

Altitude Capability

General:

Jet aircraft operate more efficiently at high levels than they do at low levels. Generally speaking, the higher the cruise level, the less fuel the aircraft will burn in any given sector.

Normally ATPL examination questions will either specify a cruise flight level, or ask that you fly at the highest level available referring to the table of IFR cruise levels (see extract below). Assessment of altitude capability can be as a stand alone question, or part of a longer “full flight plan” question.

Questions on altitude capability/limits can be asked for...

- Normal 3 engine operations.
- 1 Engine inoperative operations.
- Landing gear extended operations.
- Tail skid extended operations.

We will deal with each one in turn. First normal 3 engine altitude capability. (refer to B727 manual page 2-14). Two engine inoperative case will be covered in the “Drift-down” texts.

ODD’s EAST up to FL290, then FL330, 370, 410, etc.
EVEN’s WEST up to FL280, then FL310, 350, 390 etc.

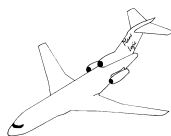
Normal 3 Engine Operations

TopC temp

FL	Mach	ISA -5	ISA	ISA+5	ISA +10	ISA +15	ISA +20
330	LRC		82.7				
	.79		83.3				
	.80		82.6				
	.82		80.2				
	.84		76.5				

Cruise thrust limit weight at TopC x 1,000 kg.

Extract from B727 manual page 2-14.



The limit GW's describe the max weight the aircraft can arrive at that flight level, in the conditions of temp, Mach No. combination specified, and have sufficient thrust to accelerate to and hold the desired Mach number, without exceeding the maximum cruise thrust imposed by turbine temperature limits.

Example 1. (Refer page 2-14)

Cruise Mach No. 0.80. Track 125M (ie: EAST). Temp at TopC is ISA. Planned TopC GW 80, 000 kg.

What is the highest IFR flight level available ?

Working: Going EAST your cruise level options are FL290, FL330, FL370.

From page 2-14. Max TopC GW's for the various IFR levels are...

FL370	M 0.80	69, 400 kg
FL330	M 0.80	82, 600 kg
FL290	M 0.80	---

If we arrive at TopC at 80, 000 kg, we will be too heavy to use FL370. FL330 max TopC GW is greater than our planned TopC GW, so FL330 is the highest IFR level available. **Answer !**

The dashes corresponding to FL290 indicate that no limiting GW applies. (ie: that this GW is higher than max structural BRW of 89, 350 kg)

Points to note:



- FL330 would not have been available if Mach 0.84 cruise schedule was to be used, due to exceedance of max cruise turbine temperature engine limits.
- Typically the highest 3 engine IFR FL for EASTERLY tracks is FL330. FL370 available later in flight, when aircraft GW has reduced due to fuel being burnt off.
- FL310, or FL350 are normal FL's if on WESTERLY tracks. FL390 not usually possible.
- Increase in cruise Mach schedule reduces altitude capability, due engine thrust limitations.
- Colder temps = higher altitude capability, as engine can deliver more thrust at lower temperatures.

Example 2.

Cruise schedule M 0.82. Tracking WEST on 295M. Planned TopC GW 70, 000 kg. TopC temp ISA+10

What is the highest available IFR flight level ?

FL390	M 0.82	58, 900 kg
FL350	M 0.82	70, 500 kg
FL310	M 0.82	79, 500 kg

Highest WESTERLY FL available is FL350. **Answer !**



Example 3. (Refer page 2-14)

Cruise Mach No. 0.84. Track 195M (ie: WEST). Temp at TopC is ISA -5C. Planned BRW 80, 000 kg.

What is the highest WESTERLY IFR flight level available ?

Working:

Approx BRW GW is 80, 000 kg - climb FBO 3, 000 kg = 77, 000 kg.

From page 2-14. Max TopC GW's for the various IFR levels are...

FL390	M 0.84	59, 400 kg
FL350	M 0.84	71, 800 kg
FL310	M 0.84	84, 700 kg

Highest WESTERLY FL available is FL310. **Answer !**

Example 4. (Refer page 2-14)

Cruise schedule: LRC. Track 135M (ie: EAST). Temp at TopC is ISA +5C. Planned BRW 77, 000 kg.

What is the highest EASTERLY IFR flight level available ?

Working:

Approx TopC GW is 77, 000 kg - climb FBO 3, 000 kg = 74, 000 kg.

From page 2-14. Max TopC GW's for the various IFR levels are...

FL370	LRC	68, 500 kg
FL330	LRC	80, 800 kg

Highest EASTERLY FL available is FL330. **Answer !**

Example 5. (Refer page 2-14)

Cruise FL350. Temp at TopC is ISA +10C. Planned TopC GW 72, 000 kg.

What is the highest cruise Mach number available ?

Mach	ISA +10
LRC	73.0
.79	73.7
.80	72.9
.82	70.5
.84	66.9

Speeds available

Mach 0.80 is the highest available speed without exceeding engine cruise thrust limits. **Answer !**

Speeds NOT available

Now attempt assignment's Alt Cap 1 & 2.