P.001.FPG

FUEL PLANNING GUIDE

First Edition

Edited by:

Wilhelm Andrei Bubeneck
Division Training Coordinator

Approved by:

Lucian Cristea
Division Director

1. Introduction

1.1. Purpose

The purpose of this document is:
a) to familiarize pilots with the more advanced calculations done in the fuel planning of an aircraft;
b) to avoid insufficient or excessive fuel as a result of inadequate of incomplete fuel planning.

1.2. Audience

This document is aimed especially at the pilots who wish to prepare themselves for the IVAO CP and ATP exams. Nonetheless it should also be accessible to pilots holding lower ratings or anyone interested in the matter presented.

1.3. Where to find this document

This document is published solely on the official website of the RO Division (i.e. ro.ivao.aero).

1.4. Abbreviations

MAP – Missed Approach Point

APU – Auxiliary Power Unit

PMDG – “Precision Manuals Development Group” ™

FCOM – Flight Crew Operations Manual

OEM – Operating Empty Mass

ZFM – Zero Fuel Mass

PAX – Passengers

NM – Nautical Miles

NAM – Nautical Air Miles

ALTN – Alternate

SID/STAR – Standard Instrument Departure / Standard Terminal Arrival Route

KG/KGS – Kilogram/Kilograms

2. Theoretical aspects

2.1. IVAO-specific considerations

To simplify the matter, it is considered that an alternate aerodrome is always to be filed and that the diversion to said alternate aerodrome occurs at the MAP.

This document covers only ICAO fuel regulations.

2.2. Common requirements for all aeroplanes

A flight shall not be commenced unless, taking into account both the meteorological conditions and any delays that are expected in flight, the aeroplane carries sufficient fuel to ensure that it can safely complete the flight. In addition, a reserve shall be carried to provide for contingencies.

2.3. Piston-engined aeroplanes

The fuel carried in order to comply with 2.1. shall, in the case of piston-engined aeroplanes, be at least the amount sufficient to allow the aeroplane to fly to the aerodrome to which the flight is planned (**TRIP FUEL+TAXI FUEL**) then to the farthest alternate aerodrome specified in the flight plan (**ALTERNATE FUEL**) and thereafter for a period of 45 minutes. (**RESERVE FUEL**)

2.4. Turbine-engined aeroplanes (Turboprops and Jets)

The fuel carried in order to comply with 2.1. shall, in the case of turbine-engined aeroplanes, be at least the amount sufficient to allow the aeroplane to fly to and execute an approach (**TRIP FUEL+TAXI FUEL**), and a missed approach (covered by **ALTERNATE FUEL**), at the aerodrome to which the flight is planned, and thereafter:

1) to fly to the farthest alternate aerodrome specified in the operational and ATS flight plans; (**ALTERNATE FUEL**)

2) to fly for 30 minutes at holding speed at 450 m (1 500 ft) above the alternate aerodrome under standard temperature conditions, and approach and land; (**FINAL RESERVE FUEL or HOLDING FUEL**)

3) to have an additional amount of fuel sufficient to provide for the increased consumption on the occurrence of any of the potential contingencies specified by the operator to the satisfaction of the State of the Operator. (**ROUTE RESERVE FUEL or CONTINGENCY FUEL**)

2.5. Other important considerations

In computing the fuel and oil required in 2.1. at least the following shall be considered:

a) meteorological conditions forecast; (part of **ROUTE RESERVE FUEL** and/or **EXTRA FUEL**)

b) expected air traffic control routings and traffic delays; (part of **ROUTE RESERVE FUEL**)

c) for IFR flight, one instrument approach at the destination aerodrome (part of **TRIP FUEL**), including a missed approach (part of **FINAL RESERVE FUEL**);

d) any other conditions that may delay the landing of the aeroplane or increase fuel consumption. (part of **EXTRA FUEL**)

2.6. Summary

2.6.1. Piston-engined aeroplanes

a) Trip Fuel (takeoff to landing);

b) Taxi Fuel (taxi [and APU - *if available*]);

c) Alternate Fuel;

d) Reserve Fuel;

2.6.2. Turbine-engined aeroplanes

a) Trip Fuel;

b) Taxi Fuel;

c) Alternate Fuel;

d) Final Reserve Fuel *or* Holding Fuel;

e) Route Reserve Fuel *or* Contingency Fuel;

f) Extra Fuel

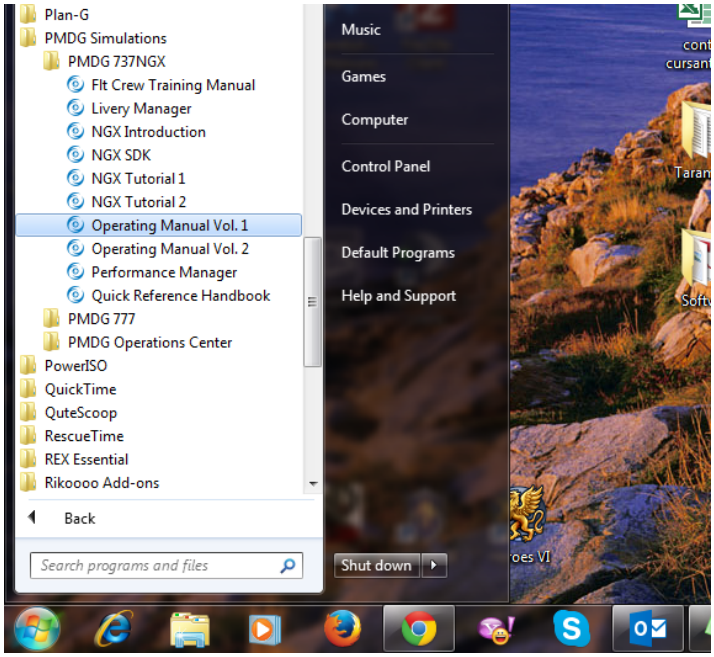
3. Practical aspects

3.1. Important considerations

3.1.1. General

The following represents a practical example of fuel planning applied on a *Boeing 737-800* aircraft according to the PMDG 737NGX FCOM. You also need to take into account that the method presented in this document is specially designed for step-by-step manual calculations in order for you to understand the specific fuel requirements and may not be the fastest or easiest available. It also does *not* cover weight and balance. This will be discussed in another document. For this entire guide it is recommended to keep the PMDG 737NGX FCOM, volume 1 PDF file handy. You can find it like this:

→ Go to Start → All Programs →PMDG Simulations → PMDG 737NGX → Operating Manual Vol.1



3.1.2. Units of measure

Throughout this guide the following convention is used:

Masses are expressed as thousands of kilograms (metric tonnes), omitting the units.

The decimal separator is always a period (“point”).

45600 kg = **45.600 tonnes** = **45.6** (**tonnes**)

3.1.3. Making interpolations

Throughout this guide you will need to work with tables that contain just some "round" values for the sake of simplicity. If you find yourself in the situation of not having a column or a row with the exact value needed, you will need to make so-called *interpolations* between adjacent columns and/or rows. Assume the growth is always linear between two adjacent cells.

Example:

Assume you have the following table, in which you input a variable "x" in order to extract a function of "x", namely f(x).

x	**f(x)**
300	1000
400	1500

Everything is perfect if x is 300 or 400, but what happens if x is *in-between* those values. We say 300 = x_{low} , 400 = x_{high} , 1000 = $f(x)_{low}$ and 1500 = $f(x)_{high}$ and calculate f(x) with the help of the formula:

$f(x) = (x - x_{low}) * (f(x)_{high} - f(x)_{low}) / (x_{high} - x_{low}) + f(x)_{low}$

If x = 330, then f(x) = (330 – 300) * (1500 – 1000) / (400 – 300) + 1000= 30 * 500 / 100 = 1150

3.2. Step-by-step guide

A. Find the necessary loading data for the flight you will perform:

You will need:

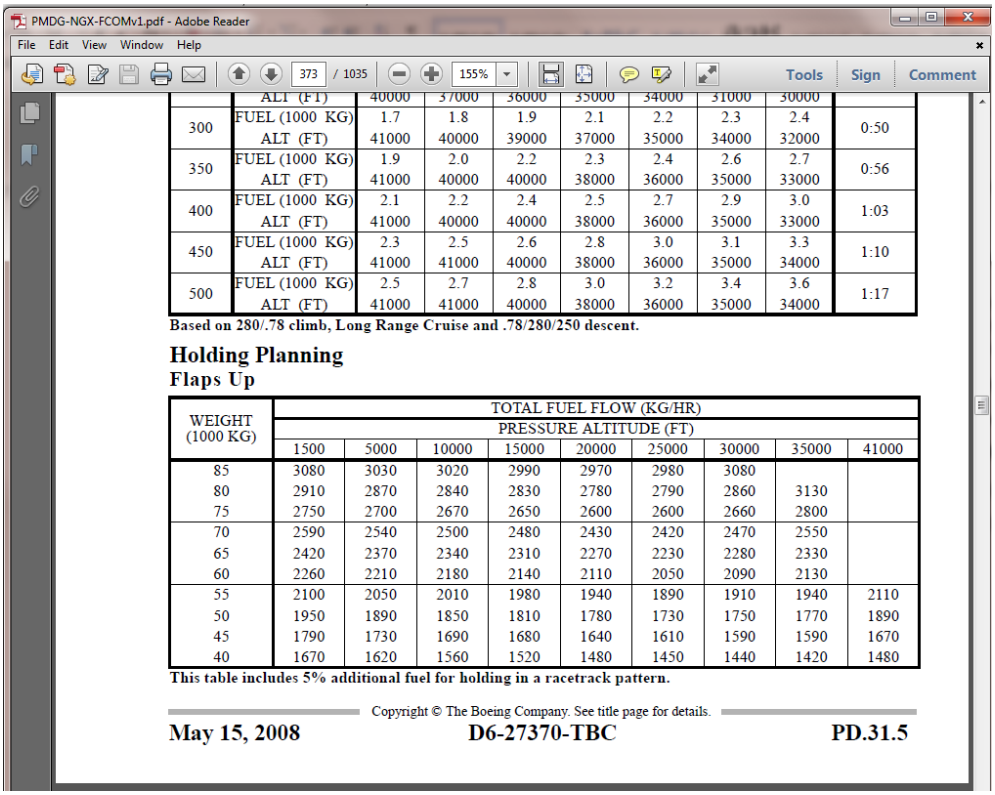
- ✓ Number of passengers onboard (you can make this up – as long as it is within aircraft limits)
- ✓ OEM (DOM) of the aircraft (in the case of the 737-800, a good value is **41.4**)
- ✓ The average mass of a passenger (a good value is **0.085**)
- ✓ The average mass of a baggage (a good value is **0.01**)

B. Now calculate the ZFM using the following formulae – assume each passenger carries one bag:

PAX * (0.085 + 0.01) = PAYLOAD **PAYLOAD + OEM = ZFM**

C. Extract the required holding fuel from the FCOM:

- ✓ Go to FCOM v1 → Chapter PD (Performance Dispatch) → Section 31 (Enroute) → 31.5 – Holding Planning Flaps Up



PMDG-NGX-FCOMv1.pdf - Adobe Reader

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	ALT (FT)	40000	37000	36000	35000	34000	31000	30000	
300	FUEL (1000 KG)	1.7	1.8	1.9	2.1	2.2	2.3	2.4	0:50
	ALT (FT)	41000	40000	39000	37000	35000	34000	32000	
350	FUEL (1000 KG)	1.9	2.0	2.2	2.3	2.4	2.6	2.7	0:56
	ALT (FT)	41000	40000	40000	38000	36000	35000	33000	
400	FUEL (1000 KG)	2.1	2.2	2.4	2.5	2.7	2.9	3.0	1:03
	ALT (FT)	41000	40000	40000	38000	36000	35000	33000	
450	FUEL (1000 KG)	2.3	2.5	2.6	2.8	3.0	3.1	3.3	1:10
	ALT (FT)	41000	41000	40000	38000	36000	35000	34000	
500	FUEL (1000 KG)	2.5	2.7	2.8	3.0	3.2	3.4	3.6	1:17
	ALT (FT)	41000	41000	40000	38000	36000	35000	34000	

Based on 280/.78 climb, Long Range Cruise and .78/280/250 descent.

Holding Planning

Flaps Up

WEIGHT (1000 KG)	TOTAL FUEL FLOW (KG/HR) PRESSURE ALTITUDE (FT)								
	1500	5000	10000	15000	20000	25000	30000	35000	41000
85	3080	3030	3020	2990	2970	2980	3080		
80	2910	2870	2840	2830	2780	2790	2860	3130	
75	2750	2700	2670	2650	2600	2600	2660	2800	
70	2590	2540	2500	2480	2430	2420	2470	2550	
65	2420	2370	2340	2310	2270	2230	2280	2330	
60	2260	2210	2180	2140	2110	2050	2090	2130	
55	2100	2050	2010	1980	1940	1890	1910	1940	2110
50	1950	1890	1850	1810	1780	1730	1750	1770	1890
45	1790	1730	1690	1680	1640	1610	1590	1590	1670
40	1670	1620	1560	1520	1480	1450	1440	1420	1480

This table includes 5% additional fuel for holding in a racetrack pattern.

- ✓ The "weight" is your ZFM. Write down the corresponding fuel flow at 1500 ft.

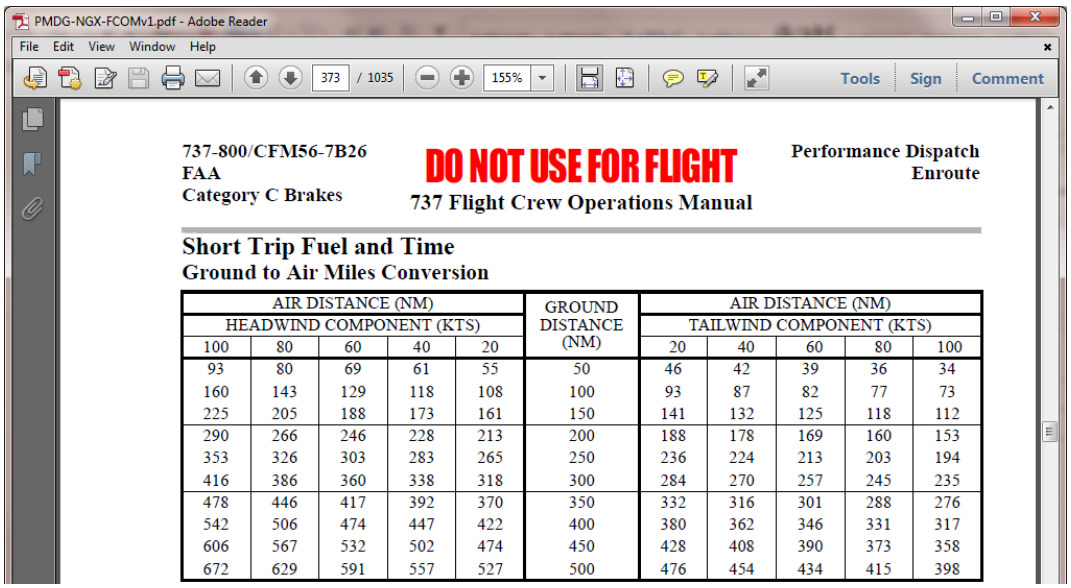
Fuel flow per hour at 1500 ft / 2 / 1000 = HOLDING FUEL (tonnes)

- ✓ The holding fuel time is 30 minutes.

D. Calculate the required alternate fuel:

- ✓ Find a suitable alternate aerodrome for the intended flight
- ✓ Find a suitable route from the MAP to the alternate aerodrome (in case you are unable to do so, assume a direct route)
- ✓ Write down the distance of that route in NM
- ✓ Check the average wind aloft on that route: What is the average head- or tailwind component? (See P.002.WCG for details on how to do this)

- ✓ Go to FCOM v1 → Chapter PD → Section 31 → 31.5 – Short Trip Fuel and Time – Ground to Air Miles Conversion



737-800/CFM56-7B26
FAA
Category C Brakes

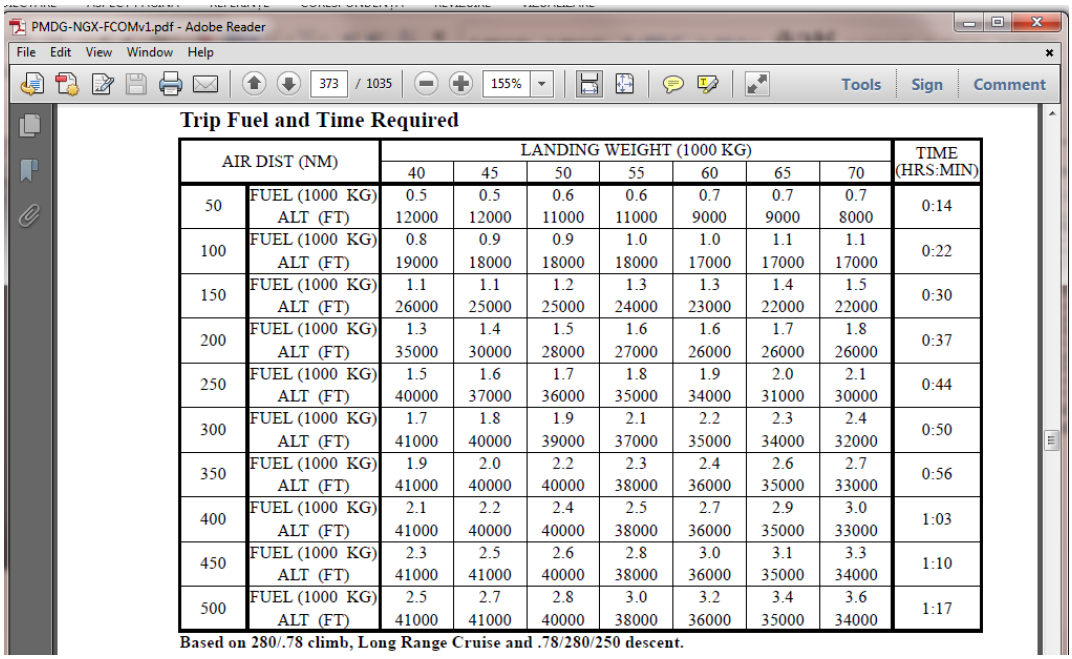
DO NOT USE FOR FLIGHT
737 Flight Crew Operations Manual

Performance Dispatch
Enroute

Short Trip Fuel and Time
Ground to Air Miles Conversion

AIR DISTANCE (NM) HEADWIND COMPONENT (KTS)					GROUND DISTANCE (NM)	AIR DISTANCE (NM) TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
93	80	69	61	55	50	46	42	39	36	34
160	143	129	118	108	100	93	87	82	77	73
225	205	188	173	161	150	141	132	125	118	112
290	266	246	228	213	200	188	178	169	160	153
353	326	303	283	265	250	236	224	213	203	194
416	386	360	338	318	300	284	270	257	245	235
478	446	417	392	370	350	332	316	301	288	276
542	506	474	447	422	400	380	362	346	331	317
606	567	532	502	474	450	428	408	390	373	358
672	629	591	557	527	500	476	454	434	415	398

- ✓ According to the table above, convert you Ground Distance (NM) in Air Distance (NAM) (Only if average head- or tailwind is more than or equal to 20 knots)
- ✓ Right below it, is another table called “Trip Fuel and Time Required”. Use it to extract the alternate fuel and the optimum altitude for diversion, as well as the alternate trip time. The landing weight at the alternate will be **ZFM + HOLDING FUEL = LANDING WEIGHT AT ALTN**



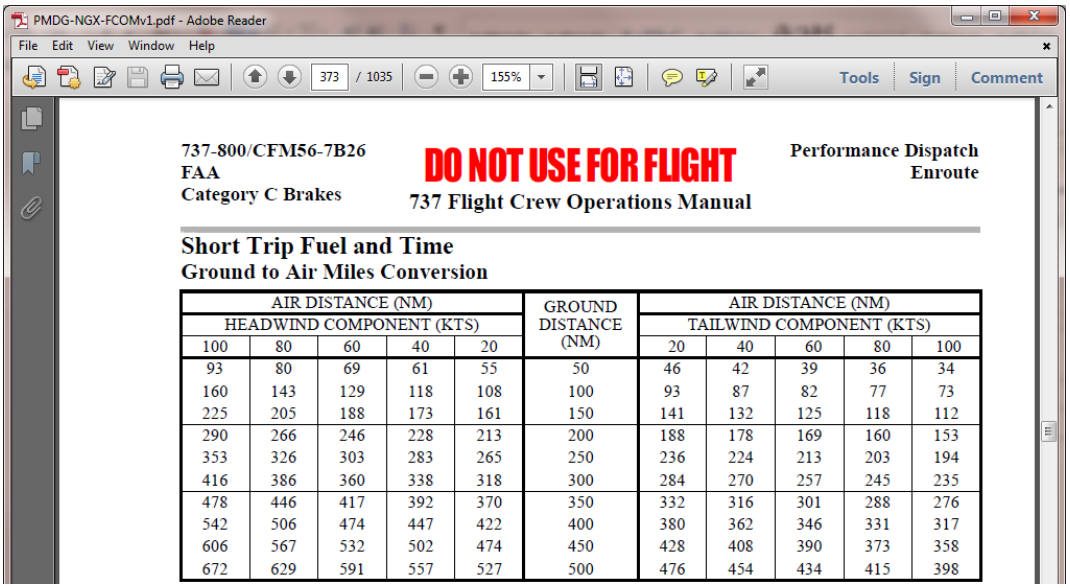
Trip Fuel and Time Required

AIR DIST (NM)		LANDING WEIGHT (1000 KG) 40	45	50	55	60	65	70	TIME (HRS:MIN)
50	FUEL (1000 KG)	0.5	0.5	0.6	0.6	0.7	0.7	0.7	0:14
	ALT (FT)	12000	12000	11000	11000	9000	9000	8000	
100	FUEL (1000 KG)	0.8	0.9	0.9	1.0	1.0	1.1	1.1	0:22
	ALT (FT)	19000	18000	18000	18000	17000	17000	17000	
150	FUEL (1000 KG)	1.1	1.1	1.2	1.3	1.3	1.4	1.5	0:30
	ALT (FT)	26000	25000	25000	24000	23000	22000	22000	
200	FUEL (1000 KG)	1.3	1.4	1.5	1.6	1.6	1.7	1.8	0:37
	ALT (FT)	35000	30000	28000	27000	26000	26000	26000	
250	FUEL (1000 KG)	1.5	1.6	1.7	1.8	1.9	2.0	2.1	0:44
	ALT (FT)	40000	37000	36000	35000	34000	31000	30000	
300	FUEL (1000 KG)	1.7	1.8	1.9	2.1	2.2	2.3	2.4	0:50
	ALT (FT)	41000	40000	39000	37000	35000	34000	32000	
350	FUEL (1000 KG)	1.9	2.0	2.2	2.3	2.4	2.6	2.7	0:56
	ALT (FT)	41000	40000	40000	38000	36000	35000	33000	
400	FUEL (1000 KG)	2.1	2.2	2.4	2.5	2.7	2.9	3.0	1:03
	ALT (FT)	41000	40000	40000	38000	36000	35000	33000	
450	FUEL (1000 KG)	2.3	2.5	2.6	2.8	3.0	3.1	3.3	1:10
	ALT (FT)	41000	41000	40000	38000	36000	35000	34000	
500	FUEL (1000 KG)	2.5	2.7	2.8	3.0	3.2	3.4	3.6	1:17
	ALT (FT)	41000	41000	40000	38000	36000	35000	34000	

Based on 280/.78 climb, Long Range Cruise and .78/280/250 descent.

E. Calculate the required trip fuel for the main route:

- ✓ Find a suitable route from the departure aerodrome to the destination aerodrome – including SID and STAR (in case you are unable to find a SID and/or STAR, assume direct route from first/last waypoint to departure/destination aerodrome)
- ✓ Write down the distance of that route in NM
- ✓ Check the average wind aloft on that route: What is the average head- or tailwind component? (See P.002.WCG for details on how to do this)
- ✓ Go to FCOM v1 → Chapter PD → Section 31 → 31.5 – Short Trip Fuel and Time – Ground to Air Miles Conversion



Short Trip Fuel and Time
Ground to Air Miles Conversion

AIR DISTANCE (NM) HEADWIND COMPONENT (KTS)					GROUND DISTANCE (NM)	AIR DISTANCE (NM) TAILWIND COMPONENT (KTS)				
100	80	60	40	20		20	40	60	80	100
93	80	69	61	55	50	46	42	39	36	34
160	143	129	118	108	100	93	87	82	77	73
225	205	188	173	161	150	141	132	125	118	112
290	266	246	228	213	200	188	178	169	160	153
353	326	303	283	265	250	236	224	213	203	194
416	386	360	338	318	300	284	270	257	245	235
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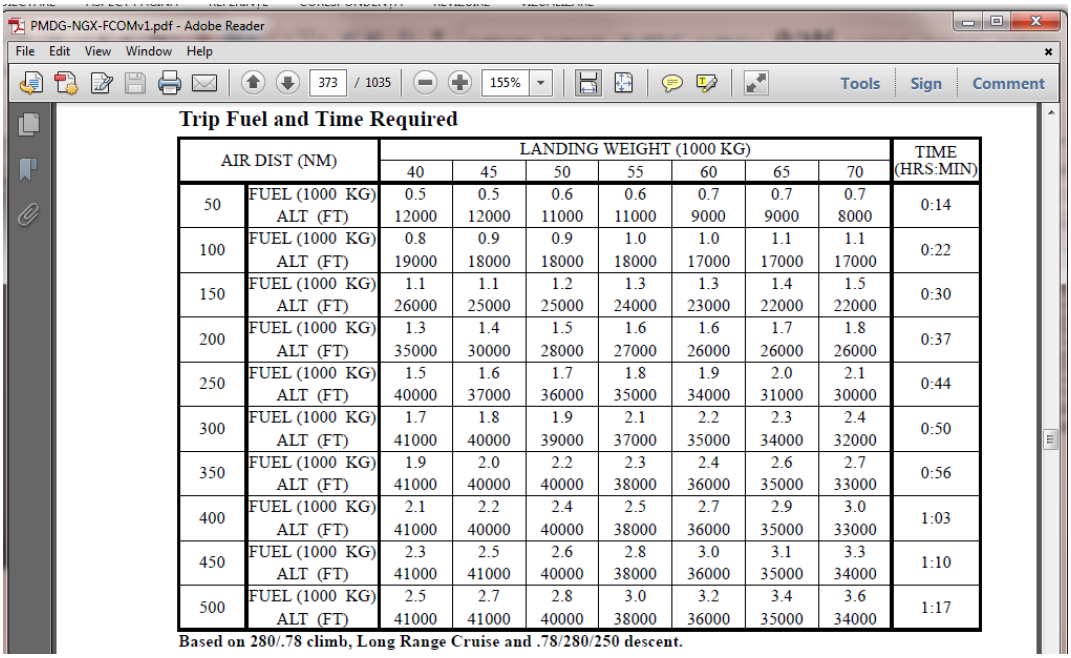
606	567	532	502	474	450	428	408	390	373	358
672	629	591	557	527	500	476	454	434	415	398

- ✓ According to the table above, convert you Ground Distance (NM) in Air Distance (NAM) (Only if average head- or tailwind is more than or equal to 20 knots)
- ✓ Right below it, is another table called “Trip Fuel and Time Required”. Use it to extract the trip fuel and the optimum cruising altitude, as well as the trip time. The landing weight at the will be **ZFM + HOLDING FUEL + ALTERNATE FUEL = LANDING WEIGHT AT DESTINATION**



Trip Fuel and Time Required

AIR DIST (NM)		LANDING WEIGHT (1000 KG) 40	45	50	55	60	65	70	TIME (HRS:MIN)
50	FUEL (1000 KG)	0.5	0.5	0.6	0.6	0.7	0.7	0.7	0:14
	ALT (FT)	12000	12000	11000	11000	9000	9000	8000	
100	FUEL (1000 KG)	0.8	0.9	0.9	1.0	1.0	1.1	1.1	0:22
	ALT (FT)	19000	18000	18000	18000	17000	17000	17000	
150	FUEL (1000 KG)	1.1	1.1	1.2	1.3	1.3	1.4	1.5	0:30
	ALT (FT)	26000	25000	25000	24000	23000	22000	22000	
200	FUEL (1000 KG)	1.3	1.4	1.5	1.6	1.6	1.7	1.8	0:37
	ALT (FT)	35000	30000	28000	27000	26000	26000	26000	
250	FUEL (1000 KG)	1.5	1.6	1.7	1.8	1.9	2.0	2.1	0:44
	ALT (FT)	40000	37000	36000	35000	34000	31000	30000	
300	FUEL (1000 KG)	1.7	1.8	1.9	2.1	2.2	2.3	2.4	0:50
	ALT (FT)	41000	40000	39000	37000	35000	34000	32000	
350	FUEL (1000 KG)	1.9	2.0	2.2	2.3	2.4	2.6	2.7	0:56
	ALT (FT)	41000	40000	40000	38000	36000	35000	33000	
400	FUEL (1000 KG)	2.1	2.2	2.4	2.5	2.7	2.9	3.0	1:03
	ALT (FT)	41000	40000	40000	38000	36000	35000	33000	
450	FUEL (1000 KG)	2.3	2.5	2.6	2.8	3.0	3.1	3.3	1:10
	ALT (FT)	41000	41000	40000	38000	36000	35000	34000	
500	FUEL (1000 KG)	2.5	2.7	2.8	3.0	3.2	3.4	3.6	1:17
	ALT (FT)	41000	41000	40000	38000	36000	35000	34000	

Based on 280/.78 climb, Long Range Cruise and .78/280/250 descent.

- ✓ Take into account the following *corrective factors*:
  - o **0.13** to account for a go-around and missed approach
  - o **0.06/min** to account for additional flight time with gear an flaps down
- ✓ Note: The trip fuel time is computed without the corrective factors above.

F. Calculate the contingency fuel:

- ✓ The contingency fuel will be 5% from the trip fuel
- ✓ Use the following formula:
  TRIP FUEL * 0.05 = CONTINGENCY FUEL
  TRIP FUEL * 60 / 2.7 = CONTINGENCY FUEL TIME (minutes)

G. Calculate the taxi fuel:

- ✓ Normally, use 30 minutes APU time (**0.0018/min**)
- ✓ Normally, use 10 minutes Taxi time (**0.0122/min**)
  TAXI FUEL = APU FUEL + TAXI FUEL = 0.0018 * APU TIME + 0.0122 * TAXI TIME

H. Calculate the extra fuel:

- ✓ Although the extra fuel can be added at the discretion of the captain, there are some standard amounts that should be taken into account:
  - o **0.26** for extra go-arounds
  - o **Approx. 0.45** for a circling approach
  - o Extra holding fuel according to the table in the FCOM v1, Chapter PD, Section 31.5 – Holding Planning (this time input the landing weight at destination)

- ✓ Calculate the approximate extra fuel time:
  EXTRA FUEL * 60 / 2.7 = EXTRA FUEL TIME

I. Calculate the grand total:

- ✓ Add up all the fuel masses from steps C, D, E, F, G and H. This is your **BLOCK FUEL** – the total fuel that needs to be loaded into the aircraft tanks. Round it up to the next highest 100 KGS (0.1).
- ✓ Add up all the corresponding flight times from steps C, D, E, F and H (note: without G). This is your **ENDURANCE** that needs to be included in the Fligh Plan.

3.3. Step-by-step example

A. Find the necessary loading data for the flight you will perform:

- ✓ **PAX = 95**
- ✓ **OEM = 41.4**
- ✓ **0.085 / PAX**
- ✓ **0.01 / BAG**

B. Now calculate the ZFM – assume each passenger carries one bag:

PAYLOAD = 95 * (0.085 + 0.01) = 9.025

ZFM = 9.025 + 41.4 = 50.425

C. Extract the required holding fuel from the FCOM:

FUEL FLOW PER HOUR AT 1500ft = (50.425 – 50) * (2.1 – 1.95) / (55-50) + 1.95 =

= 0.425 * 0.15 / 5 + 1.95 = 1.963

HOLDING FUEL = 1.963 / 2 = 0.982

D. Calculate the required alternate fuel:

- ✓ The intended flight will be from LOWW to LOWI. A suitable alternate is EDDM.
- ✓ Assuming a direct route. Distance from LOWI to EDDM is **70 NM**.
- ✓ On average, we will have a **20 knots headwind** →

  AIR DISTANCE = (70 – 50) * (108 – 55) / (100 – 50) + 55 =

  = 20 * 53 / 50 + 55 = 76 (approx.)

- ✓ **LANDING WEIGHT AT ALTN = 50.425 + 0.982 = 51.4 (approx.)**

- ✓ Firstly, we will interpolate the two adjacent rows for both columns, then the columns for both rows (calculating both fuel and altitude)

Trip Fuel and Time Required

AIR DIST (NM)		LANDING WEIGHT (1000 KG)							TIME (HRS:MIN)
		40	45	50	55	60	65	70	
50	FUEL (1000 KG)	0.5	0.5	0.6	0.6	0.7	0.7	0.7	0:14
	ALT (FT)	12000	12000	11000	11000	9000	9000	8000	
100	FUEL (1000 KG)	0.8	0.9	0.9	1.0	1.0	1.1	1.1	0:22
	ALT (FT)	19000	18000	18000	18000	17000	17000	17000	

First red, then blue, then orange.

Red:

(76 – 50) * (0.9 – 0.6) / (100 – 50) + 0.6 = 26 * 0.3 / 50 + 0.6 = 0.756

(76 – 50) * (1.0 – 0.6) / (100 – 50) + 0.6 = 26 * 0.4 / 50 + 0.6 = 0.808

(76 – 50) * (18000 – 11000) / (100 – 50) + 11000 = 26 * 7000 / 50 + 11000 = 15000 (approx.)

(76 – 50) * (18000 – 11000) / (100 – 50) + 11000 = 26 * 7000 / 50 + 11000 = 15000 (approx.)

Blue:

(51.4 – 50) * (0.808 – 0.756) / (55 – 50) + 0.756 = 1.4 * 0.052 / 5 + 0.756 = 0.771

(51.4 – 50) * (15000 – 15000) / (55 – 50) + 15000 = 0 + 15000 = 15000

Orange:

(76 – 50) * (22 – 14) / (100 – 50) + 14 = 26 * 8 / 50 + 14 = 18 (approx.)

Final results:

Alternate fuel: **0.771**

Optimum altitude for diversion: **15000 ft / FL150**

Diversion time: **00:18**

E. Calculate the required trip fuel for the main route:

- ✓ Distance of the route from LOWW to LOWI is **235 NM**.
- ✓ On average, we will have a **20 knots tailwind** →

AIR DISTANCE = (235 – 200) * (236 – 188) / (250 – 200) + 188 =

= 35 * 48 / 50 + 188 = 222 NM (approx.)

- ✓ **LANDING WEIGHT AT DESTINATION = 50.425 + 0.982 + 0.771 = 52.2 (approx.)**

Trip Fuel and Time Required

AIR DIST (NM)		LANDING WEIGHT (1000 KG)							TIME (HRS:MIN)
		40	45	50	55	60	65	70	
50	FUEL (1000 KG)	0.5	0.5	0.6	0.6	0.7	0.7	0.7	0:14
	ALT (FT)	12000	12000	11000	11000	9000	9000	8000	
100	FUEL (1000 KG)	0.8	0.9	0.9	1.0	1.0	1.1	1.1	0:22
	ALT (FT)	19000	18000	18000	18000	17000	17000	17000	
150	FUEL (1000 KG)	1.1	1.1	1.2	1.3	1.3	1.4	1.5	0:30
	ALT (FT)	26000	25000	25000	24000	23000	22000	22000	
200	FUEL (1000 KG)	1.3	1.4	1.5	1.6	1.6	1.7	1.8	0:37
	ALT (FT)	35000	30000	28000	27000	26000	26000	26000	
250	FUEL (1000 KG)	1.5	1.6	1.7	1.8	1.9	2.0	2.1	0:44
	ALT (FT)	40000	37000	36000	35000	34000	31000	30000	

✓ We will interpolate: First red, then blue, then orange.

Red:

(222 – 200) * (1.7 – 1.5) / (250 – 200) + 1.5 = 22 * 0.2 / 50 + 1.5 = 1.588

(222 – 200) * (1.8 – 1.6) / (250 – 200) + 1.6 = 22 * 0.2 / 50 + 1.6 = 1.688

(222– 200) * (36000 – 28000) / (250 – 200) + 28000 = 22 * 8000 / 50 + 28000 = 31500 (approx.)

(222 – 200) * (35000 – 27000) / (250 – 200) + 27000 = 22 * 8000 / 50 + 27000 = 30500 (approx.)

Blue:

(52.2 – 50) * (1.688 – 1.588) / (55 – 50) + 1.588 = 2.2 * 0.1 / 5 + 1.588 = 1.632

(52.2 – 50) * (30500 – 31500) / (55 – 50) + 31500 = 2.2 * (-1000) / 5 + 31500 = 31000 (approx.)

Orange:

(222 – 200) * (44 – 37) / (250 – 200) + 37 = 22 * 7 / 50 + 37 = 40 (approx.)

Final results:

Trip fuel: **1.632**

Optimum trip altitude: **31000 ft / FL310**

Trip time: **00:40**

Due to the challenging approach at LOWI and the ever-present possibility of a go-around or a circle to land or even both, we need to add the following corrective factors:

Go around and missed approach: **0.13**

Gear and flaps down correction for starting lowering the gear and flaps earlier due to the circling: **0.06 * 3 = 0.18**

Total trip fuel: **1.632 + 0.13 + 0.18 = 1.942**

F. Calculate the contingency fuel:

CONTINGENCY FUEL = 1.942 * 0.05 = 0.097

CONTINGENCY FUEL TIME = 0.097 * 60 / 2.7 = 2 minutes (approx.)

G. Calculate the taxi fuel:

TAXI FUEL = 0.0018 * 30 + 0.0122 * 10 = 0.176

H. Calculate the extra fuel:

We may need to perform an extra go-around and missed approach, so we add: **0.26**

There is also a great chance we will have to perform a circle-to-land procedure, so we will add: **0.45**

EXTRA FUEL = 0.26 + 0.45 = 0.71

EXTRA FUEL TIME = 0.71 * 60 / 2.7 =

I. Calculate the grand total:

- ✓ Add up all the fuel masses from steps C, D, E, F, G and H. This is your **BLOCK FUEL** – the total fuel that needs to be loaded into the aircraft tanks.
- ✓ Add up all the corresponding flight times from steps C, D, E, F and H (note: without G). This is your **ENDURANCE** that needs to be included in the Flight Plan.

	MASS	AIR TIME
C. Holding fuel	**0.982**	**00:30**
D. Alternate fuel	**0.771**	**00:18**
E. Trip fuel	**1.942**	**00:40**
F. Contingency fuel	**0.097**	**00:02**
G. Taxi fuel	**0.176**	**-**
H. Extra fuel	**0.710**	**00:15**
BLOCK FUEL	**4.678 → approx. 4.7**	**01:45**

END RESULT :

In the aircraft tanks need be loaded 4700 KGS of fuel.

The endurance to be entered in the FPL is 01:45 (one hour and forty-five minutes).

The optimum FL for cruise is FL310 and the optimum FL for diversion is FL150.