completed before any other manoeuvre is started. The speed must be in the range 300 to 650 kts/2.0 M. Rolls in excess of 360° are prohibited.

d. Aerobatic manoeuvres. Aerobatic manoeuvres involving rapid rolls through not more than 360° using full aileron control are permitted between 300 and 550 kts/0.9 M below 15,000 ft in a symmetric missile configuration (two or no missiles) or with rocket launchers closed or with reconnaissance pack, subject to the following:

- All rolls must be smoothly executed from a normal upright attitude and must be fully completed before any other manoeuvre is started.
- 'Classic' slow rolls involving less than 1 g are permitted.
- 'Derry' turns involving less than 1 g and 'hesitation' rolls are prohibited.

10. Aircraft approach limitations (AAL)

Aircraft approach limitations are detailed in Table 2.

TABLE 2 – AIRCRAFT APPROACH LIMITATIONS

	BREAK-OFF HEIGHT (in feet) ABOVE RUNWAY			
	GCA/AUTO-ILS		MANUAL ILS	
	Indicated	True	Indicated	True
2½° glide path slope	250	300	300	350
3° glide path slope	300	350	350	400

b. If main altimeter and VSI failure have occurred, the AAL is 500 ft indicated. In these circumstances it is preferable that an ILS approach is made.

c. Manual and auto-ILS approaches should be GCA monitored where possible.

11. Airfield restrictions

a. Runway length. The aircraft should be operated from runways of not less than 7500 ft in length; in certain circumstances, e.g. high ambient air temperature or high altitude, runways of greater length will be required and the Lightning ODM should, therefore, be consulted.

b. Runway load classification number

(i) Rigid pavements – the aircraft LCN is 34 at 42,000 lb AUW.

(ii) Flexible pavements – the aircraft LCN is 40 at 42,000 lb AUW.

12. Crosswind limitations. The maximum crosswind components for take-off and landing is:—

25 kts – dry runway
20 kts – wet runway
15 kts – flooded runway

Chapter 2

EQUIPMENT LIMITATIONS AND MISCELLANEOUS RESTRICTIONS

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1. Flight control system

a. Autostabilizer mode. The autostabilizer may be used throughout the flight envelope from before take-off to after landing, except that the following restrictions and recommendations apply:—

(i) Selection of autostabilization should not be made in flight whilst the aircraft is in close proximity to the ground or another aircraft. This restriction is imposed because there may be a latent malfunction which, on selection, would become effective.

(ii) The autostabilizer can be used during close formation flying, provided that the limitations in para. (i) above, are observed.

(iii) It is recommended that, with the autostabilizers engaged (STAB on), speeds above 500 knots should not be flown at heights less than 1000 ft above ground level.

b. Autopilot general restrictions

(i) The autopilot MASTER switch should be on at all times exceot following a malfunction.

(ii) Before engaging any autopilot mode the autostabilizer must be on and operating correctly.

(iii) An autopilot mode should not be selected when near to the ground or another aircraft.

(iv) In any mode with the autopilot engaged (i.e. (c), (d) and (e), below 10,000 ft the pilot should have his hand on the stick so that immediate recovery action can be guaranteed in the event of a malfunction.

c. Attitude hold. The attitude hold mode, including the use of 'little stick', is cleared for use within the following limits:—

(i) 250 kts to 400 kts from 1000 ft to 5000 ft above ground level (AGL).

(ii) 250 kts to 650 kts/2.0 M from 5000 ft AGL to 50,000 ft.

(iii) Bank angle must not exceed 65° at any time.

d. Height lock, and height and heading lock. The height lock and height and heading lock modes, including the use of 'little stick' are cleared for use within the following limits:—

(i) 1000 ft AGL to 15,000 ft at speeds between 250 kts to 400 kts/0.95 M.

(ii) 15,000 ft to 45,000 ft, at speeds between 250 kts to 650 kts/2.0 M.

(iii) These modes should not be used during transonic accelerations or decelerations between 15,000 ft and 25,000 ft.

(iv) With a single missile fitted, turns may not be attempted at supersonic speeds with the autopilot engaged.

e. Height and heading lock using the Track mode. The use of the Track mode of the auto-ILS (without ILS) as a height and heading lock is permissible when carrying two missiles or none with undercarriage up within the following limits:—

(i) 250 kts to 350 kts

(ii) 0.95 M must not be exceeded

(iii) 1000 ft AGL to 40,000 ft

(iv) Heading change demands must not exceed 40°

2. Weapon firing or jettisoning limits

a. Air-to-air weapon firing. When firing missiles at low level, to allow for the missiles initial loss of height, attacks against targets below 300 ft should be undertaken only from altitudes above 300 ft. For targets above 300 ft, attacks may be made from altitudes below 300 ft.

(i) Firestreak

Maximum speed	the lesser of 650 kts/1.8 M
Normal acceleration	+0.5 g to +3 g
Minimum speed	the greater of 300 kts/0.6 M at altitudes above 300 ft. Below 300 ft this is increased to the greater of 300 kts/0.7 M.

In the event of a misfire with Firestreak missiles the missile fins may still operate and if one or both missiles remain on the aircraft, 3 g should not be exceeded for a further 30 seconds.

(ii) Red Top

Maximum speed – below 10,000 ft	550 kts
– 10,000 ft and above	the lesser of 650 kts/1.8 M
Normal acceleration	+0.5 g to +4 g
Minimum speed	the greater of 300 kts/0.7 M

(iii) 2-inch rockets

Maximum speed	the lesser of 650 kts/1.7 M
Normal acceleration	+0.5 g to +3 g

(iv) Aden guns

Maximum speed	the lesser of 650 kts/1.8 M
Normal acceleration	+0.5 g to +4.5 g

To avoid possible damage to the missiles it is recommended that gun firing over missiles should not be undertaken except under operational necessity.

Firing of all the above weapons is safe up to the maximum altitude achievable although some degradation in performance must be expected at altitudes above 60,000 ft.

The rolling limitations given in Part 2, Chap. 1, should be strictly observed during any break-away manoeuvre following the firing of one or two missiles.

b. Air-to-ground weapon firing

(i) 2-inch rockets

Maximum speed	0.9 M
Normal acceleration	+0.5 g to +3 g

(ii) Aden guns

Maximum speed	0.9 M
Normal acceleration	+0.5 g to +3 g

(iii) SNEB rockets

Maximum speed	Type 252/3 (practice) head – 450 kts Type 253 (HC) head or Type 256 (HE) head with nose cones fitted to launchers – 520 kts
Normal acceleration	+0.5 g to +3 g

(iv) 1000 lb bombs

Maximum speed	520 kts/0.9 M
Normal acceleration	+0.5 g to +3 g

c. Jettisoning

The jettison limits are:—

Firestreak and Red Top	300 kts/0.7 M (250 kts with U/C down) within +1 g to +2 g
Matra launchers	300 kts within +0.5 g to +2 g
1000 lb bombs	500 kts within +0.5 g to +3 g

Sideslip should be minimized before jettisoning

3. Carriage of Red Top missiles without wings

a. At speeds below 650 kts/1.8 M the normal limitations on carriage of complete Red Top missiles apply, including rapid rolling. At speeds above 1.8 M up to 2.0 M, the maximum normal acceleration is 3 g and rapid rolling is prohibited.

b. Missile jettisoning or firing is prohibited.

c. Carriage of single missiles is prohibited.

4. ILS. ILS is not to be switched on above 40,000 ft or above 400 kts.

5. Emergency arrester hook

a. The arrester hook is cleared for emergency use with either the Bliss or All American runway gear at speeds up to 140 kts at weights up to 45,000 lb.

b. The arrester hook must only be lowered when the aircraft is on the runway. Provided the hook has been released whilst the aircraft is on the runway, it is safe to overshoot and fly with the hook lowered at speeds up to 250 kts.

c. Engagement should be confined to the span 40 ft either side of the arrester wire centre.

d. After lowering, efforts should be made to avoid running the hook along the runway centreline markings when these are composed of a material that forms raised surfaces on the runway.

e. Use with the Bliss arrester gear

(i) At engagement speeds above 140 kts there is a risk of structural failure and the pilot should be prepared to eject.

(ii) After engagement at any speed the aircraft and hook blade must be visually examined. After engagement above 95 kts the hook blade must be changed. At engagement speeds above 115 kts, the integrity of the aircraft's structure must be checked before further flight.

f. Use with the All-American arrester gear

(i) Safe engagement is possible at speeds up to 170 kts. Above this speed structural failure is possible and the pilot should be prepared to eject.

(ii) The aircraft and hook must be examined after an engagement and the hook blade changed if engagement takes place above 115 kts. At engagement speeds above 140 kts the integrity of the aircraft's structure must be checked before further flight.

Chapter 3

ENGINE LIMITATIONS

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1. Avon Mk. 302C operating limitations

The Avon Mk. 302C operating limitations are detailed in Table 1.

TABLE 1 – AVON Mk. 302C OPERATING LIMITATIONS

POWER RATING	% RPM	MAX. JPT (° C)	TIME LIMIT (PER FLIGHT)
MAXIMUM (with and without reheat)	104	800	15 minutes Combined duration
INTERMEDIATE	98	755	30 minutes
MAX. CONTINUOUS	97	720	Unrestricted
APPROACH	60 (minimum)	—	Unrestricted
GROUND IDLING GROUND FAST IDLING	36 63 (minimum)	750 750	Unrestricted Unrestricted

NOTE 1. . .

During reheat selections and cancellations, transient RPM overswings lasting up to 5 seconds may be permitted up to 106% RPM.

NOTE 2 . . .

During certain engine accelerations, temperatures in excess of the limiting JPT may be experienced. If full JPT control is not established within 5 seconds, temperatures up to 850°C may be tolerated for a further 10 seconds.

NOTE 3 . . .

Under adverse conditions of hot day and/or tail wind, the ground idle and ground fast idle temperatures may be allowed temporarily to exceed the limit of 750°C, but must not exceed 800°C. Refer to Part 3, Chap. 2.

2. Oil pressure. The oil pressure warning lights must be out at 45% RPM and above.

3. Reheat time restriction. The total period for which reheat may be used is 15 minutes per flight. This may be continuous or cumulative and applies to all degrees of reheat.