Energy management
(in the approach phase)
Part 2 – Practical Examples

Pilot tips and tricks

An aircraft is a moving thing operating in a three-dimensional environment. For the operation of an aircraft energy is vital. This article will explain to you in a slightly simplified way, how energy influences your flight – especially in the approach phase – and why energy-management plays a vital role in operating your aircraft safely and correctly.

This article consists of two parts:

- Part 1 will deal with the basics of energy of an aircraft
- Part 2 will add some practical examples and top-of-the-head calculations

1. Take-aways from Part 1

Let’s go back for a second to part 1 of this bulleting and remember the 5 thumb rules:

- *Rule No 1: the faster you fly the bigger the drag*
- *Rule No 2: on the approach phase, you will be able to reduce altitude by 1000ft every 3 NM (thrust idle, without your speed increasing)*
- *Rule No 3: you will be able to reduce your speed by 7 to 10KIAS per NM in level flight*
- *Rule No 4: if you’d like to achieve both, you cannot simply add the two together. Of course, you can simultaneously descent and reduce speed, but for the calculation you need to separate the two.*
- *Rule 5: Wind can mess up everything you have planned for if you don’t take it into consideration; every 10kts of tailwind reduce your descent capabilities by about 0.1°*

Remember again the basic challenge of the pilot in terms of energy management:

How much time/distance will it take to reduce the energy of my aircraft from the actual level/speed down to the Final Approach Fix (e.g. FL370/Mach .80 to 4000FT/180KIAS).

2. Practical examples

Let’s jump straight into the practical application – as a preparation grab your LSZH STAR and Transition charts, without charts you will be lost (as always when online flying).

2. A. Example 1:

You are approaching LSZH from the East. You expect to be cleared for the NEGRA2A arrival and from the ATIS you’ve already noticed that ILS approach onto RWY 14 is in use. You assume that you will reach RAVED at around FL200 with a speed of IAS 280KIAS. You target to reach OSNEM (FAF) at 4000ft with a speed of IAS 180KIAS.

Your route will lead you from RAVED via NEGRA and MATIV to AMIKI, the transition thereafter from AMIKI via ZH375 – ZH403 – ZH405 – ZH407 (which is abeam TRA) – ZH409 – ZH410 – ZH414 to OSNEM, which is the Final-Approach-Fix (FAF) for the ILS approach onto RWY14. The total track distance from NEGRA to OSNEM (see the charts) is 76.9 NM.

Means between RAVED and OSNEM you will have to reduce speed from IAS 280KIAS down to IAS 180KIAS and you will have to descend from FL200 down to 4000ft and you've got 77NM to achieve this.

The question now is which is the maximum altitude at NEGRA in order to reach OSNEM at 180KIAS/4000ft.

Let's go into computing:

Reducing speed by 100KIAS (from 280KIAS at NEGRA down to 180KIAS at OSNEM) will take 14 NM (Rule No 3). This leaves us with 63 NM for the descent (77 NM minus 14 NM).

During 63 NM we will be able to decrease by 21000ft (Rule No 2). We therefor know that even FL 250 by NEGRA would be ok for our descent (provided ATC does not give us a shortcut). Anything higher than FL 250 may require additional drag.

Furthermore, it might be wise to know about some intermediate checkpoints (pilots call them "gates") as well, in order to verify frequently, whether we are on track energy wise. Let's try it (ideally you compute that backwards):

OSNEM		4000 ft	180 KIAS
ZH414	4 NM	4300 ft	200 KIAS
ZH410	4.9 NM	6000 ft	200 KIAS
ZH 407 (~TRA)	11 NM	7000 ft	250 KIAS
ZH403	9.5 NM	10000ft	250 KIAS
AMIKI	14 NM	13000ft	280 KIAS

Do you believe in this calculation? The better way would be – verify it yourself!

2. B. Example 2:

As we all know, once is as good as never – another one:

Your inbound LSZH RWY14 from the NW. You are cleared the BLM3G arrival and instructed to cross BLM at FL 180. Knowing that this approach from the West into Zurich is quite tight, you are eagerly waiting for further descent from ATC. Here it comes – "maintain FL180 for the time being due to traffic". Whoops, that was not exactly what you had hoped for. You want yourself to answer on two questions

1. Can we make it without additional drag from BLM FL180/IAS280KIAS into OSNEM at 4000ft/IAS180KIAS?
2. How do we manage the fact, that ATC might delay further descent?

To Question No 1:

Descending 14000ft and reducing by 100KIAS will take …

Descending by 14000ft will take 42NM
Slowing down by 100KIAS will take 14NM

… in total 56NM. The total track from BLM for an approach via GIPOL14 transition is around 56NM. We can just make it. However, bear in mind that this is valid only if you follow the entire length of the transition (GIPOL14). Often aircrafts get vectored from GIPOL on a direct right base approach onto the LOC RWY 14. This reduces the number of track miles significantly. In such case, the descent as calculated in the example must be supported by additional drag, otherwise you will end up too high or too fast.

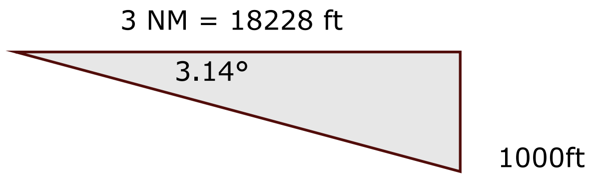
<u>To Question No 2:</u>

If you are not allowed to descend yet, do you have to ask for additional track miles? No, there is a way out – you have to slow down <u>first</u>. Without instruction on speed, we decelerate down to minimum clean speed, even though we are still at FL180. Once the further descent is approved – you can start descending and …….. increase the speed again (remember, at high speed the drag is higher). This works well, but only if you speed up by increasing the descent rate – by no means by adding thrust.

To turn it even more ambitious? Let's add some tailwind. What would be the impact of westerly winds (270/40)? Can you figure out yourself?

2. C. Let's add some tailwind

Let's go back to example No 2 and assume there are westerly winds (270/40). Rule No 5 let's us know, that the descent angle reduces by 0.1° by each 10KN of tailwind. In our case 0.4°. But, what's the angle of descent without the wind (in degrees). For this we have to remind ourselves to some trigonometry and apply it on rule no 2.



The angle is:
arctan (1000/18228) = 3.14°

0.1° less descent rate on a basis of 3.14° calculated descent rate equals 3.2%. In other words, the descent performance deteriorates by 3% per 10 KN of tailwind.

In our example we have 40KN of tailwind, means the performance reduces by 12%.

To reduce altitude by 14000ft we no longer need 42NM but rather 47 NM. To reduce speed by 100KIAS we no longer require 14NM but rather 16NM. Altogether 63 NM. With only 56NM available, we know much ahead, that we will need to apply additional drag in order to manage the descent correctly.

By the way: do you know how to calculate the tailwind component if the wind does not come from straight behind? I leave that up to you …

3. Personal fitness exercise

Why don't you try yourself to do a calculation of any approach of your choice. If you lack imagination, take this:

You are at RILAX FL140 with 220 KIAS and you plan for ILS14/LSZH. You know (or can find it in the charts) that the track to OSNEM (FAF) for a direct left base approach is about 24.9 miles. For a stable approach you need to reach OSNEM at 4000ft and 180KIAS. Possible? What's the maximum altitude by RILAX in order to make it?

Grab the charts - give it a go – that's good airmanship!

Happy computing and enjoy VATSIM!

Hans Peter Baumgartner
Leader Pilot-Training-Dept VACC Switzerland