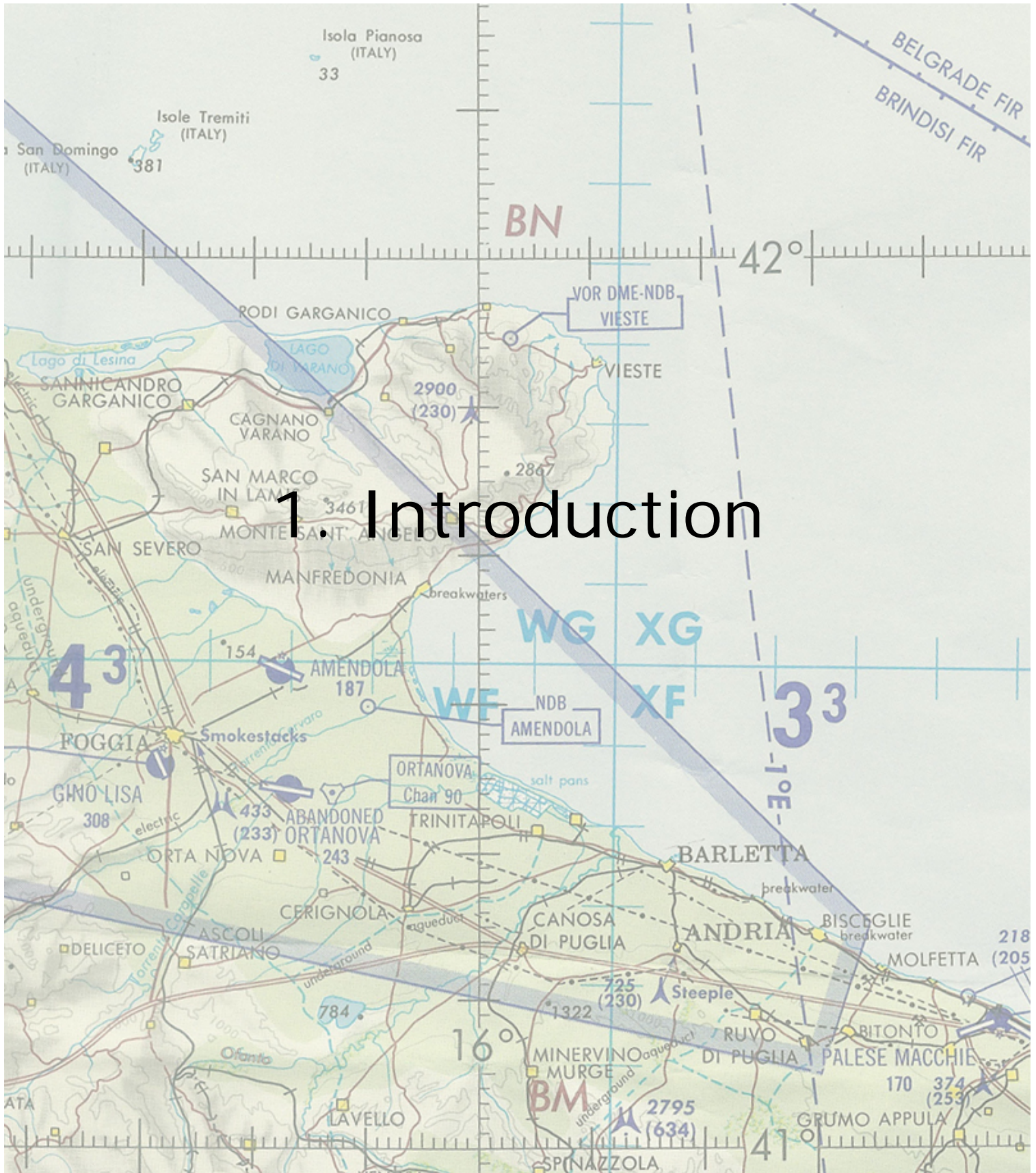


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The purpose of this tutorial is to document the Falcon 4 navigation charts I have been creating for the past 5 years. Those charts refer to specific symbols, abbreviation and IFR (Instrument Flight Rules) procedures that the average F4 flyer might not be current with. Let's try to clear it up a little.

First, let me stress the point that I'm not in any way a specialist of the matter. I'm just an IFR freak, flying flight sims for more than two decades now, especially IFR flight sims like Elite or alike. So my experience and knowledge is pretty limited and I am responsible for any mistake in this document – You have been warned, it's not a tutorial about real life IFR flying – just the way I do it in Falcon.

Now, F4 is very far from being an IFR flight sim, but since BMS1.3, we had some nice weather effect and then taken back in widely available OF versions, but the idea was appealing to me and I decided to press further by doing a chart set for each South Korean airbase. Fortunately, the weather effects are now reintroduced with the current BMS version, making the charts quite useful nowadays – as this tutorial.

I took the liberty to take some distances from real life IFR procedure to adapt them to Falcon.

Beside the weather aspect, the idea was also to give reference points to members of the same multiplayer flights by naming (and giving relevant F4 GPS coordinates) specific waypoints around the airports. The purpose here is obvious. Each member would follow the published route alone and rendezvous with the other member of the flight by holding at a certain point.

And finally, the lack of decent ATC in Falcon can also be avoided by following the charts. It's even possible to assign a human controller in multiplayer to act as ATC and vectors the flight around the airports, completely bypassing the original ATC.

You have it figured out by now; most of what will be explained might be relevant to human flights only. There is no way at this time that the AI controlled flights or the AI ATC might play the charts game. Meanwhile, having one AI wingman doesn't really complicate the problem if you make it stick your wing closely (otherwise, it will turn around you in circle keeping his speed up). The other annoying aspect will be the Falcon ATC, but as you will see, there are workarounds and at worst it can be completely ignored. The best solution is when multiplayer squadron assign a human flight controller who endorses the charts.

The charts were created for BMS. Over the past 3 years, it has become a problem to support many different versions of Falcon (BMS, OF, AF) With the release of BMS to the public again, there is no doubt in my mind that this version will supplant any other. As a consequence, I'm supporting BMS only in my charts and checklists work.

Disclaimer:

It took me about 3 years to create a chart set for each South Korean airbase. It is obvious that during that time, my experience and my way of viewing things changed a little. Add to that the Falcon code changed as well... As a consequence some early charts are quite different from late charts. Beside while writing this document, I realized some charts had errors needing correction. Hopefully, by the time this rewrite is finished, all Korea charts will be updated and available in your doc folder of your install - or through my website ([www.combatsimchecklist.net](http://www.combatsimchecklist.net))





We can't really hope to explain how to use the charts in Falcon without talking a little bit about radio navigation, can we?

Radio navigation is a very vast subject and there are publications and tutorials available on the web to learn how to master IFR flights. One of the best resources for us is the lessons in Microsoft Flight Simulator. There are also a lot of Jeppesen publications very useful. (See sources ...)

Opposed to VFR (Visual Flight Rules), IFR (Instrument Flight Rules) use radio beacons aids and allow the pilots to fly without any visual reference. In real life, there are quite a few different beacons:

- NDB: Non Directional Beacon
- VOR: VHF Omni Directional Range
- DME: Distance measuring equipment
- VORDME: beacon combining the VOR and the DME.
- TACAN: TACTical Air Navigation system.
- ILS: Instrument Landing System

....

Falcon supports only TACANs and ILS system. In this version of BMS, the ILS are not collocated anymore to the tacan and each runway may have its own ILS frequency.

For Falcon, we will consider the TACAN as a VORDME: A beacon emitting in all directions (360°) with a fixed range and a distance measuring capability. In the cockpit, we read the Tacan information through the HSI Instrument.





## 2.1. Tacan mechanisation

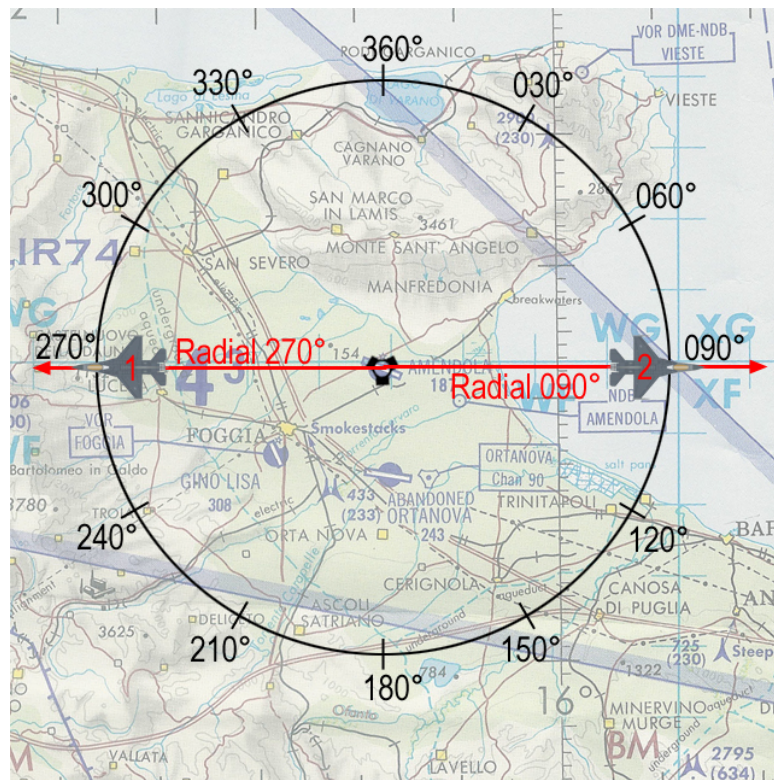
But let's first come back a while on the TACAN.

The station is emitting 360 radials, one for each degree of the circle. We could be more precise than this but by default the falcon HSI is able to increment radials by 5° only, we actually have 72 relevant radials. Please note that the further you are from the station, the further apart the radials are and as a consequence, navigating far from a station is less precise than navigating near the station.

It may be interesting to say that it is possible to enable 1° radial increment with BMS, please refer to the BMS -34 manual for further instruction. Let me just add that with the mouse, it may take a long while to make a full turn on the dial. As a consequence, I suggest you keep the 5° setting unless you have an encoder available for HSI implementation.

Radials are half-line with a fixed origin (the station) but are reaching infinity on the other side. Please note, here the infinity stops at the station maximum emitting range ☺ which is set in the stations.dat file. In real life, they are line of sight limited, as any radiowave is. In Falcon, the curvature of the earth is not implemented and the tacan emissions go through the mountains as well.

We accept the fact that , as for the headings, 360° is North, 090° is East, 180° is South and 270° is West.



As a consequence, we need two radials to cover one direction:

Radial 090° for the right quadrant and radial 270° for the left quadrant for instance.

Those two radials draw a full line in the middle of the circle.

An aircraft cannot be on the 270 radial if it is east of the station. It is on the 090 radial.

But established on the same radial (090° for instance), you can fly a heading of 090° (outbound the station – your distance to the tacan is increasing) or 270° (inbound the station – your distance to the tacan is decreasing)

This is mainly semantic, because you will realize that using R-270° or R-090° whatever your quadrant is has no real importance in F4. The important thing to note here is that when you talk to somebody, being a wingman or ATC, you need to stay coherent and use the correct terminology. So even if you are flying a heading of 270° to the station but you're still east of the station, you need to state that you are on the 090 radial inbound the station.

I know this is probably confusing at this time, but read on.

Tacans also have a distance measuring equipment (DME) that gives the distance in Nautical Miles (Nm) between your aircraft and the selected station. That indication is given in the top left window labelled "miles" in the HSI.

There is a maximum distance at which the tacan is emitting according to different parameters in real life. In Falcon, the range varies between 25Nm and 150Nm. Past that distance, the HSI will be flagged with large red indicators to notify the pilot that the data received are not useable. See the HSI description further down for more information.



## 2.2. Setting up the cockpit

Obviously, the first thing you'd need to do is to set the correct information in the system. Tacan channel, tacan band, Tower frequency, ILS frequency etc.

With the original Falcon, we only had access to the BACKUP navigation system of the F-16. With current versions however we now have access to both the backup system and the "normal" system. I mention it because I know a lot of you still use the old backup system while you should really start learning how to use the UFC to set all the navigation data in the cockpit.

The backup system is implemented on the AUX-COMM cockpit panel. When the CNI



switch is in the backup position – tacan channels and band are to be inputted from this very panel by clicking the channel numbers and X or Y band. You also need to specify if you will track a ground station or an airborne station. That is done with the T/R or A/A TR switch. The A/A TR being for airborne emitters like the tankers. Now again, it's not the correct way to do it, it's a backup way only used when the main system is inop.

The correct system to input the tacan channel and band into the cockpit is through the Up Front Controller (UFC) by using the ICP and the DED. For that to work, obviously the CNI switch of the AUX COMM panel needs to be placed in the UFC position, but that's an item required to be done at the ramp start (see checklists).

Depress the T-ILS button #1 of the ICP to enter the Tacan/ILS page of the DED:



The tacan channel can then be typed in the scratchpad by using the ICP buttons. First check that the asterisks are correctly placed around the scratchpad (DCS up or down if necessary) and depress the ICP numeric keys 5 and 4 then the ENTER key supposing you

want to input Amendola AB tacan channel. In the example below, the picture on the left shows the T-ILS page with a 118Y AA tacan selected.



Next is to set the correct band. In F4, we have the X band (for ground) and Y band (for air). Strictly speaking it's not 100% accurate, but it's the way it's supposed to work in F4. To change the band, simply input "0" (zero) in the scratchpad and press ENTER. That will toggle the band from Y to X to Y ... (see figure above right)

The last thing you need to set as the tacan is concerned is the T/R or A/A TR. That is done by depressing the DCS switch to the right (SEQ position). The value will toggle from T/R to A/A TR and back.



This is also the page where you input the ILS frequency.

The UFC is capable of detecting the difference between a tacan channel and an ILS frequency, so if you enter 10930 in the scratchpad the UFC will understand it's an ILS frequency and will input it in the FREQ line after you hit ENTER. As you have noticed, BMS allows each runway to have its own ILS and ILS frequency are no more tied to the tacan channels as it was the case with older version of Falcon.

To be able to communicate with ATC, you also need to input the correct frequency for the tower. This is of course given in the approach charts in both UHF and VHF frequency. UHF is COM1 and VHF is COM2 in Falcon. We mostly use Uniform (UHF) to communicate with extra flight facilities and Victor (VHF) for intraflight communications. So to set a tower frequency in the UFC, you select COM1 page with the ICP button and simply enter the required UHF frequency: example 292300 for Kunsan. There are many more information about the newly implemented radio system in BMS in the /34 document in your doc folder of your falcon install.

Okay; the basic steps are done. Now is a great time to introduce the main navigation instrument of the F-16 cockpit: the Horizontal Situation Indicator. Well a note of warning first. When you're simply following your pre planned route, your main instrument will of course be the MFD on the HSD page. But when you will be doing radio-navigation relative to a steerpoint or a tacan station, you will need to use the HSI.

Before giving a rundown of the instrument purpose, you need to know that the HSI has 4 different working modes. Those modes are set on the small panel just left of the HSI:

**TCN MODE:** The instrument uses the set tacan station as a reference and gives bearing and distance relative to that station.

**TCN/ILS MODE:** Same as above but gives steering cues for the Tacan collocated ILS.

**NAV MODE:** The HSI in this case will not use a radio-navigation station as a reference but the currently selected INS steerpoint. That is very handy when you want to navigate to a waypoint and arriving with a set heading. In this mode, the steerpoint is considered a virtual tacan.

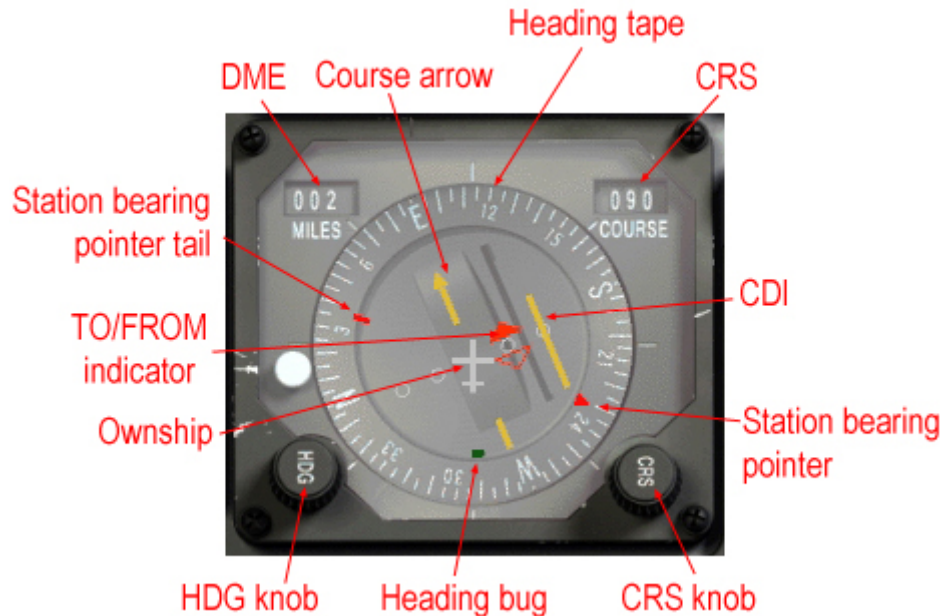
**NAV/ILS MODE:** same as above but providing ILS steering cues at the same time. That position will be used for instance when returning at the pre-planned airbase and shooting an ILS approach.





## 2.3. The main navigation instrument: the HSI.

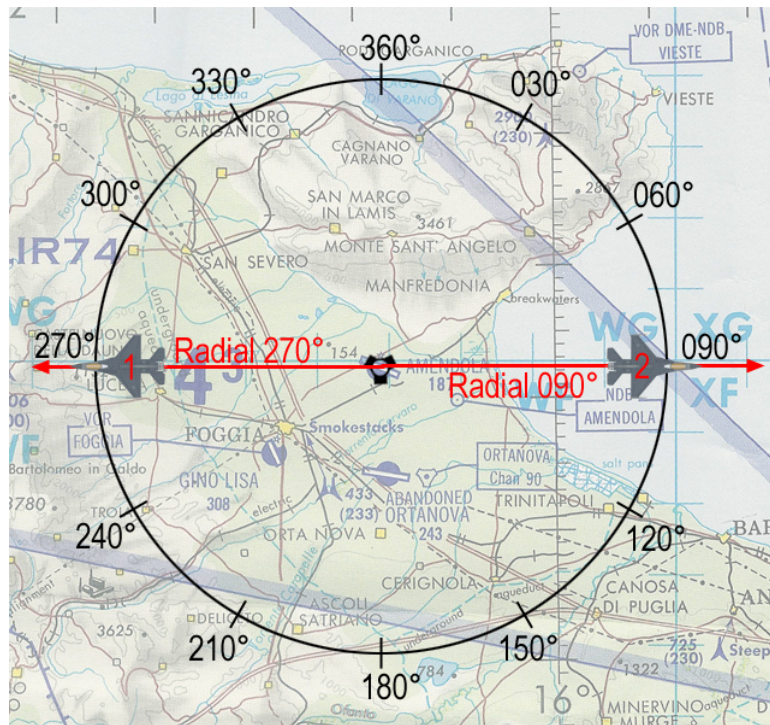
Still there? Perfect. Let's move on to the main course, the Horizontal Situation Indicator.



The instrument gives you a god's eye view of your aircraft (in the centre of the instrument) and its position relative to the selected reference (radio-navigation station in TCN mode or Steerpoint in NAV mode)

- The Heading tape: Gives your heading on the 12 o'clock position.
- The DME window: Gives the slant range between you and the selected station.
- The Course window: Gives the currently selected radial.
- The Course knob: Set the desired radial
- The Heading knob: Allow to set the heading bug on a selected heading.
- The Course arrow: points to the selected course on the heading tape.
- The CDI (Course Deviation Indicator): Gives the position of the selected radial relative to the position of your aircraft.
- Station bearing pointer: Points directly to the selected station. This arrow is really interesting both for the beginner and the advanced user. Firstly it clearly gives the bearing to the station and for the most advanced user it can be used as an ADF (Automatic Direction Finder) able to track a virtual NDB. More on this later.
- Station bearing pointer tail: That's the tail of the red pointer, giving the reciprocal heading of the station bearing.
- To/From indicator **xxx**
- Heading Bug: Moves accordingly to the HDG knob. It's a reference heading that is used by the autopilot system in ROLL HDG SEL mode. It can also be used as a reminder of headings (wind corrections, ...) when you don't use the autopilot.

Let's start with a simple ☺ example, Taking fig1 above:



The airplane #2 is on the 090 radial. But the HSI can display two readings, depending which radial is selected:

First, notice that the actual heading is 090°, since you see the position of AC#2 on fig1; you know the aircraft is EAST of the station and is going away. We say it's **OUTBOUND**.

The station bearing pointer points at 6 o'clock, meaning the station is right behind AC#2.

The set course is 090 and the course arrow is aligned with the 090° on the heading tape.

The CDI is centred; meaning AC#2 is spot on the radial. If the pilot were to continue flying on the 090°

heading (considering a no wind condition) the aircraft would continue flying away from the station established on the 090° radial.



AC#2 – Option 1 : Set R-090°



AC#2 – Option 2 : Set R-270°

The second picture on the left is taken at exactly the same moment but this time the course 270° has been selected. The aircraft is still on a 090° heading **OUTBOUND** the station. The Course arrow points at the 270° mark on the heading tape and the CDI is centred, meaning we are still on the 090° radial. This is where which radial you are on gets tricky !

Obviously, it is easier to radio-navigate with option 1 when the course arrow is pointing to the actual heading. So you will want to align as much as possible the Course arrow with the actual heading to avoid thinking about reciprocal radials. In case of option 1 above, it is clear we want to fly outbound using the 090° radial. Because first we are flying outbound and secondly we are indeed on the radial 090°.

Notice the TO/FROM indicator. On previous versions of falcon, the TO/FROM indicator was bugged and never worked in FROM. If you falcon version does not show the same as the above HSI pictures then, I suggest you update to a falcon version that has it working correctly ☺

The following paragraph was left in from the previous version of this tutorial. It illustrates that the TO/FROM in BMS is now working right. Compares the two above pictures with the two below ☺

Let's take the indicator from FS2004 for instance, on the same situation:



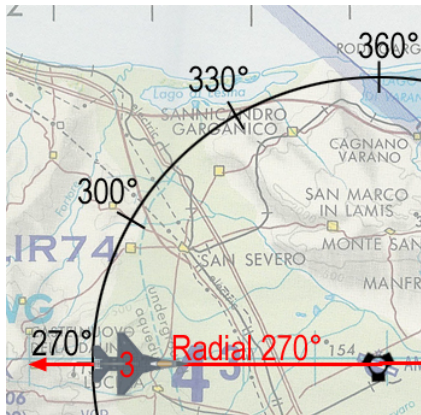
We are flying a beech baron established on Radial 090° from a VORDME. The RMI is set to 090° as indicated by the course arrow and we are on the radial, as indicated by the centred CDI. Now look at the TO/FROM indicator which in this case is white... it points backwards, meaning we are FROM the station. This is what the F4 HSI should display in the above example. Now let's turn the Course knob to select R-270 on the RMI and see what happens with the TO/FROM indicator. If it were to work as in Falcon (unlikely) it would rotate with the course arrow and finally points UP once the radial 270 is set which would be highly incorrect. Now what really happens is that, the TO/FROM indicator rotates with the course arrow but it changes its state at the 360° mark (actually 90° off the selected radial) and continue its rotation until R270° is set where it points downward as it should. See the two pictures on the left.



As you see in both images, taken at the same moment but with a different radial selected, the TO\_FROM indicator remains coherent and correctly indicates the FROM state we are in. This is how the F4 HSI should work as well. Unfortunately, the F4 TO/FROM indicator always is completely useless in F4. So don't use it at all. I will refer to INBOUND and OUTBOUND course instead in this document.



Let's go back to Falcon by considering the following example:



AC#3 is on the WEST of the station and is flying toward the station with an actual heading of 090°. It's actually on the 270° radial. But it will be easier to use the 090° course in the HSI because the reading will be clearer. Indeed, if we select course 090° in the HSI, the course arrow points at the 12 o'clock position and is the same as the heading – as pictured below. On the contrary, if course 270° is set, the course arrow points at the 6 o'clock position and although it is more correct, it's not easier to work with.



**As a conclusion, even though the radials are half-line with a fixed origin, it's always better to use the radial pointing at the heading as long as you always keep in mind the true radial you are on.**

So far, we have been considering very easy cases where the aircraft is already tracking a radial – with the CDI centred – it is called 'tracking' a radial and it's the easy part. The hard part happens before that stage when the pilot tries to intercept the desired radial.

Initially, when the pilot sets the required radial in the HSI, he gets something like this:



So what does the instrument tell us?

1. The tacan is somewhere behind on the right hand side. On the 230° bearing. So we are going away from the station
2. The selected course is 090°
3. The 090° radial is on my right (CDI is offset to the right) So we are LEFT of course.
4. I'm flying on a 112° heading
5. The station is at 2 Nm from me.
6. Anything else? Yes: discard the TO/FROM indicator ☺ in that picture, it was taken before the TO/FROM was fixed.

With a little experience, you will have a rather good idea of your position in space relative to the station. If it's clear for you, go direct to the next section. If not, read on...

A good trick to visualize in space your position before starting a radial interception is to centre the CDI by turning the CRS knob. Once the CDI is centred, you know for sure on which radial you currently are... Bear in mind that the CDI will be centred on two reciprocal radials (310° and 130° for instance) and that you are usually moving at high speed in your F-16 and the CDI may not remain centred for long.

The picture above was taken on the threshold of Amendola runway 11. Let's centre the CDI to check the radial we are on:



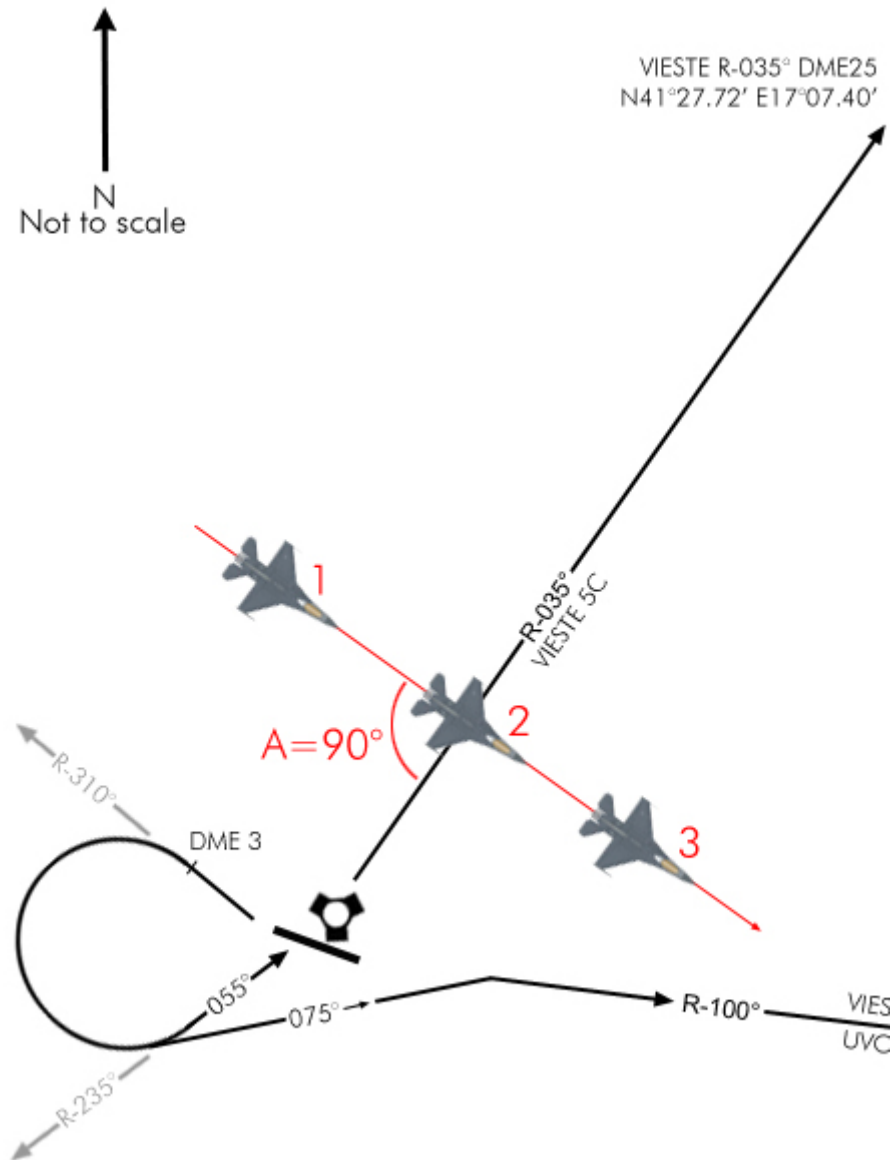
We are on R-135 (reciprocal is R-315°)  
Knowing that information, you know you are somewhere on a line originating at the station and extending on the 135° direction. The DME indication gives you the distance to the station, fixing the point on that imaginary line where you exactly are.

You will have understood it, to succeed in correctly intercepting a radial; you first need to know exactly where you are relative to the emitting station, hence the relevant radial.

## 2.4. How to intercept a radial.

Once you know where you are and you know which radial you need to intercept, you need to fly towards the imaginative line drawn in space by the radial. The shortest route to that interception point is to fly a heading at 90° from that line. With such a perpendicular heading, you will reach the radial very fast but you will have lots of difficulties to make a smooth interception because the CDI will pass from one side to the other very fast.

Let's consider the following example:



We have to intercept R-035° outbound Amendola tacan. We are on the ground, ready to take-off on RWY 29 and once airborne, we will make a right turn to heading 310° as the procedure implies. Once we flew away a little from the airbase, we will make a large 180° to the right and attack the radial with a 90° angle and see what happens on point 1, 2 and 3. The HSI is in tacan mode, radial set to 035° and we are rolling on the runway.





At point 1, we show a 90° attack angle (A) on the 035° radial. The “A” angle is clearly pictured on the HSI by the angle created by the actual heading (125°) and the set course (035°). Note the position of the station bearing pointer. As you are nearing the radial, it will descend to the 215° mark that will be reached when the radial is intercepted.



Nearing the radial, the CDI will start to move towards the centre of the dial. The greater the interception angle, the faster the CDI will move. When the CDI is centred with the yellow arrow, it means you are spot on the radial. That is point 2. Note that the course arrow points to the left, meaning that the 035° radial extends to the left side. So if you were to intercept it OUTBOUND, you should turn LEFT. If you were to intercept it INBOUND, you should turn RIGHT, towards the tail of the arrow, or toward the station bearing pointer.

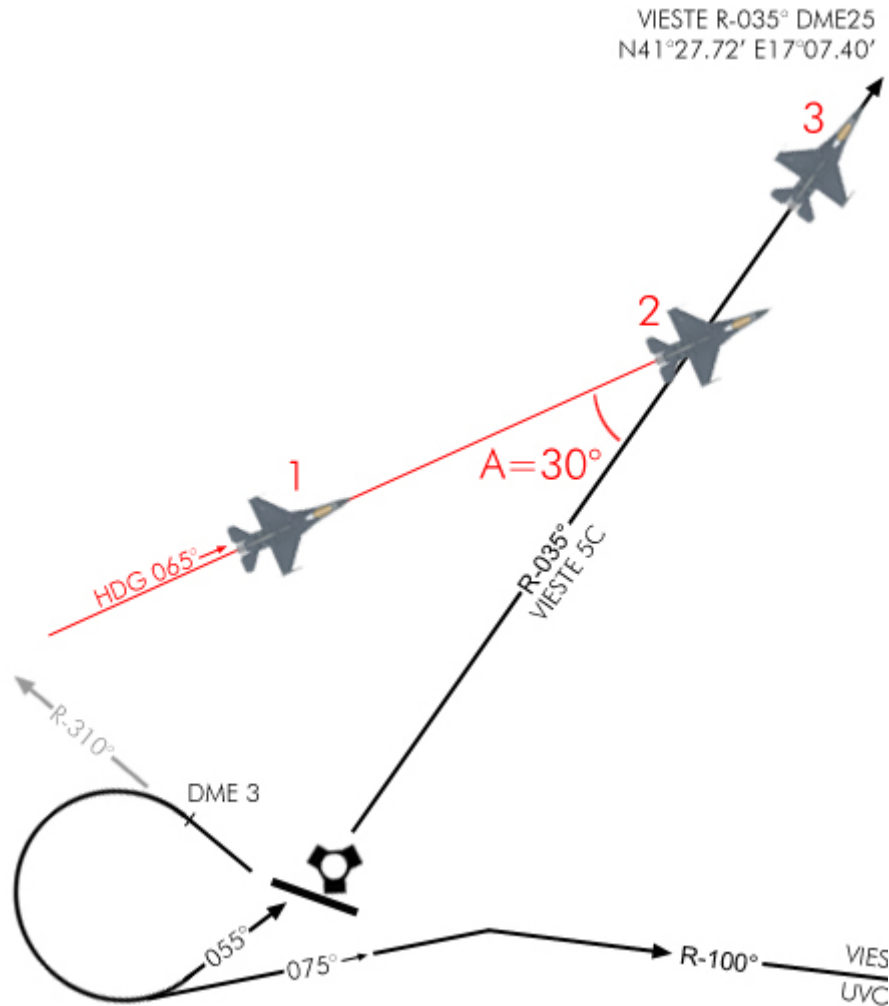


Now of course you are flying a 125° heading, so you're just a fraction of a second on the radial. After that time, the CDI will start to move on the other side of the course arrow. You have just passed the radial and are now on the other side. That is position #3. Notice the station bearing pointer that continues its progression past 215° now that you overshoot the radial.

Notice that according to your distance to the station, the amount of time it takes the needle to swing from one side to the other will be different. Really fast at close range, slower but still faster than desired due to the 90 intercept at longer ranges

Fine, you probably have it figured out by now; intercepting a radial with a 90° attack angle won't provide a smooth ride. But who cares? You don't have passengers – do you? The guy in the back you say – don't worry about him, he likes being bounced on the canopy.

In general aviation, they teach you to intercept a radial with a 30° attack angle. That indeed will provide plenty of time for the pilot to see the CDI start moving towards the centre and the final turn will be smooth: Here's how it's done still using the same example:



After taking off from runway 29, we turn right to a heading of 065° to have a 30° interception angle on the 035° radial. As before, that interception angle is perfectly visible on the HSI as pictured on the left. At position 1, the CDI is offset to the right (meaning the set radial is on your right side) and will start to move slowly towards the centre of the dial as we near the imaginary line.



At point 2, the CDI is centred and we turn to follow the radial on a heading of 035°. Notice, I already started a gentle turn to the left to intercept. If you delay your turn too long, you run the risk of overshooting the interception and fly parallel to the radial right next to it. You would have then to restart a smooth interception to get back on the correct route.  
At 13 DME and with such a small interception angle, the CDI moves very slowly giving you plenty of time to intercept smoothly.



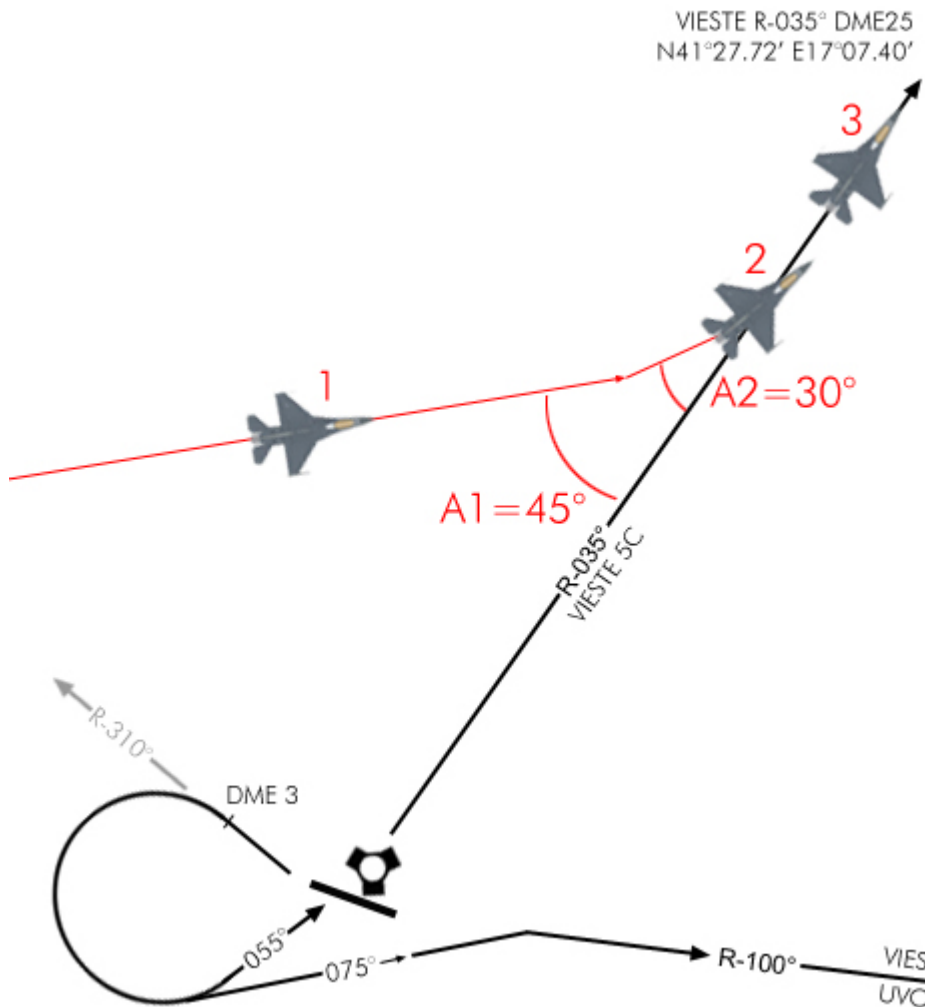
Here's the instrument view at point 3. We are going away from the tacan, aligned on the 035° radial. The station bearing pointer shows the tacan right behind us, confirming the fact that we are outbound.  
In a no wind situation, we would remain on the radial and the CDI would remain aligned with the course arrow. In a windy situation, you might drift off the radial and might need to start compensating for wind drift with a small correction angle.

Of course, the situation is a little bit more dynamic than explained on paper. Once the CDI starts to move toward the course arrow, you will need to be ready to turn. You might also turn a little; say by 10° increment, to slow the CDI progression toward the centre. That will give you more time and will flatten the final interception turn and decrease the risks of overshooting the radial.

With a little experience, you will increase your interception angle; according to the distance you are from the station (the closer you are, the faster the interception will occur) and smooth it on the run to fly a curved interception on the radial, finishing your turn correctly aligned.



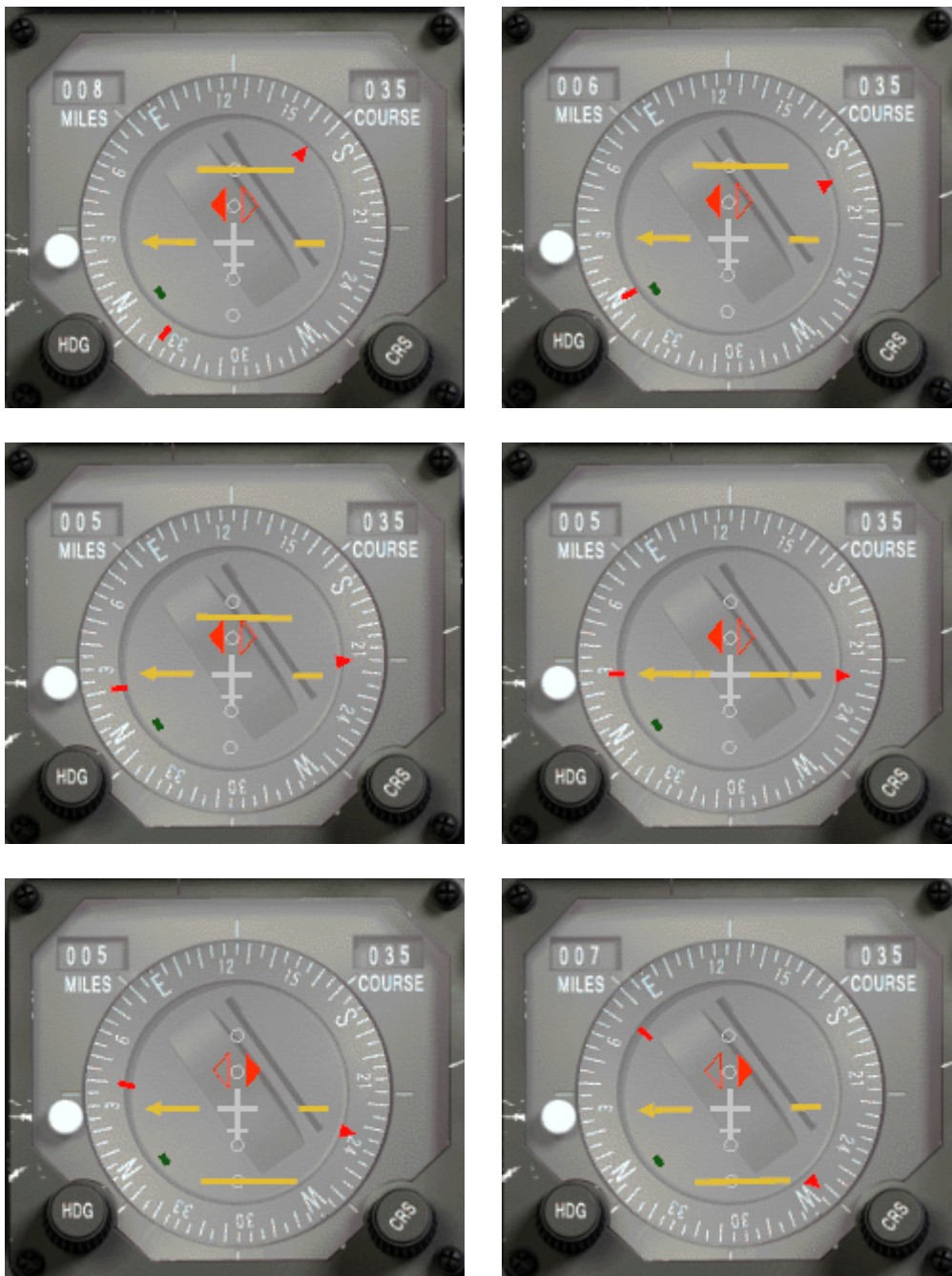
Personally, in Falcon, I tend to use a 45° interception angle and decrease the angle a little once the CDI is one dot from the centre.



As I mentioned above, when you are very far from the radio navigation station, you might want to start your interception with a rather large angle to ensure that you do not go too far away especially when intercepting outbound. (Tacans in F4 have a limited range, remember?) So start with a 90° intercept angle and decrease your angle once you near the radial. Bear in mind the distance to the station also when deciding an intercept angle!

A very good tip here is to use the station bearing pointer. Indeed, you know it points directly to the station, so when the bearing pointer start to move toward the course arrow (or the end of the course arrow when intercepting outbound – you know the radial is nearing, even before the CDI starts to move. That indication is good information to help you decide what interception angle to use.

Consider again the following images and concentrate on the red bearing pointer:



The example is the same as the 90° interception above. The important thing here to visualize is the progression of the red bearing pointer starting at the 1 o'clock position and descending to the 5 o'clock position.

As you know the red arrow points to the selected station and as you are nearing radial 090°, the pointer will move toward the course arrow (point or tail depending if the radial you set is outbound or inbound). When you are on the radial, the pointer will be aligned with the yellow line (right picture of the middle row). As we are just passing the radial in this example, the pointer continue drifting downwards as the tacan goes to our right rear quadrant.

The bearing pointer is a very helpful instrument to help you visualize your position in space relative to an emitter, which is after all the goal of radio navigation. Don't hesitate to use it.

Then there is a trick to intercept the radial very precisely. You know the small aircraft icon in the centre of the HSI represents your aircraft. If you extend a line in front of your aircraft longitudinal axis, you picture your flight path (the white arrow). If that line were to always remain between the CDI and the course arrow (the green lines), you will constantly turn your aircraft until the three lines are perfectly aligned and you have then flown a perfect intercept.



We are intercepting R-280° outbound, meaning we are following the radial to get away from the station. We know we are not too far away from the radial because of the position of the bearing pointer, close to the course arrow tail, and we are at 14 DME from the station. The interception starts with an angle of 45° on the left image. Once the CDI starts to move inboard, the angle between the green lines will get narrower. The trick is to keep the white arrow close to the middle.



The green angle narrows, the projection of the flight path remain in the middle area. Do take care, because if you fix your attention on the HSI, there's a great chance your attitude will become dangerous. Better check your artificial horizon, speed and altitude as explained below in 2.8.





The green angle gets even narrower and on the right picture we are almost there. Since we are getting away from the station, the CDI will move slower at greater distance, so in this case, the interception is easy to perform because we have more time to make it nice.



Once established on the radial, all the reference lines are aligned. The CDI is centred on the course arrow, the 2 green lines are common and the white line is also aligned with the green one. As pictured on the left image, we made a textbook perfect interception.

Of course, in the cockpit, you don't have the green lines or white arrow. Still there is the 12 o'clock mark on the HSI that could be used as the white arrow to help you, as pictured on the right image.

**For the green lines, you will have to find your way, but it becomes second nature very quickly with a little experience.**

## 2.5. Tracking a radial once established

Now that you know how to intercept a radial, let's see if we can track it. Maintaining the aircraft on the selected radial is very easy in a no wind and no turbulence situation. And we all know we have a very stable platform with Falcon, so that makes things easy for you to learn basic radio-navigation. Be aware though, in Current BMS, it

is quite possible to get variable wind and turbulence. Furthermore The possibility to extract the instrument to secondary monitors (via third party software also increase the IFR capabilities of Falcon.

Established on R-180° inbound the station, you need to fly a heading of 360°. Let's say you concentrate on your mission and drift slowly to the 002° heading. It's visible with your HUD heading tape, but you are head down in the cockpit checking the SMS system. (Next time turn the autopilot on, you rookie) Slowly, the CDI will start to drift to the left side of the course arrow. After a while, you notice the drifting of the CDI and decide to centre back on the selected radial. Now don't go take a 45° interception angle to get back on course, there is a great chance that you will overshoot the line and zigzag around it. The best course of action here is to first fly a heading of 360° to stop the drifting from the radial then turn left 2 to 5 degrees (depending how far you have drifted) to gently intercept back the radial.

Try to visualize the position in space by looking at the god's eye view the HSI pictures for you. The yellow line is the set radial, you are in the small aircraft in the centre, and the CDI pictures the radial position. The intercept angle will become obvious at a glance: place the longitudinal axis of the small plane always between the CDI and the course arrow. Turn your airplane accordingly and you will make a perfect interception. Once the CDI centres; turn right to fly a heading of 360° to remain on the radial.

The closer you get to the station, the more precise the CDI will become, so it's normal to have to adjust your course when you fly inbound an emitter. The contrary is true as well. The further you fly from a station, the least accurate the CDI becomes.



## 2.6. What about the wind ?

You know the wind will naturally push you on one side or the other of the radial, so depending on its force you will need to fly a wind corrected angle to remain perfectly aligned.

Of course that means you need to be aware of the wind direction and speed – but that's easy. Just dobber right on the DCS switch (SEQ position) while the DED in on the main page (STPT) and a new line will appear with wind settings. On the example on the right, wind is 340° at 9 Kts. With that information in mind, it's easier to decide which wind correction angle to apply and especially on which side!



Again, in BMS we got the weather back and winds can be strong and variable with weather and altitude. Be prepared to fly WCA (wind corrected angles) to stay on your radial.

## 2.7. Station passage.

Imagine that you're tracking R-130° inbound of a known tacan. Your flight plan will take you right over the emitter and then you will continue on your heading and fly on R-310° outbound the same tacan.

You will overfly the station and your heading will remain unchanged on 130° (in a no wind situation).

Nearing the station, the CDI which is centred will start to drift one side or the other. And the bearing pointer will make a 180°. Once the CDI starts to move (in F4, it usually starts at DME1-2) don't try to follow it. You're too close to the station and the instrument readings are inaccurate. Just fly along your heading until you are on the other side of the emitter where the CDI will centre again. It might not centre perfectly, and you may want to fly a new interception angle until it centres again.

In real life, we talk about a cone of uncertainty (sp?) when we are that close to the station. It starts sooner the higher you fly. But in Falcon, it's mostly happening very close to the station, whatever your altitude is.



## 2.8. IFR instrument scanning.

Radio-navigation will bring you from point A to point B on a pre planned route but try to remember that your first goal is to fly the plane safely. So don't get fixated on the HSI because obviously it does not give you information about the altitude and speed of your aircraft.

To be able to fly correctly a letdown chart, you will need to master heads down flying by completely forgetting the HUD (and that is the real challenge!)

Down below on the instrument panel, you only have some analogue instruments you will need to use all at the same time – I know, the HUD is much easier, but you can't see the HSI in HUD view, no escape here.



You have 3 main instruments you need to scan one after the other at all times. The artificial horizon, altimeter and machmetre. I won't cover their purpose here, if you don't know – don't even try to master radio-navigation, it's too soon. What you need to do is this:

1. Look at the artificial horizon, check it's correct according to what you want to do;
2. Look at the altimeter check your altitude is correct;
3. Look back at the artificial horizon, check it's still correct;
4. Look at the Machmetre to check your speed;
5. Look back at the artificial horizon, still correct?
6. Look at the HSI for radial alignment or intercept
7. back at the artificial horizon...

And start all over again. That technique is called scanning and it helps the pilot checking that his airplane is doing what he wants it to do. By acting like this, there's a very small chance that you'd miss a parameter going out

of limit (speed too high, wrong altitude,...) You also noticed you always have to go back on the artificial horizon. Because it really is the instrument giving your attitude. For instance, if the artificial horizon is flat and shows no turn or a climb, then you're almost sure your speed will remain the same (if the throttle hasn't been touched) and the altitude will be fine as well. So centre your scanning technique on that primary instrument.

You can also include other instruments on your scanning like the AOA and VVI indicator. And according to the situation, you might want to concentrate on the HSI for a little while, but always do get back often to the artificial horizon and maybe less often on the other instruments. But do check them.

Needless to say, that scanning technique is mandatory once you switch to heads down view and transition to IFR flying. It is also the only method that will let you fly an IFR approach, STAR or SID procedure because you will need to be at specific altitude, specific headings and specific speed all along the route.

I also discovered while training that talking to myself greatly enhanced my scanning and gave me an aural cue of what need to be done next. That is especially useful when climbing or descending. I state warning that I have a thousand feet to go before level off.

Or I always remind myself by speaking what would the next step to be completed. It's really useful. Just be sure you are cold mike (teamspeak, IVC hotmike can spoil your reputation) My wife already has a good idea of my reputation, so I don't care if she hears me ☺ !

## 2.9. Transition Altitude / Level / Layer.

Here comes one aspect that probably most if not all the Falcon flyers are confident with. And I reckon it's not easy to grasp. One feature dearly missing from Falcon is a correct atmospheric model with pressure changing with altitude (amongst other things). In BMS, it is now implemented and that makes the whole aspect much more realistic and introduces a real need for altitude calibration and a common reference above a certain altitude. What does it all mean?

Pressure varies with many different variables. One of them obviously being weather and the second obvious variable is altitude. A lesser variable is temperature. In BMS, all those variables are taken into account and may change your data in your altimeter since that instrument uses pressure to give altitude.

As a consequence, your altimeter may give you an altitude one day in fair weather and gives another data at the exact same spot another day in bad weather.

Why? Because if the altitude remains the same, pressure (hi pressure system in good weather and low pressure system in bad weather) is different and temperature is different to a lesser extend as well.

Your instrument needs calibrating with the local pressure. That information is usually given by ATIS but we don't have that in Falcon, thus it is given by a new ATC menu: Request QNH.

QNH is the code word for local pressure (also referred to local altimeter setting) it is given in Hecto Pascal (millibars) or inches of Mercury for you Americans, depending on how your BMS config file is set (see BMS/34) for further information.



Once you have that pressure, you need to set your altimeter to that exact same value.

The current calibrated pressure is displayed in the altimeter instrument, below right of the altitude block. If you rotate the bottom left knob on the altitude bezel, the value changes. Set it to the value the tower gave you. Once done, you should check that the altitude displayed now by your analogue instrument matches the airport elevation given by the chart. You have just calibrated your altimeter for the first time in Falcon.

On the left picture, the local pressure setting (QNH) given by the tower is 1038 and sitting at Kunsan we crosscheck the altitude given by the altimeter with the airport elevation: 10 feet.

Obviously, when you travel in an aircraft you travel through air mass with different characteristics and the local area pressure change often. It is impossible to always fly with the local altimeter setting on cross country flights, especially for long distance flights. That is where the transition altitude/level comes into play. It is an imaginary altitude where pilots are required to switch their altimeter to the standard pressure (QNE) of 29.92 inches of Mercury or 1013.25 Hecto pascals (millibars).

In Korea the transition altitude/level is set at 14000 feet/FL140. So anytime a pilot climbs through 14000ft he must change his altimeter setting to 29.92InHg or 1013hPa.



From that moment, altitude is not called in feet anymore, but in flight levels. 15000feet= FL150, 23000feet= FL230. Basically, it's the hundredth of the altitude expressed in feet.

If all pilots do so, they will all be on the same standard pressure setting and that will make it easy to coordinate altitude calls. One single pilot forgetting to do so may create a safety hazard because of wrong indicated altitude and a potential of midair collision when deconflicting with altitudes when flying IFR. It is therefore important not to forget to make the switch of altimeter calibration. A very convenient way NOT to forget is to use the MSL floor in the UFC. By depressing button A-LOW #2 of the ICP, you can easily set an aural ALTITUDE warning at a specific altitude.



The first line is the cara ALOW and often used for specific altitude floors, the best suited floor is the MSL Floor you can reach by dobbering down. It is by default set to 10.000feet but I suggest you set it at the transition altitude (14000ft for Korea – 7000ft for Balkans, etc etc) You can change its value once the

asterisks are around the value and then enter the new value. You can even set this in the DTC (through your callsign.ini file in the config folder so you don't have to change this for every flight. Once done, Betty will call altitude as soon as you climb through or descent past 14000feet, warning you to switch your altimeter setting.

When you descent back through the transition level, you will of course reset your altimeter to the local altimeter setting QNH. But since the weather model in Falcon is now dynamic, it might be different than the one you had at takeoff. So you must contact a tower in the vicinity and request QNH. You can request that information outside of the 30Nm Range of your destination. Although I recommend that in fast changing weather you keep it updated as you come closer to the Initial approach fix.



In tactical situation, you may need to descend lower than the transition altitude and have no facility to contact to get the local altimeter setting. Well you can always contact the nearest tower, even if outside of the 30Nm radius. That was implemented to compromise the fact that Awacs or Jstars can't get you the local altimeter settings. And you always have the radar altimeter when you are in North Korea and when you don't know the local altimeter setting. Just use extra caution when that happens. Falcon still isn't perfect, but we are way more advanced than before with no atmospheric model implemented.

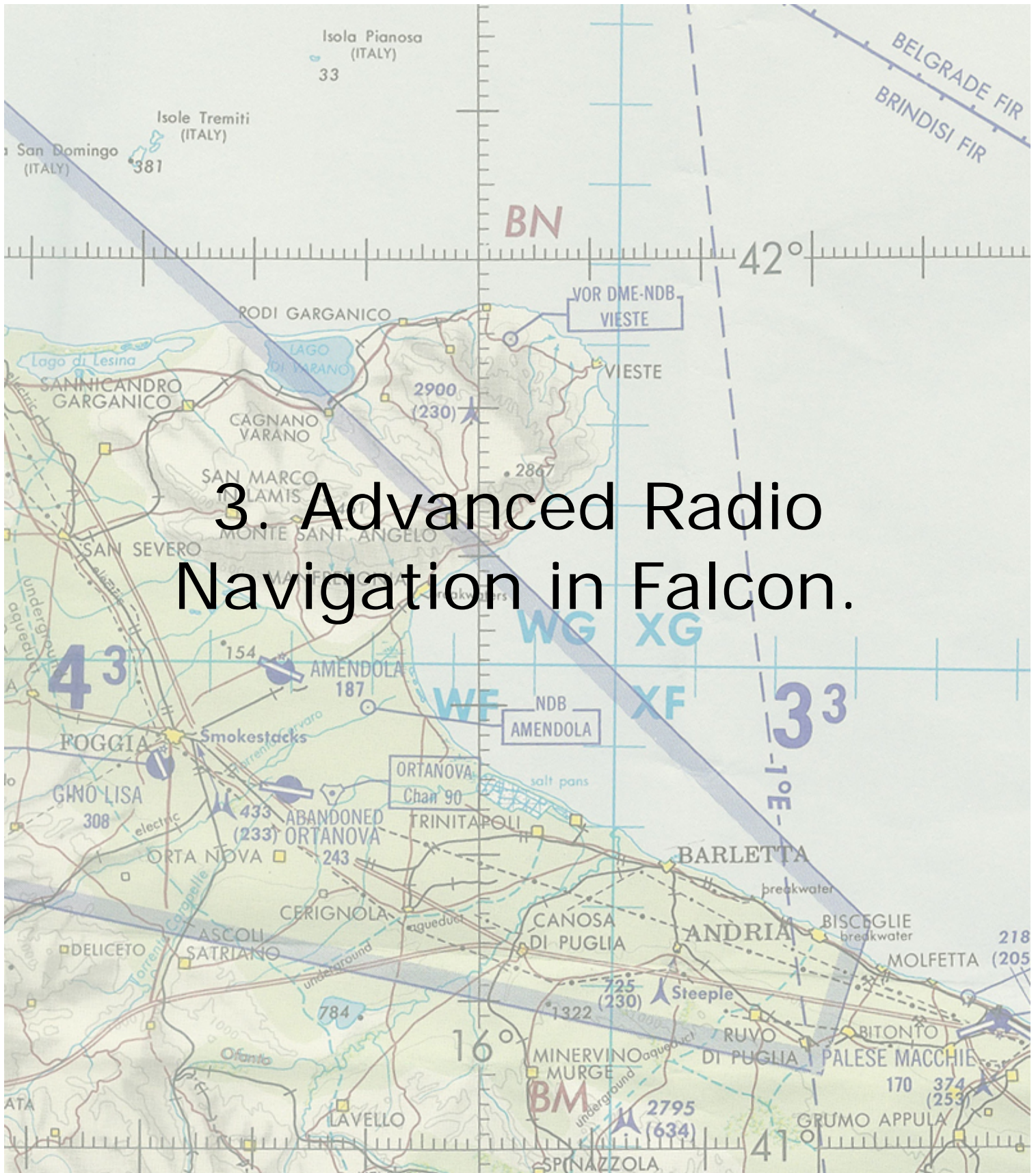


## 2.10. Things to remember.

Although what has been covered is only the very basic stuff, it's enough for basic radio-navigation in Falcon. You should now stop reading and launch the sim to make some very basic exercises. Start by making sure you know how to fix your position with a tacan (by centring the CDI) and try some radial busting (90°) and finally some intercepts, both outbound and inbound. Experience will do the trick here – we aim for precision flight, so you will need to learn to intercept a radial with a nice curve and finish the turn perfectly aligned and directly correcting for wind drift. So get some practice, read back some pages from this document and/or call for help if anything is still unclear.

Some points to remember:

- The interception angle will vary according to the distance of the emitter due to radial spread.
- The interception angle has to be determined accordingly to outbound or inbound intercepts.
- To intercept a radial by flying a nice curve, keep the longitudinal axis of the small HSI airplane between the CDI and the course arrow.
- Within 2 DME of a tacan, the reading of the HSI becomes erratic – just fly the constant heading
- Don't forget to check the wind.
- Reduce speed; it gives you more time to think things over.
- When you're heads down in the cockpit, SCAN the instruments or you'll buy the farm.
- Mind your altimeter setting, it became quite important.



Before reading further, you should be able to intercept and track precisely any inbound or outbound radial while maintaining a set speed and set altitude.

To follow the charts, you will need to understand the principles of some more advanced manoeuvres such as performing DME ARC, follow an ILS, study the different holding pattern entries and performing circle to land procedures. Offset tacan approaches will also be documented.

### 3.1 Following the ILS to the minima.

The ILS works the same way as a fixed tacan radial along a runway centreline with some important differences though. It's a double radio emitter. One emits in VHF for the localizer also referred as LOC, and is usually located at the end of the runway (opposed to the approach). The other emitter is paired to the localizer but emits in UHF for the glideslope, also called glide for short. It's usually placed offset to the runway centreline at a distance from the approach end of the runway.

The localizer provides guidance to the centreline of the runway and is pictured in the cockpit by the vertical line in the HSI and the ADI and the HUD. The width of the localizer emission cone varies between 3 and 6°. Such a small cone provides higher sensitivity of the CDI than when tracking a tacan radial. As a consequence, pilots tracking the ILS should make smaller corrections and should make them more promptly than tracking a simple radial.

As mentioned above, the localizer emits only in the runway centreline direction. That's why you don't need to set the course for the HUD&ADI vertical bars to work as advertised. The HSI course arrow doesn't really need to be set to the runway approach course, the reading of the CDI will remain correct to the ILS but it may lead to some confusion if the course arrow points backward. The deviation of the CDI will then be opposite to the side of the ILS. This is a normal behaviour when the course arrow points to a reciprocal heading of the approach runway heading.

So to avoid any confusion, it's better to set the HSI course arrow on the runway approach heading. That way the CDI deviation will point to the Localizer as it would to tracking a radial inbound.

The glideslope provides the vertical guidance to the optimum descent profile which is usually 3°. In the cockpit, it is pictured by the horizontal needle in the HSI, ADI and HUD. Since the emitter is offset of the runway centreline, the glideslope can't be followed until touchdown. Usually, pilots needs to transition from an instrument approach to a visual approach at the minima. There are visual aids helping the pilot's transition at this critical point, we will cover these later on.

ILS procedures also use two (or more) beacons along the approach track: the outer/middle marker and the inner marker. Markers are displayed in the cockpit both visually by flashing lights and aurally by different frequency Morse code. Fortunately BMS/OF features them. The F-16 cockpit does have the corresponding instrument: A green lighted indicator labelled MRK BCN on the right of the HSI, above the FUEL QTY panel.





The markers provide range information to the runway. The outer/middle marker is usually placed between 4 and 7 Nm (usually 6) from the runway threshold and is actually the point where the glideslope is intercepted.

Inner marker are placed closer to the runway, usually 3500 feet and should be heard and seen in the cockpit around 200ft above the ground, usually near the minima.

In BMS, both markers light up the MRK BCN indicator making it flashes at different frequency: (low freq for OM and higher freq for MM). Although in general aviation, the colours for each marker are different, in the F-16 cockpit, the indicator is monochrome and remains green.

Backing up the visual cues, a different Morse code would be played in the pilot headset according to which marker is overflown.

Finally visual aids are placed on the runway to help the pilot's transition from IFR flight to visual short final approach. In BMS, we have different kind of lighting aids such as the bright runway approach lights (ALSF1&2 (precision) and MASLF (non precision)) which should help the pilot to get the runway in sight at minima. And the glideslope visual aids: VASI or PAPI.

PAPI (Precision Approach Path Indicator) is a row of four light placed right or left of each runway. They give your position relative to the optimal glideslope by varying each of the 4 the lights from white to red:

Four whites mean too high,

Four reds mean too low,

2 reds & 2 whites mean on glideslope. 1 white, 3 red mean a bit too low, and 3 white and 1 red mean a bit too high.



The VASI: Visual Approach Slope Indicator. This system consist of a double bar row each side of the runway. The system reflects coloured lights according to your position on the 3° glidepath. The pilot should attempt to fly the aircraft so the far bars are red and the near bars are white. When all bars are red, the aircraft is below the glidepath and when all bars are white, the aircraft is above glidepath.

There is a mnemonic to remember easily the VASI lights:

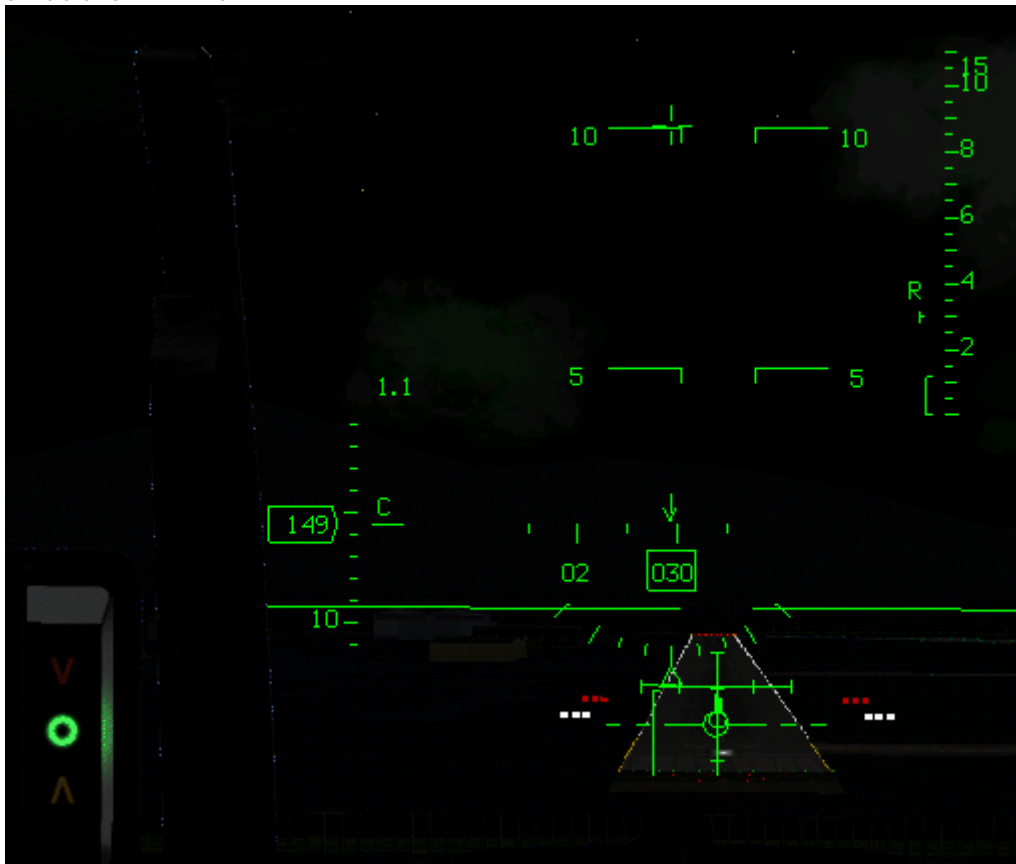
"Red over white is alright – Red is dead"

Those systems are extremely useful especially in low light conditions when the lack of contrast makes the descent angle difficult to gauge for the pilot.

Intercepting the ILS is done in two steps. The first step is to intercept the localizer. This usually happens at the longest distance from the runway. With the F4 charts it's usually done between 14 and 9 DME. At this point, you concentrate on getting the localizer centred while having stabilized the aircraft at a certain altitude with a certain speed. Between 9 and 7 DME, you usually should be at 2000ft with

the loc centred and the glideslope above you and coming down to meet your flight path. At DME 6 or 7 according to the approach, you should meet the glideslope (and the outer marker when implemented). Pop the airbrakes if they are not out already and lower the landing gear. In Falcon, extending the gear also lower the flaps so your aircraft may pitch up for a moment but speed will greatly decrease because of the increased drag. Usually, the drag created by the gear is enough to create a pitch down motion so your aircraft starts descending along the glidepath. If not, reduce speed a little and place the flight path marker on the minus three degrees on the HUD scale. Concentrate on the instruments; keeping the Loc and glide centred the on speed AOA (13° green doughnut) and you should make a perfect approach.

The HUD is a real great help here because you can keep the ILS indicators, speed tape, altitude and heading tape as well as the AOA indicators all in view at the same time. And on top of that the runway will be seen as well helping greatly the transition to visual approach at the minima.



Quite often, in F4 and in real life, you may get a visual on the runway well before reaching the minima just to loose the visual a few moments later because a low cloud drifted in the way or because of low fog. So care should be taken to keep scanning the instruments as long as you are unsure that the approach can be finished visually. Since you committed the minimum decision height to memory, you wait for this moment at the final stage of the approach (see the chart section for a discussion about the decision height) A good clue for minima is also the inner marker. Pilots should then announce runway in sight and finish the approach using the VASI lights and maintaining the green AOA doughnut lighted. Would the runway not be in sight, the pilot should initiate a missed approach and call it on the radio.

### **3.2. DME ARC**

Many instrument approaches start with a DME ARC because they are an easy mean to transition from the enroute phase of the flight to the final approach course. It seems quite complicated but actually it is very simple to fly.

A DME ARC is simply part of a circle around an emitting station (here a tacan) at a given distance. The arc is 1 Nm wide and the pilot tries to remain within that arc by constantly turning toward the station. The trick is to keep a constant mental image of your position throughout the ARC and to the tacan.

Larger arcs are easier to maintain than smaller ones. The speed at which you fly the arc will also define its difficulty level. Obviously higher speeds make it more difficult. And if you try to fly a small arc at high speed, you are in for a lot of fun!

Flying a DME ARC is done in three steps: Intercepting the ARC, flying the ARC and intercepting the final approach course.

The first and last parts are usually the most difficult ones because they usually induce a 90° turn which takes time to perform

#### **3.2.1: Intercepting the arc:**

A 90° turn takes time. And that time is dependent of your speed. Obviously, if you wait to hit the DME mark to start your 90° turn, you will not be able to fly the correct DME arc and you will be inside it. So the basic problem of correct DME arc interception is actually to be able to lead the initial turn. Luckily, we know how to do that with the following formula:

$$\frac{Kias}{60} - 2 = \text{Distance of lead required.}$$

Example: You need to intercept a 14 DME arc with a speed of 300 kts indicated:

$$\frac{300}{60} - 2 = 3 . \text{ You need to start your turn 3Nm before DME14: that is at DME17.}$$

You can also apply this formula with a Mach number:  $(M*10)-2$  ex:  $(0.5*10)-2=3$

#### **3.2.2: Intercepting the final approach course:**

This one is a little bit trickier. You are at the end of your DME arc and you need to intercept a specific exit radial and thus will be required to perform a 90° turn again. Since you are often close to the ILS, it is best to make a correct interception that will give you a smooth transition to the ILS track. So obviously you will first need to calculate your distance required to lead the turn with the above formula. Very often, your speed will be the same or close and your lead distance might be the same. Id est: 3Nm  
So the big question here is how many radial will I cross while doing that 90° turn over a 3 Nm turn radius ?

Well, there's a rule saying that at 60Nm, the distance between two radials is 1Nm. That's the famous 1 to 60 rule. Knowing that, you realize that at 30Nm the distance between two radial is ½ Nm, at 20Nm = 1/3 Nm at 10Nm = 1/6 Nm.

So if you come out of a 20 DME arc, you know that the distance between two radials is 1/3Nm, that's 3 radials in 1Nm . And since you need a 3Nm radius, you know that over the turn, you will cross 3x3radials = 9 radials.

So you start your turn let's say 10 radial before the intercept radial. If that one is Radial 360 from Kunsan for instance, you start your turn at R-010° from Kunsan. What do you do with that information? Simple. In the DME arc, set your CDI to that specific radia (10°) and check it while in the arc DME. Once that radial centres, that's your clue to start your turn. Don't forget to reset your CDI to the final intercept radial (360 in this example) so you can fly a smooth final interception.



So to summarize:

1. Calculate the lead distance (Nm<sub>lead</sub>):  $\frac{300}{60} - 2 = 3$
2. Calculate Radials per Lead turn =  $\frac{60 \times Nm_{lead}}{ArcDme} = > \frac{60 \times 3}{20} = 9$  radials

For a 14 Dme Arc, the formula would give:  $\frac{60 \times 3}{14} = 13$  radials

The above is correct for an indicated speed of 300 kts. If you slow down in the ARC to 250 kts:

1.  $\frac{250}{60} - 2 = 2.16 =$  lead distance
2.  $\frac{60 \times 2.16}{14} = 9.25$  radials

Obviously you don't have a calculator with you when flying Falcon, and all calculation will be done mentally, so keep it simple, round your numbers and the decimal part won't be of great importance anyway. You will soon realize that the your speed below 10.000 feet is most of the time between 250-300kias and since all the DME arcs are often the same (14Nm, 20Nm) very few different formulas are needed and it's always the very same one that come back.

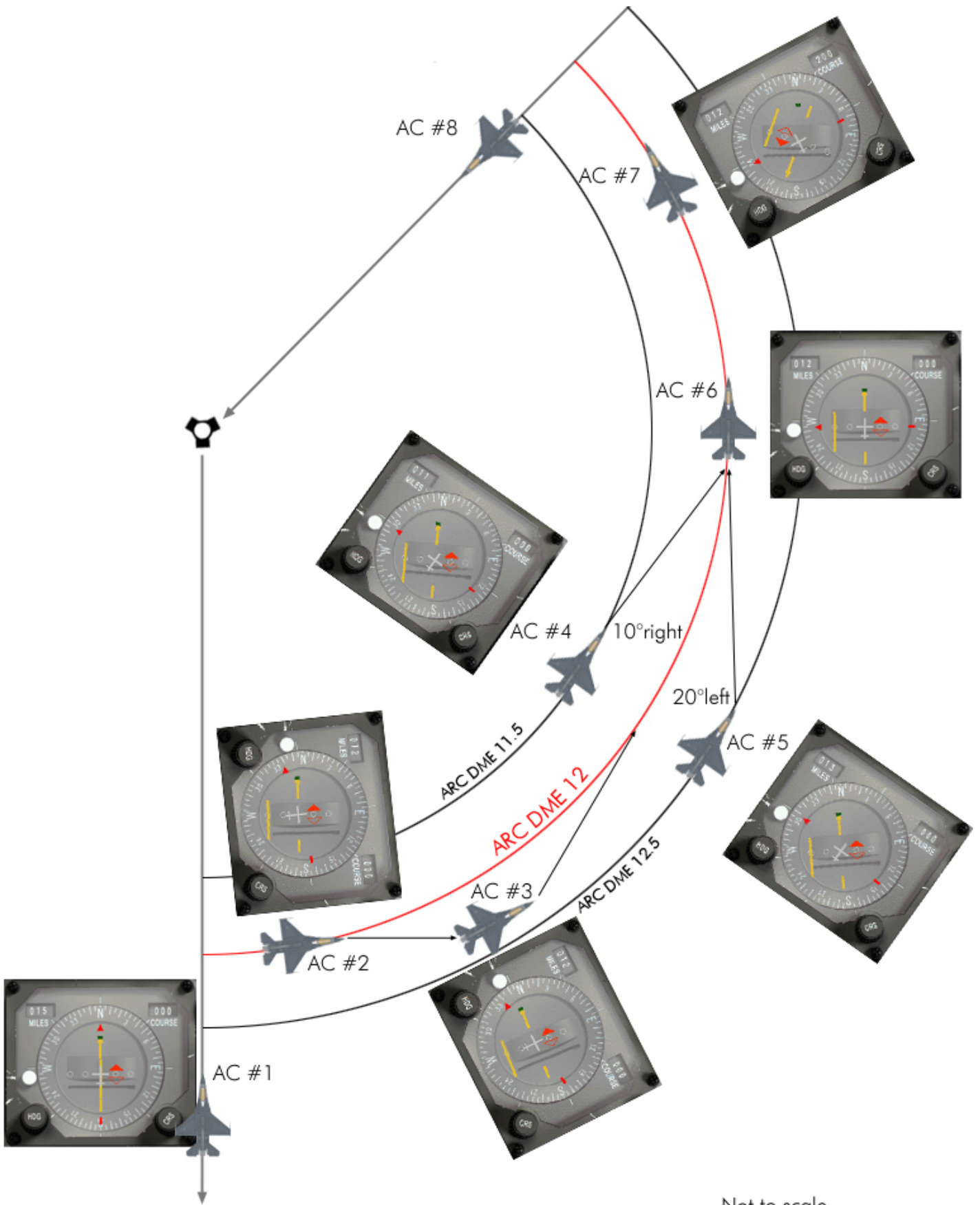
As a rule of thumb, for 250-300 kts, Lead turn distance is 3Nm and number of radial to lead is often 10 as well. The later is often referenced on the charts. The former is not, so you need to know it.

### 3.2.3 Maintaining the arc:

Maintaining the arc is done by using once again the red station bearing pointer (it's not red anymore in BMS but it is in the pictures below). Since you want to turn around the station, all you actually need to do is to maintain the bearing pointer on your wingtip and turn accordingly so it remains there for the duration of the arc. It is as simple as that! As you see on the image on the next page, once the DME ARC has been intercepted (by leading the initial 90° turn), the bearing pointer is on the nine o'clock position on the HSI (left wingtip). That's position #2. The aircraft flies a heading of 90° or already a little less. In a no wind situation, it would be possible to make a constant turn toward the station to maintain the bearing pointer exactly on the nine o'clock position and the required DME distance. In real conditions, it's best to let the bearing pointer drift some 5 to 10° past the wingtip and then turn to replace it some 5 to 10° forward of the wingtip. And start the process as often as necessary to maintain the ARC.

At position #2, If the pilot were to continue on this heading, it would reach position #3 and the bearing pointer would start drifting aft of the left wingtip position. The pilot should then turn left some so the bearing pointer points ahead of the left wingtip position. Then he can fly in a straight line, letting the bearing pointer points to the nine o'clock position and slightly past it, where the process start all over again.

At position #3, If the pilot over correct (by placing the bearing pointer too far forward of the left wingtip position), he would find itself in position #4 with the DME indicator reading 11Nm. On the other hand, if he corrected not enough (by placing the bearing pointer not forward enough of the nine o'clock position) he would find itself in position #5.



Its simpler to fly the DME ARC on the inside of the curve, letting the ARC comes to you and then turning a little to replace the bearing pointer forward of the wingtip. To come back on track when inside the curve – like at position #4, a 10° turn (for each half mile deviation) outside the ARC is enough. If the pilot is outside the arc at position #5, a 20° turn (for each half mile deviation) inside the arc will be required to get back on the required DME ARC. That is of course when the bearing pointer is correctly placed on the wingtip position.

AC #6 is spot on the DME ARC, flying a heading of 360° and having completed a 90° of the turn. AC #7 is also perfectly on the DME ARC and the pilot gets ready to intercept the final approach course as pictured by AC #8. A lead turn will be required to intercept correctly the radial – notice the 200° radial has been set on the Course arrow to give the reference point of the lead turn. Bear in mind that you might also want to intercept an ILS instead of a tacan radial. Refer to the approach chart section for an explanation of the final turn.

Correcting for the wind may seem complicated since your heading is not constant and the wind correction angle will constantly change. If the wind is pushing you away from the station, place the bearing pointer ahead of the wingtip position and use this as the new reference for your turns. If the wind is pushing you towards the station, use a new reference point past the wingtip position. The wind correction angle is then easily viewed: it's the angle between the wingtip position and the new reference point on the HSI.

Beside speed, keeping the altitude at the correct level is critical. Quite often you are flying below the MSA (Minimum Safe Altitude) and there are mountains around you. So scan your instruments properly to not only remain on the DME ARC but also to keep the correct speed (300- 250 kts) and the correct altitude mentioned on the charts.

Usually you start the DME ARC at a relatively high altitude and higher speed (350-300kts) and you want to leave the DME ARC at a lower altitude and with a lower speed near the gear down speed. As a consequence flying the DME ARC, you will need to change your speed and altitude according to the charts and that will certainly spoil your trim settings ☺ Did you know you can trim the F-16? Pretty handy flying an IFR procedure.

### 3.3. Tacan approach

Following a tacan radial to the minima is the same kind of approach as the ILS, but with less guidance. You don't have glideslope information while shooting a TACAN approach so the altitudes are given in levels to be at a certain distance from the runway threshold in the side view of the tacan approach chart (refer to the approach chart overview). Once again, pilots don't need to fly in level. As long as they can reach a specific DME at the required altitude, they can fly a gentle descend to the minima.

The other aspect specific to Falcon is that since all tacan stations are placed alongside the runway, most of the tacan approaches are offset from the runway axis. The reason is simple, by angling the final approach course from the runway centreline; it's often possible to intersect the runway threshold at the minima. Then only a gentle visual turn is required to align the craft on the centreline.

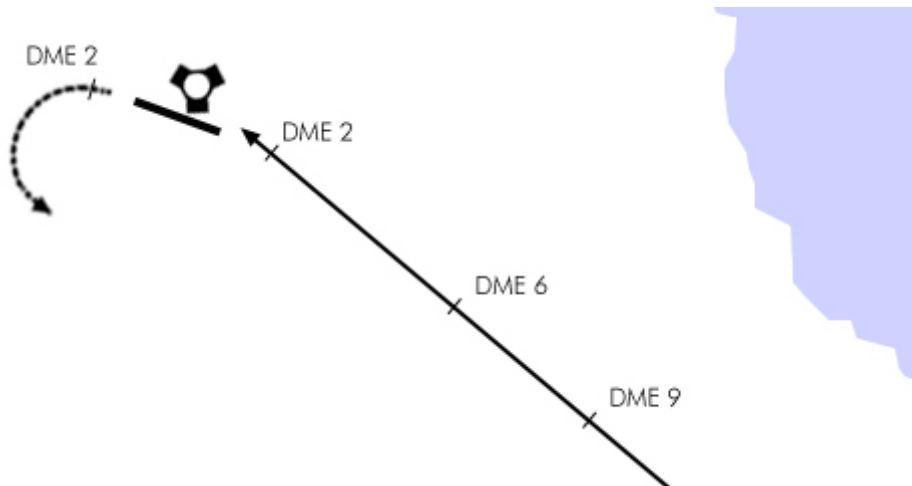
If the chosen tacan radial for the approach was the same as the runway axis (Radial 230° for a 23 runway for instance) the pilot would find himself parallel but aside the runway when looking out of his instrument at the minima. A visual S would then be needed to get on the runway centreline. This double turn is more difficult to fly than the angled approach.

In the charts I created, both type of tacan approach are available... I found the angled radial trick a while after doing the first tacan approaches.

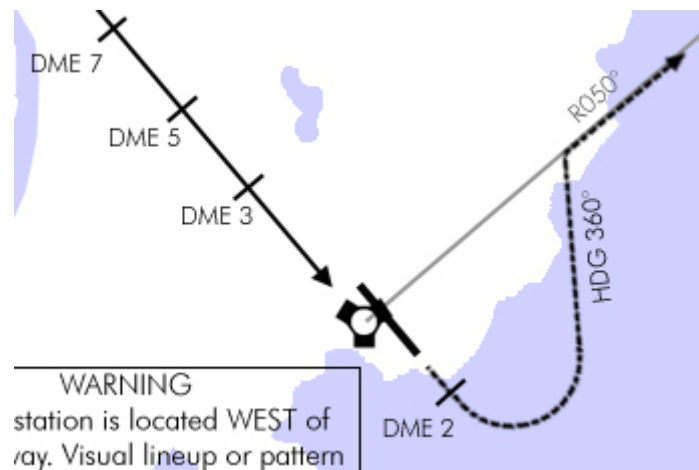


In real life, we can find both approaches as well – but quite often, the emitter is placed somewhere on the runway centreline axis to allow easy alignment on a fixed radial. It's not necessarily a Tacan; it can be a VORDME, a VORTAC or even a NDB.

Since a final turn is almost always necessary for the pilot to align his aircraft visually with the runway, the minima for tacan approaches are always higher than an ILS approach. They are around 500 - 700 feet above ground level. That will leave plenty of time for the final line up.



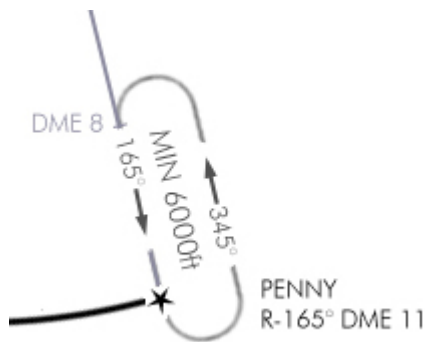
Amendola runway 29 tacan approach is 20° offset and runs down the radial 130° on a 310° heading. As you can see DME 2 is perfectly aligned with the centreline and that's where the minima is. So right there, a left line up turn is all it takes to get on the runway centreline.



Pusan RWY 14 tacan approach is not offset with the runway. As such the pilot will need to make an aligning S turn at DME3 to get on the centreline.

### 3.4. Holding procedures

Holding in Falcon is not something you will do often unless you are masochist ☺. Still performing a CAP is a kind of holding, albeit with longer legs. The charts have holding patterns published on most approach charts and even on some SID charts. So you need to know how to fly them and more difficult how to enter the holding area.



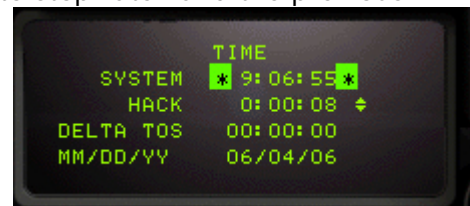
Holding are racetrack patterns where the aircraft fly at a specific altitude while waiting for trailing element to rejoin, or waiting during a refuelling, or waiting clearance from ATC... you get the picture, it is all about waiting.

It is indeed not unusual to receive the hold command from the Falcon ATC while other flights are landing. Patrolling can also be a reason to hold. Flying a longer holding pattern allow 4 aircraft on opposed legs to scan the airspace with their radar in front of them. Both directions are then searched for intruders.

The holding entry point (usually the IAF or the exit point) is marked along a known radial and at a given DME. I fly the racetrack pattern at 300 kts or less and the turns are made at std rate : 45° bank angle – 1.5G. Which is a great time to introduce a way to calculate your standard rate of turn. A standard rate of turn is a 180° turn in one minute. Obviously it depends on your speed. The formula to calculate it is:

$$\frac{Speed}{10} + 50\% \Leftrightarrow \frac{300}{10} + 15 = 45$$

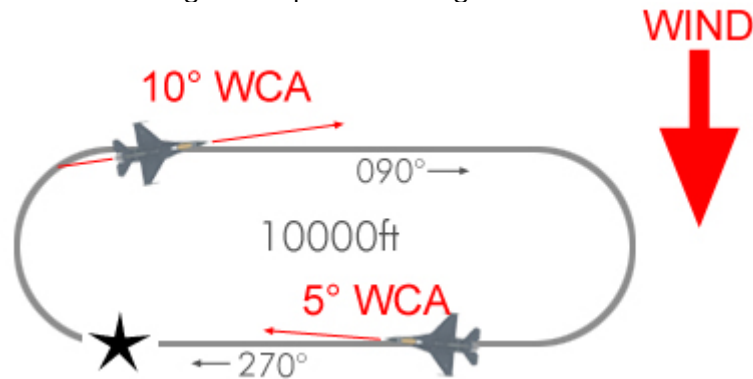
That means that at 300Kts, a one minute 180° turn will require a 45° bank angle. Using your standard rate of turn, each turn takes about a minute to complete, which is also the requirement in real aviation. The straight legs are also flown for one minute, unless a DME is mentioned on the chart. In this case, the turn should be started passing the mentioned DME. At 300 kts, a minute leg covers a distance of 5 Nm. Note that usually one leg is timed and the other leg is adjusted according to the wind. To time your legs, you need a stopwatch which is available on the right aux console for us cockpit flyers, or there is a hack time clock available in the UFC by pressing ICP button #6: Time. The ICP next button (up arrow) starts and stop to stopwatch and the previous button (down arrow) reset it. Start timing the leg once the turn is finished. Then fly the required heading until the stopwatch reads 60 seconds and start the next 45° bank angle turn. At 300 kts, such a bank angle will make the nose of the aircraft pitch down so constant back pressure at 1.5G will keep the flight path marker on the horizon line. Keeping your altitude is critical since other aircraft may be in the pattern above of below you and you want to maintain separation.



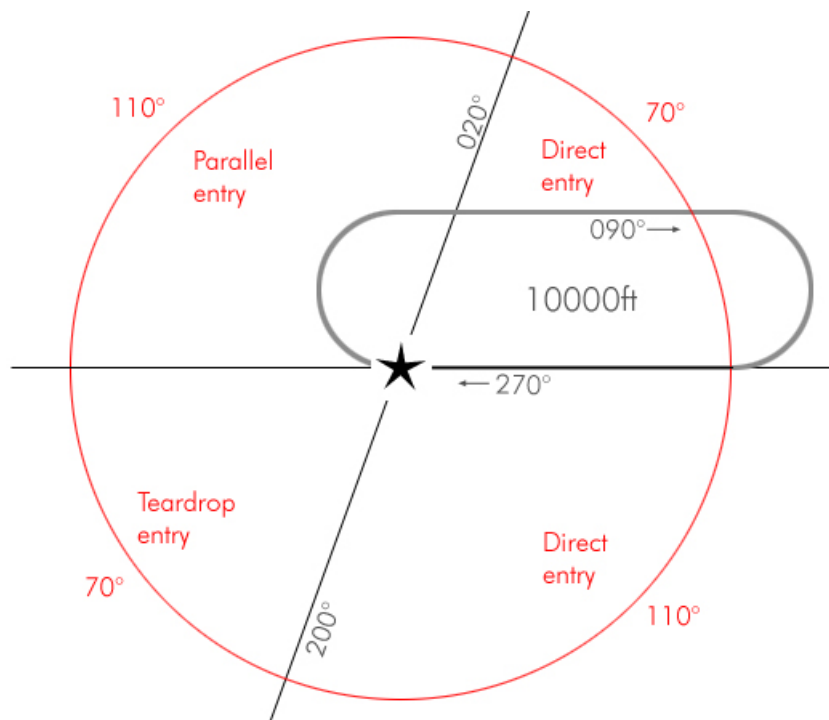
Both heading legs are mentioned on the chart, so you don't even have to calculate the reciprocal headings. You will need to account for the wind though. Heavy winds can push you out of the holding area. You calculate the wind drift when tracking the inbound leg of the holding – the one you are tracking a radial. (165° in the image above) if you encounter tailwind during that leg that shortens the leg to 45 seconds, you might want to lengthen the outbound leg by 15 seconds to compensate. So fly the 345° leg for one minute and fifteen seconds. The same method applies when you encounter head wind on

the inbound leg that will this time lengthen the time. Just shorten the outbound leg by the same time difference.

Crosswind can be trickier and you will probably notice it when doing the final turn to intercept the holding radial. If that turn is very steep, there is a great chance that the wind is pushing you. Once again, calculate the wind correction angle while flying the inbound leg. If you have to apply a 5° correction to compensate wind drift, double that correction on the outbound leg to keep the holding in the safe area.



The biggest problem with holding patterns is to know how to enter them. When you are coming from the holding radial, it's very easy since you naturally enter the racetrack. Unfortunately, it's hardly the case. Depending on your arrival heading, there are three different entries: Direct entry, parallel entry and teardrop entry.

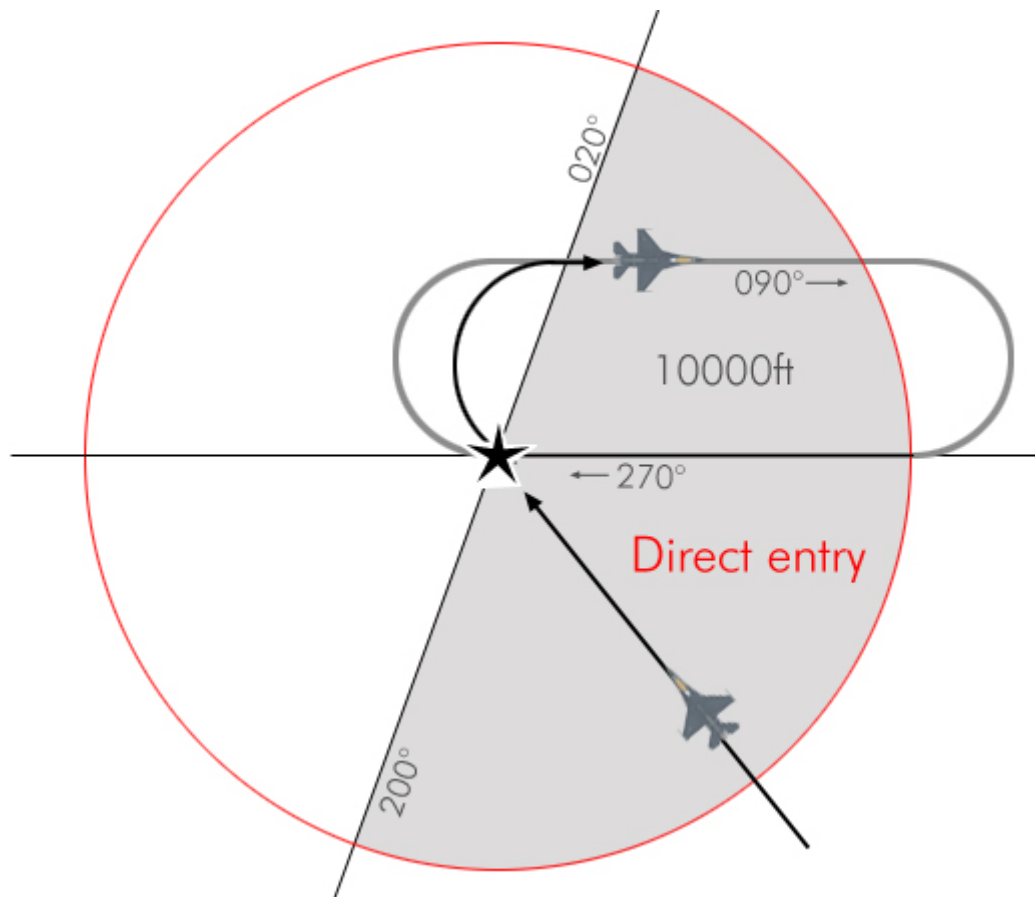


The first thing to do is to visualize the 20° angled line from the entry point. Here, it is particularly easy since the holding axis is 090°/270°. So the angled line is 020°/200°. But it's not always the case and determining the entry you have to fly is often the hardest part of the holding procedure.



### 3.4.1 Direct Entry

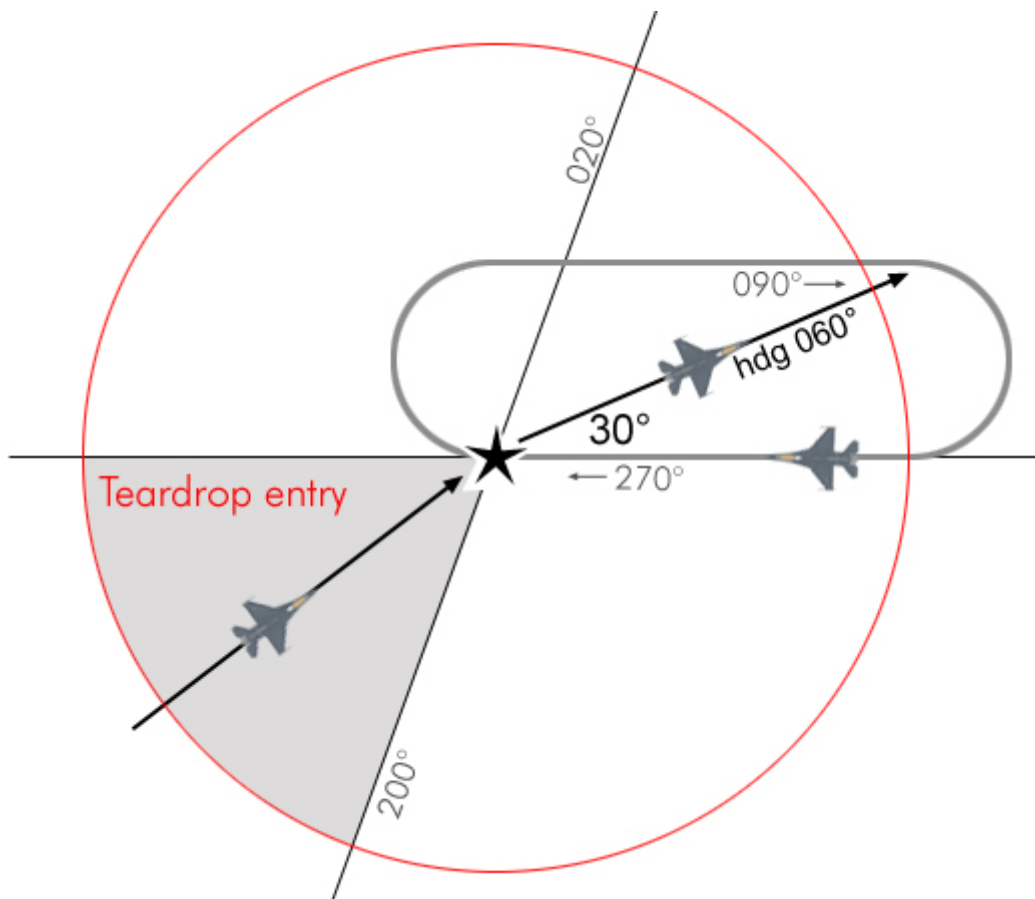
The direct entry is the easiest one and luckily covers 180° of arrival route, so with a little planning, you can easily manage to always enter the racetrack with this procedure. Flying this entry, you just have to overfly the entry point, and then turn towards the outbound leg. It may take several turns for you to fly the correct racetrack but use the inbound leg to position your aircraft easily on the holding radial.



In the above example, the aircraft reach the holding area with a 315° heading which is within the direct entry quadrant. The pilot simply overflies the entry point, turn right to the outbound leg of 090° and start the clock when abeam the entry point. The racetrack should be easy to fly since the aircraft is almost directly established. If the aircraft was coming from the North East on a 220° arrival route, the pilot would do the same but since the initial turn will remain south of the holding area for a certain time, it might fly the outbound leg a little south of the published route. By intercepting the holding radial on the inbound leg, the pilot will be able to correct his racetrack.

### 3.4.2 Teardrop Entry

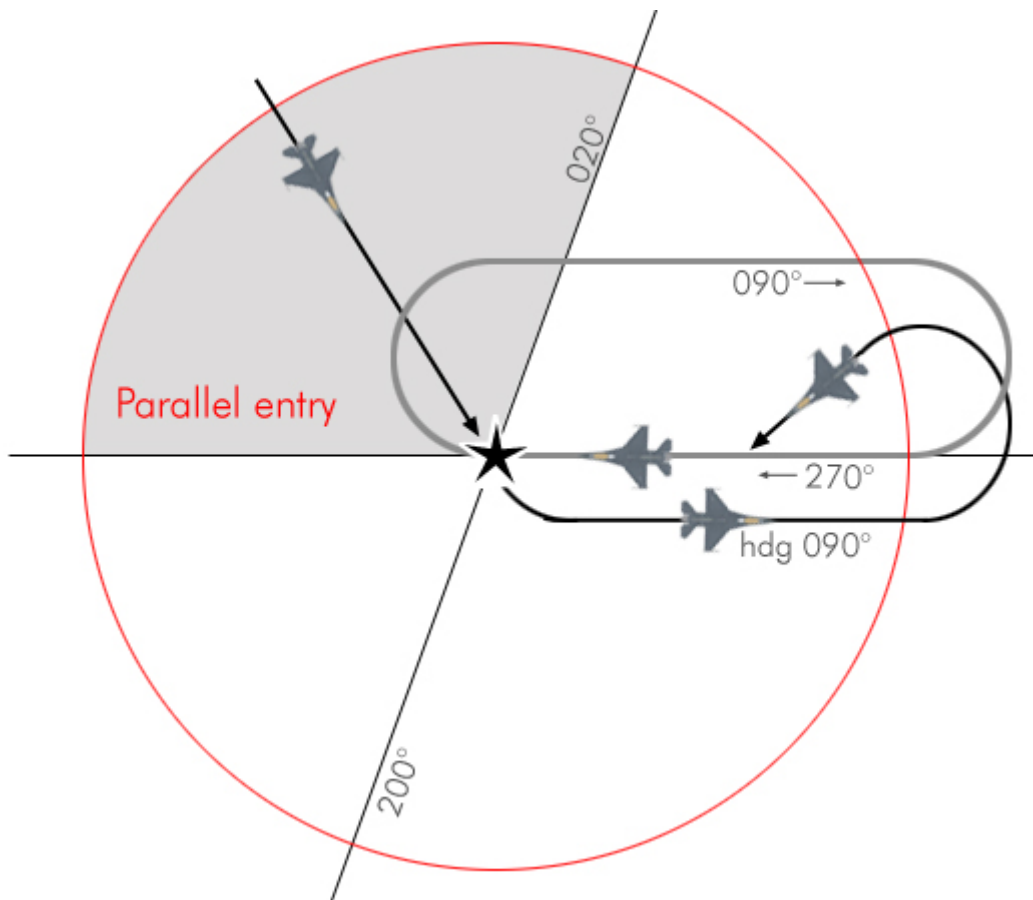
Obviously, turning directly as pictured would push you too far away from the racetrack. So when doing a teardrop entry, the pilot should aim his craft some 30° off the inbound track so he cuts the racetrack in two parts. Once established on this heading, time for a one minute leg and then start your right turn to intercept the holding radial.



Arriving from a 040° heading, the pilot overfly the entry point and then turn on a 060° heading which is 30° away from the holding radial. That will give him enough room to execute the intercept turn on the holding radial. He flies that teardrop leg for about 60 seconds before starting the turn.

### 3.4.3 Parallel Entry

As its name implies, the pilot will need to fly a parallel course outside the holding area before making a turn to intercept back the holding radial. After overflying the entry fix, the pilot will turn his craft to the reciprocal heading of the inbound leg while taking care to remain outside the holding area where other aircraft might fly the racetrack. That parallel course needs to be timed to one minute as well. Then turn left and cross the inbound holding radial and intercept it from the holding area. Once the radial is intercepted, proceed to the entry fix and fly the racetrack.



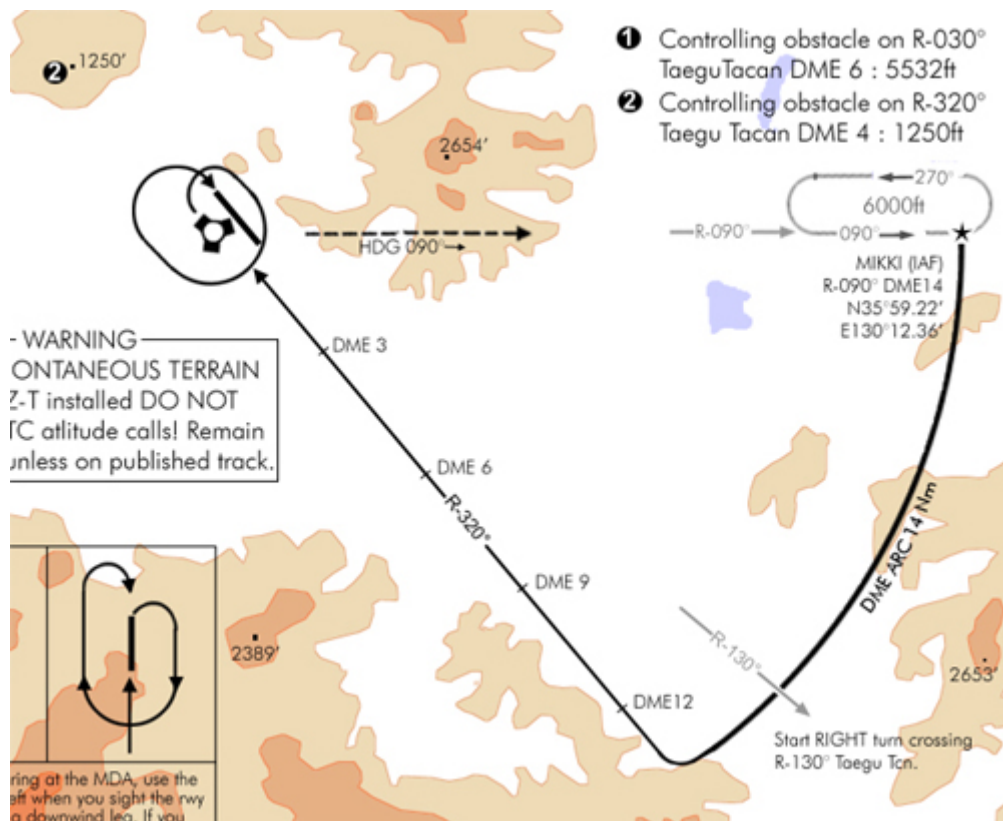
In real life, the holding patterns are rarely published on the charts and the ATC gives the hold instruction on the fly and it's the responsibility of the pilot to visualize the racetrack mentally so he can decide which entry to use.

In Falcon, since the ATC guys are kind of lazy, I decided to publish all the holding patterns, so you can have a quick reference and decide easily which entry to fly. The other aspect is that I didn't use always standard holding pattern (with a right turn) but tried to ease up holding entries keeping in mind both the holding entry and the transition to the final approach. As a consequence, not all holding are standard. Just fly them the way they are pictured on the charts.

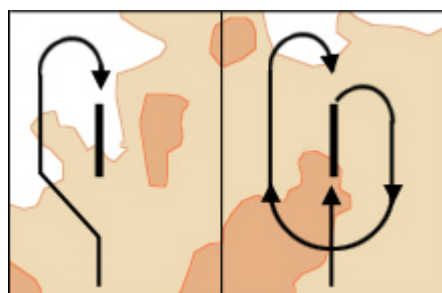


### 3.5. Circle to land

On some airbases, the approach track on one runway can't be flown because of elevated terrain or other restricted airspace. In the Falcon charts, it is the case with Taegu which is surrounded by high mountains and the glideslope to runway 14 would be too steep to ensure flight safety.

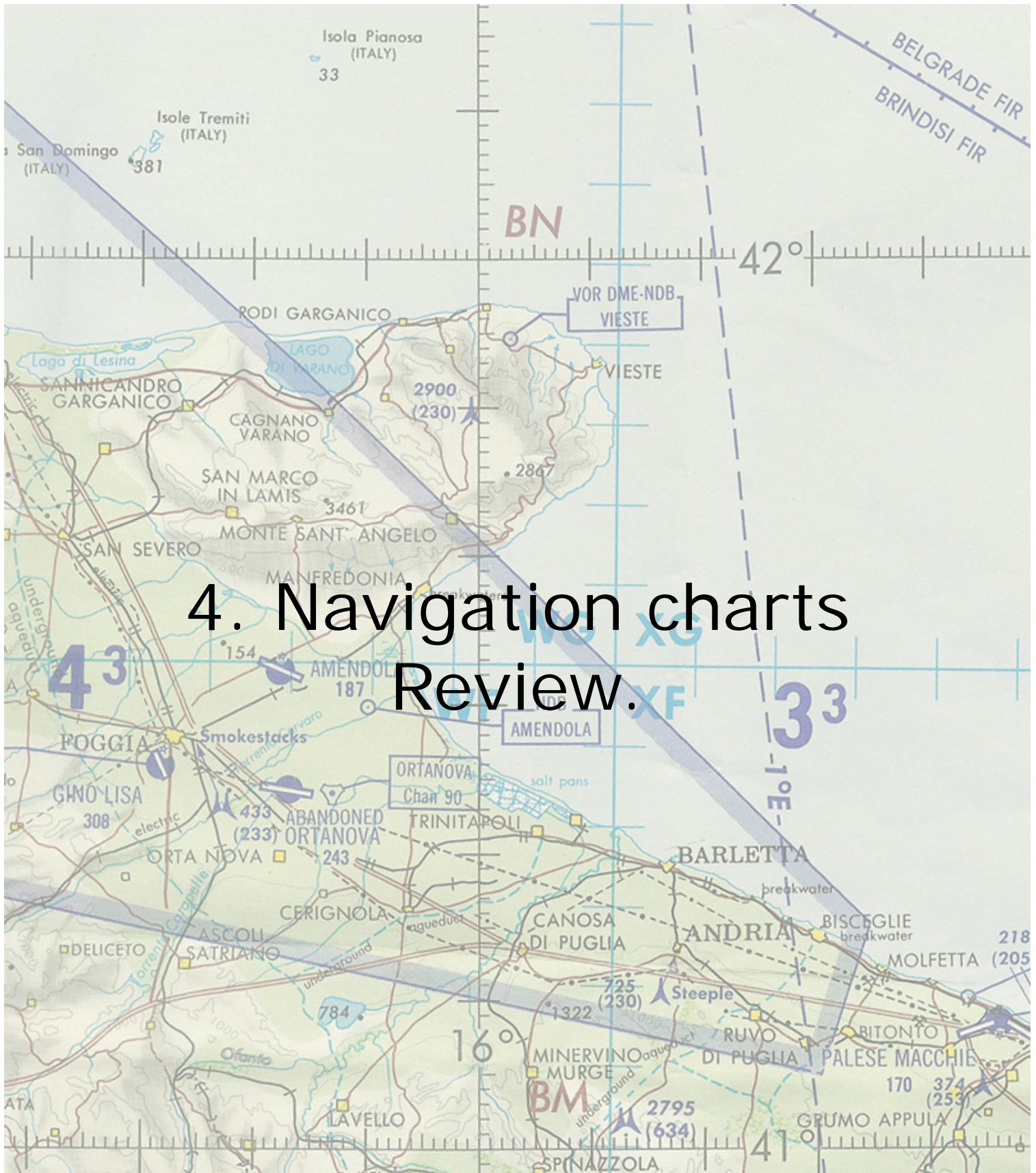


The difficult part of the approach is the non precision final approach that is done visually. Basically, you need to fly the ILS 32 approach, get the airport in sight above the minima and circle the airport at slow speed and remaining at or above the decision height to get on the opposed runway heading. You cannot leave the decision height as long as an unobstructed descent to the runway is possible. In the Taegu example above, there are



mountainous terrains all around the airport so it is critical that you stay very close to the airport while performing the circle to land. On many occasion a pilot thought he was safe because he had the runway lights in sight but couldn't see the mountain he crashed into. You don't have necessarily to wait for the minima to fly the circle. You can do it as soon as you have acquired the runway visually for good. The sooner you have it in sight, the easier the circle will be because you can then enter the downwind leg earlier (the drawing on the left on the above picture). If you get a late visual you will need to fly the pattern on the right, which is longer and more difficult.

It does look simple enough for most of you average Falcon flyer. However the circle to land is not an easy manoeuvre because you're low and slow and need to fly precisely while keeping the runway in sight – which unless you have a Track IR will induce a new dimensions real pilots don't have to cope with: the view panning. Beside when low and slow, your AOA will probably be close to  $13^\circ$  and forward visibility may be decreased. If at any time you loose sight of the runway, declare missed approach and climb as fast as you can on the missed approach track.





Every pilot needs charts, even the fighter pilots. Charts are a mean to ensure safety when navigating, especially in an aircraft rich environment around airbases for instance. The falcon charts are heavily inspired from real navigation charts. Unfortunately, many real life aspects are not transposable in Falcon. Such as terrain altitude, runway orientation and type, radio navigation emitters... As a consequence real navigation charts cannot be used in our simulation. I decided to make a chart set for each South Korean airbase using the relevant real navigation charts where appropriate and a lot of guessing when I was lacking real world information. At this time the whole Korea is covered and I'm already working on the Balkan terrain.

Each set is made of an airport diagram, at least one departure chart and one approach chart per runway wherever possible. Some sets have more "special" charts as we will see later in this document.

One of the many downsides of F4 is that we only have tacan as far as radio-navigation stations are concerned. And worse, those tacans are only collocated to airbases. Most of the tacan IRL are also collocated to airbases, but often placed cleverer than in F4 where they are in the middle of the airbase, next to the runway, making tacan approaches always offset. There are also a lot more radio-navigation stations in real life. Especially the NDB (Non Directional Beacons) that are placed between 4 and 7 miles from the threshold and correctly aligned with the approach track. Unfortunately we don't have those in F4 although an INS waypoint can be used to replace them.

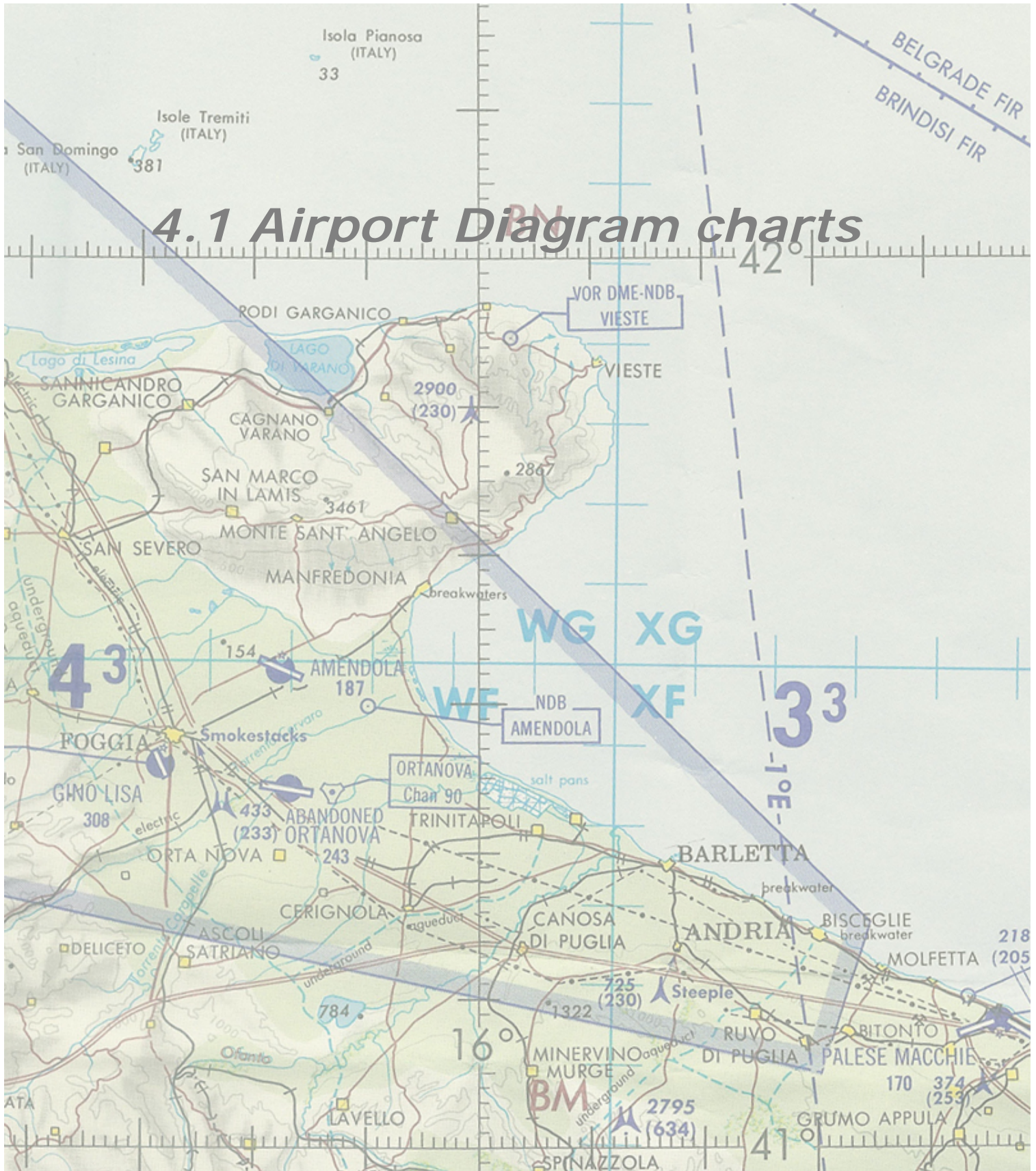
The tacans we have in most of the currently available Falcon versions are accurate and correspond both in range and channels at the real world data. Although real life data have probably been updated since that work was done back in the SP2 days.

The charts have been created (for most of them) with BMS. The elevation figures are correct only when using that version. Although I changed version from time to time, I always tried to check the final work with this 'master' working version.

The falcon development made it impossible for me to track the different routes the different versions took at one point or another. Today with the release of BMS, I decided to support only BMS which in my mind makes no doubt that it will be the most used version of falcon for the years to come.

Using charts will greatly enhance your ability to fly safe IFR. But don't make the mistake that you can get into the air without preparing your flight and your procedures. Charts induce a lot of planning, careful review of relevant procedures and you need to be prepared before starting to follow a specific route. Setting correctly the tacan frequencies, the instrument mode or the navigation system may take some time which is very precious when you need to scan the instrument to fly in the blind with a very high level of precision. Add to that the fact that when you really need it, the weather conditions might be very bad or it might be at night with a very high wind situation (and thus great drift) and you will realize that the sooner you set your airplane and the sooner your review the procedure and clear any unknown aspects (for instance the DME ARC initial lead and final numbers of radials) will greatly help you getting safely on the ground.

A final note sounding pretty obvious, but modern times force us to state the following: These charts are for simulation purposes only – don't use them in real life ☺

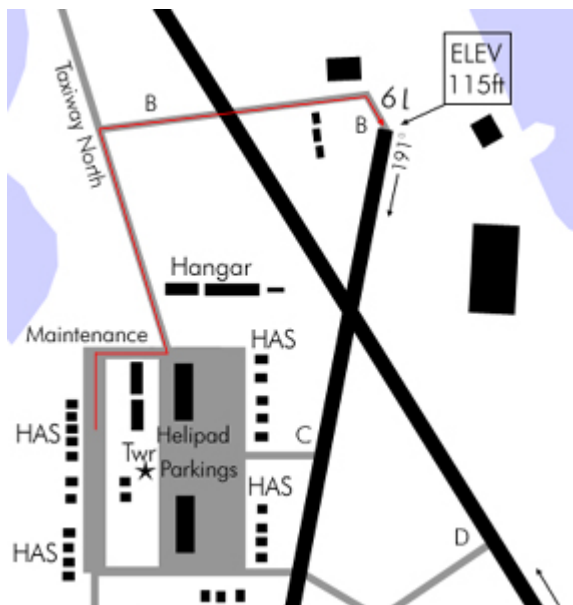


This chart is a vertical view of the airbase in F4. It has been redrawn from a satellite view in the 3D world, so it corresponds perfectly to Falcon. Although once again, depending on the version of F4 you will use, some objects may change (building missing or other ones placed). The important thing is that the airport and its layout are always the same.

The purpose of this chart is pretty obvious, it allows the pilot to taxi to any place on the airbase according to ATC instructions or multiplayer procedures of each squadron. The runways are marked with their orientation: 15/33 and 01/19 in the Fukuoka example on the right. 15/33 means that the general orientation of the runway is running along the 150° heading and the reciprocal to 150° which is 150+180=330°. Only two large figures are painted on the runway pavement, there is no room for three. So it was decided to give the orientation with the two first number of the runway heading. Of course the precise orientation might be slightly different, such as it is the case in our example. Runway 19 of Fukuoka is actually 191°: 1 degree more than 190. So the reciprocal would be 1 degree more than 010: 011°. Indeed, 191-180=011°. The actual heading of the runway is always given along the runway edge, in full, with a black arrow. (See picture on the right)



Except for the specific remade airbases, the runway lengths in Falcon are standards. The length of usable runway is given alongside the runway on the charts. The taxiways are labelled from A to F or more whenever necessary. That will allow a multiplayer pilot to state its position very easily for other members of its flight. The leader can also state its taxi route from the parking position to the runway for all his flight members: "Sting flight, lead – taxi to runway 19 via taxiway North, Bravo. Of course it's the ATC job to give such an instruction to the leader of the flight but since the F4 ATC is kind of lazy, it falls on the leader responsibility to keep his flight informed. As pictured above by the red line, the flight would then follow the assigned taxi route to the runway – provided they were initially parked at the HAS (Hardened Aircraft Shelter) Care should also be taken before crossing Rwy 15/33 that there is no aircraft taking off or landing on that strip. Probability is low but better safe than sorry – you won't lose your life over it, but you may lose more than an hour of mission planning and briefing.





Initially, I marked the place where the player's aircraft is supposed to appear from the UI as the MIL RAMP, but as my work slowly progressed – the entrance point changed, so the Mil Ramp is not accurate anymore and I even discarded on the last charts I did.

You may also have noticed, the charts always share the same colour codes. The runway and objects such as buildings and installations are always black. Tower is always a star symbol (★). Taxiways are always grey, ground is white and water is blue. The magnetic North is always pictured by a black arrow – for obvious reasons, I choose not to illustrate the magnetic variation. Most of the airport charts are oriented with the North pointing on top of the page, but in some cases, like the 08/26 airport diagrams, I preferred to rotate the whole airport layout so it may be printed larger. Thus on those charts, you may find a north arrow pointing toward the side.

Most indications on the airport templates are self explanatory. (I will explain the charts header later on)



Taxiways are labelled by capital letters starting with A. On the ground, you see those labels on yellow signs – so use them to taxi correctly.

In falcon, only the taxiways crossing to a runway are labelled. The ones parallel to the runways are not labelled - which of course is a serious breach of safety. I decided to call these according to their main direction from the centre of the airbase. So you may find taxiway North, South, East and West. With this information, any taxi route should be clearly stated.

Here's a list of some terms used which may not be understood directly:

**HAS:** Hardened Aircraft Shelter.

**POL:** Petroleum Oil Lubricant – basically some large tank

**Twr:** Control Tower

**Apron:** parking area for planes - mainly used on the airstrips charts

**Base Ops:** Stand for base operations; it's just some buildings I designed as such.

**Mil Ramp:** was initially designating the spot where the player would enter the 3D world but was abandoned in the process.

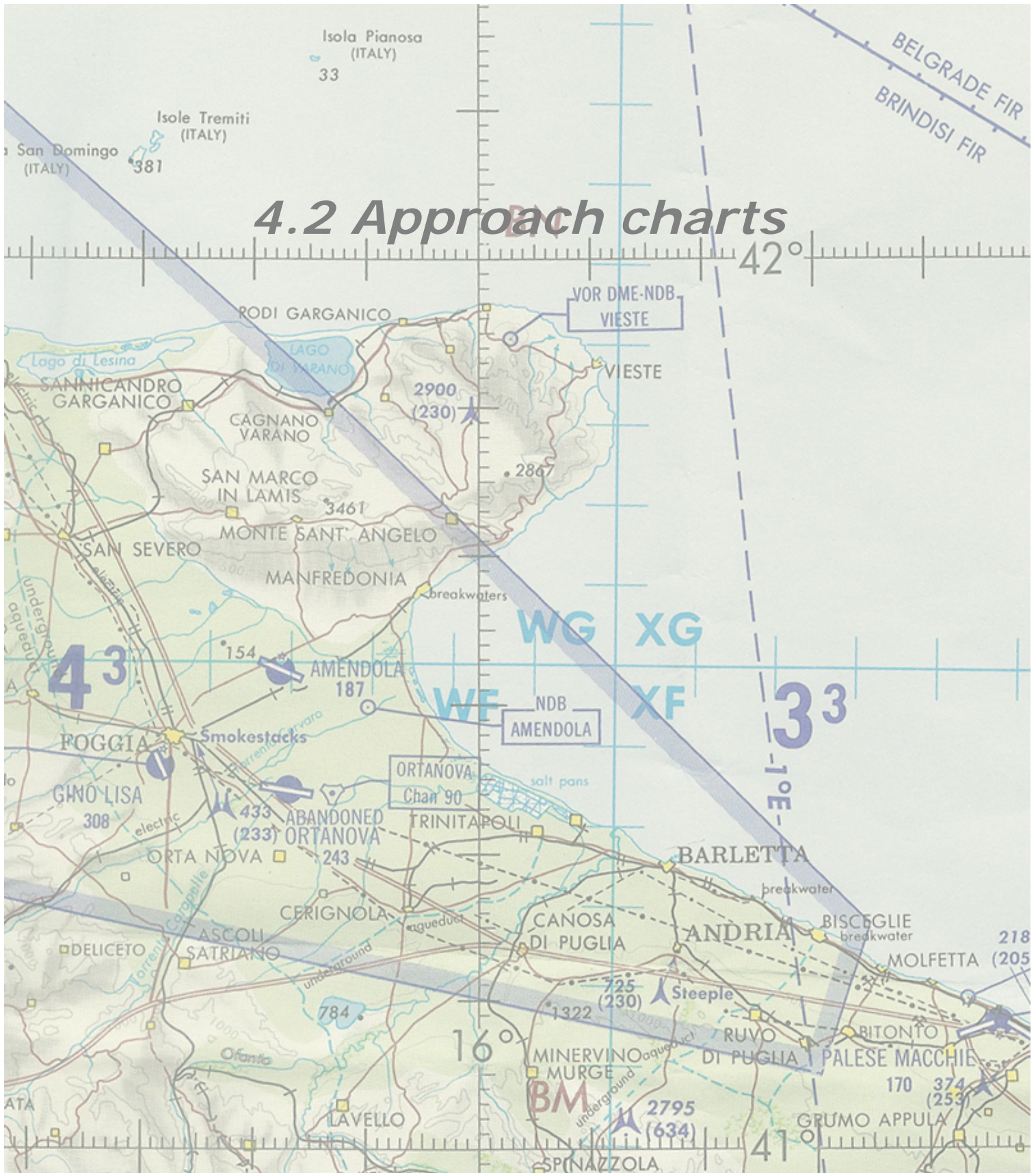
Each runway end has its elevation in feet given in a square box. Those are MSL (Mean Sea Level – altitude given with the level of the sea as zero.) In Falcon, it will not change because the entire airbase stands on the same tile with a fixed altitude. But in real life, you may have variations from one end to the other, telling the pilot if the runway course will climb or descend.

Sometime, a warning or a caution or a notice box will also be displayed on the airport charts warning the pilots of any event that may be a concern to flight safety. I admit; some of those boxes might just be eye candy and not really appropriate for the Falcon world. Still do read them, some might be important.

**WARNING:**  
Extensive helicopter traffic all quadrants  
Uncontrolled vehicles on parallel taxiways ...  
*and sometimes runway - use extra caution!*

The airbases in F4 are quite always the same because they share the same template according to their runway orientation. There are actually **27** different layouts some of which are not used at all. That is the reason why the F4 airport can't be modelled at this time according to their real world counterpart. Only Seoul, Sunan, Osan and Kunsan and Kimpo have a unique layout in Korea and are modelled close to the reality. All the others are generic airbases categorized according to their runway headings. A 03/21 airbase will always be the same – the taxiway may switch side but the layout will remain identical. So it is not uncommon to see two airports almost identical.

If you are interested in airbase layout and tiles, I wrote a document quite a long time ago about that. It can be found by following this hyperlink:  
[http://www.candyparty.com/ST/SP/Airbase\\_tiles.pdf](http://www.candyparty.com/ST/SP/Airbase_tiles.pdf)





Let's get to the heart of the matter. The approach charts are clearly what makes these charts worthy. The purpose of the approach charts is to ensure that the pilot can land on the assigned runway whatever the meteorological conditions are. As a fighter pilot with modern systems needs to be able to hit his assigned target in bad weather, he thus needs to find his way back and land safely in the same kind of weather.

Once the weather goes bad, the pilot transitions to IFR which stands for Instrument Flight Rules as opposed to VFR (Visual Flight Rules). As the names imply, VFR is flown with the head outside of the cockpit looking for visual landmarks and IFR is flown with the head inside the cockpit, looking at the flight instruments and navigation charts.

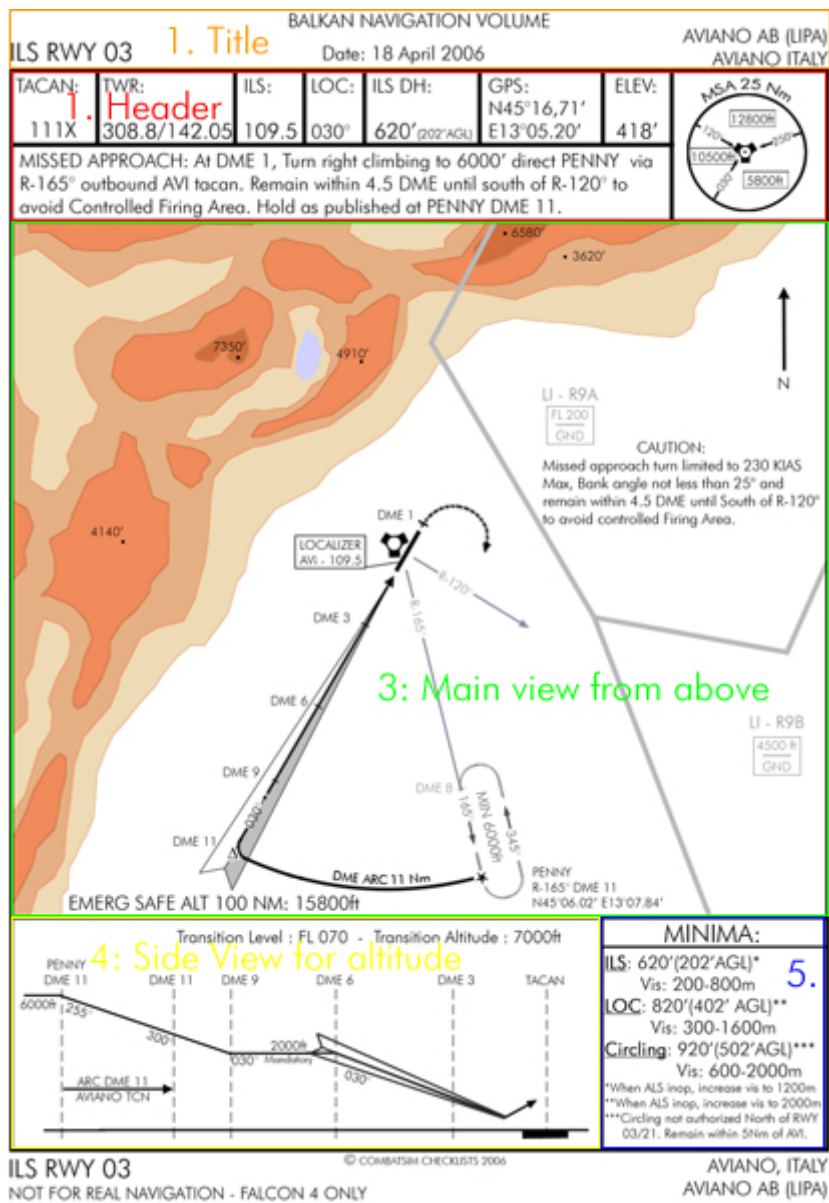
Each approach plate is subdivided in five different zones – as pictured on the following page:

1. Titles (orange)
2. Header (red)
3. Main View (or better named Plan view) which provides a god's eye view around the airport. (green)
4. Side view (or profile view) of the approach to see the altitude throughout the approach track (yellow)
5. Minima: A window giving information about the minimum altitude according to the type of approach. (blue)

In Falcon, we have four different types of approaches

- Visual where no chart is required. This is the standard overhead recovery.
- ILS (instrument Landing System) where the pilot follow the ILS steering cues.
- Tacan approaches when there's no ILS available and the approach is flown along a set tacan radial
- Circle to land approaches when for any reason the approach cannot be made on a certain runway – we use the other runway approach and then circle the airport to land to land on the correct runway.

Once again, there are many more approach types in real life such as NDB, VOR approaches, GPS approaches, radar controlled approaches, ... But the charts mainly cover the four type mentioned above.



The above picture illustrates the five different zones of the approach chart for the RWY 03 ILS approach on Aviano – Italy.

Let's see each section in detail but bear in mind that as the pilot, you will need to read all of them at the same time, according to the position of your aircraft on the approach.

### 4.2.1. Titles

BALKAN NAVIGATION VOLUME		AVIANO AB (LIPA) AVIANO ITALY
ILS RWY 03	Date: 18 April 2006	
© COMBATSIM CHECKLISTS 2006		AVIANO, ITALY AVIANO AB (LIPA)
ILS RWY 03	NOT FOR REAL NAVIGATION - FALCON 4 ONLY	

The titles actually are made of the top and bottom section.  
 The first indication is for which navigation volume the chart is made for. Here Balkan, but most are made for Korea. Then it clearly states the type of approach, (here an ILS), the runway the approach refers to (here rwy 03) and the name of the airbase: Aviano AB which is in Italy. The second Aviano actually state the city because sometime the name of the airport might be different than the city close-by.  
 The date is simply the date at which the chart was completed and besides eventually telling you it's the latest one (because no more recent chart is available through my website) it is not important.

### 4.2.2. Header:

TACAN:	TWR:	ILS:	ILS DA(H):	LOC:	GPS:	ELEV:	
083X	240.9/118.05	109.9	296' (200'AGL)	144°	N37°36,868' E127°42.801'	096'	
MISSED APPROACH: Climb straight ahead outbound via R-140° Kimpo tacan until DME 7. Then turn RIGHT 260° to intercept and proceed outbound via R-300° Suwon tacan to CHAMP fix. Hold at 4000ft.						ALSF-2 PAPI	

The header section gives the pilot plenty of information relevant to the airbase and approach. The headers are always similar, even for a different approach types. Of course tacan approaches won't mention the ILS, but the Tacan radial and the Tacan DH instead.

The top left section gives the airbase Tacan channel and band. Although this information is not really useful when shooting an ILS approach, it is nevertheless required because most of the navigating before intercepting the ILS will be made using the tacan as the main radionavigation station.

The second section states the airbase tower frequency both in UHF and VHF. At least one of those has to be inputted in the UFC via the COMS Master modes buttons to be able to communicate with ATC, Usually we use UHF for that.

The third section gives the ILS frequency. For the ILS cues to be displayed the aircraft instrument needs to receive the radio emissions of the ILS. As explained earlier, that frequency is inputted in the UFC via the T-ILS page.  
 Bear in mind that not all runway have their own ILS approach. In some cases, it may not be suitable to place an ILS approach because of the terrain (glideslope too steep, ...)

Basically, you will find an ILS approach in the falcon world where there is actually one in real life. If there's no ILS on an airbase for whatever reason, there will not be an ILS chart, but a tacan approach chart.

The following box gives the ILS DA(H) which stands for ILS Decision Altitude (Height). Decision Altitude being in MSL and Decision Height being AGL.

The value is given in feet MSL (here 296' where ' means feet) which is the altitude above seal level where the pilot should have the runway in sight to be allowed to continue the approach. If the runway is not visible, the pilot needs to go around and start the approach all over again. We the say the runway is below minimum. The smaller numbers (200'AGL) is the real **DH** because it's given above ground level.

Notice that the indicated altitude given by your altimeter in the F-16 cockpit gives you the altitude MSL. But you always have the Radar altitude box in your hud giving you your height above the ground.

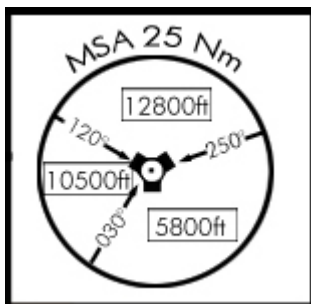
We will talk back later about the minima when covering this section later on.

The next box is the GPS coordinates of the airbase. Due to some projection problem in the way F4 was originally coded, these GPS coordinates don't correspond to the real world. No big deal since the one given on the charts are the ones used to navigate to the airbase by punching them into the STPT page of the UFC. Please note that BMS requires to add a zero in the last position as it needs three decimal.

The ELEV box gives the elevation in feet of the airport above mean sea level. Kimpo stands at 96 feet above sea level. It means that sitting on the ground, the altimeter should read 96 feet, if calibrated properly with the local altimeter setting. That information is quite important for landing but unfortunately, it varies according to the flavour of Falcon you're flying. My charts gives the BMS elevation.

The long window is the Missed approach procedure. In case of a go around, the pilot needs to follow this route back to the IAF (Initial Approach Fix) unless otherwise instructed, which of course in Falcon never happens. A pilot may decide to go around at any moment along the approach but he has to go around if he has not the runway in sight at the minimum altitude. When going around, the pilot declares missed approach on the radio frequency and start flying the correct route – The ATC expects no less from you.

The next box gives information about the ALS (Approach Lighting System) for that Runway. In BMS, we have three types of approach lights: MALSF, ALSF1 & ALSF2 and 2 type of glide slope lights (VASI and PAPI). MALSF are non precision approach light system and we use them for tacan approaches in Falcon. ALSF1&2 are precision approach light systems and only the runways with ILS have those kinds of lights. As stated here, Kimpo has ALSF-2 lights. Also of interest are the type of landing aid lights (VASI or PAPI) and in the case of Papi, the side where the PAPI is located is also given (here PAPI LEFT)



The final section is the large square on the right with the big circle in it. It's the MSA information: Minimum Safe Altitude. It gives a topside view of a circle of fixed radius centred on the relevant tacan with safe altitude (MSL) according to quadrants limited by arrival headings. On this example, pilots should notice that the minimal safe altitude between arrival headings of 250° and 030° is 5800 feet MSL. The minimum safe altitude between arrival heading of 030° and 120° is 10500ft MSL and the last



sector between arrival heading of 120° and 250° is 12800ft MSL. Basically, it means that we have high terrain at least 11000 ft on the northern sector and high terrain at least 9000ft high on the western sector.

Pilots should stay at or above MSA when arriving to an airbase unless they are on approach track which of course will go lower while remaining safe because clear of known obstructions. In the Falcon charts, the radius of the circle will always be 25 Nautical miles. Those figures are checked in the 3D world and once again are relevant to BMS. An empty circle with only the tacan in the centre and only one altitude means that the MSA is valid all around the airbase for the fixed radius.

Tacan approaches charts have a different header since some information such as ILS are not required.

TACAN: 054X	TWR: 250.2/118.2	TACAN RAD: 130° (hdg310°)	TACAN DA(H) 560' (400'AGL)	GPS: N41°07,44' E16°47.02'	ELEV: 160'	
MISSED APPROACH: Climb on RWY heading to DME2. Then LEFT climbing turn to FL10 direct LEMON. Hold as published at LEMON DME 17.						

The ILS section is replaced by the TACAN RAD giving the radial along which the approach is flown. Note that the corresponding heading is given as well. The ILS DA(H) is obviously replaced by the Tacan DA(H) giving the corresponding minimum altitude (height) for this tacan approach.

### 4.2.3. Plan view.

The main view is also called the airport plan view and illustrates the airport and its surroundings with the approach track when viewed from topside. A lot of information is given to the pilot on this view.

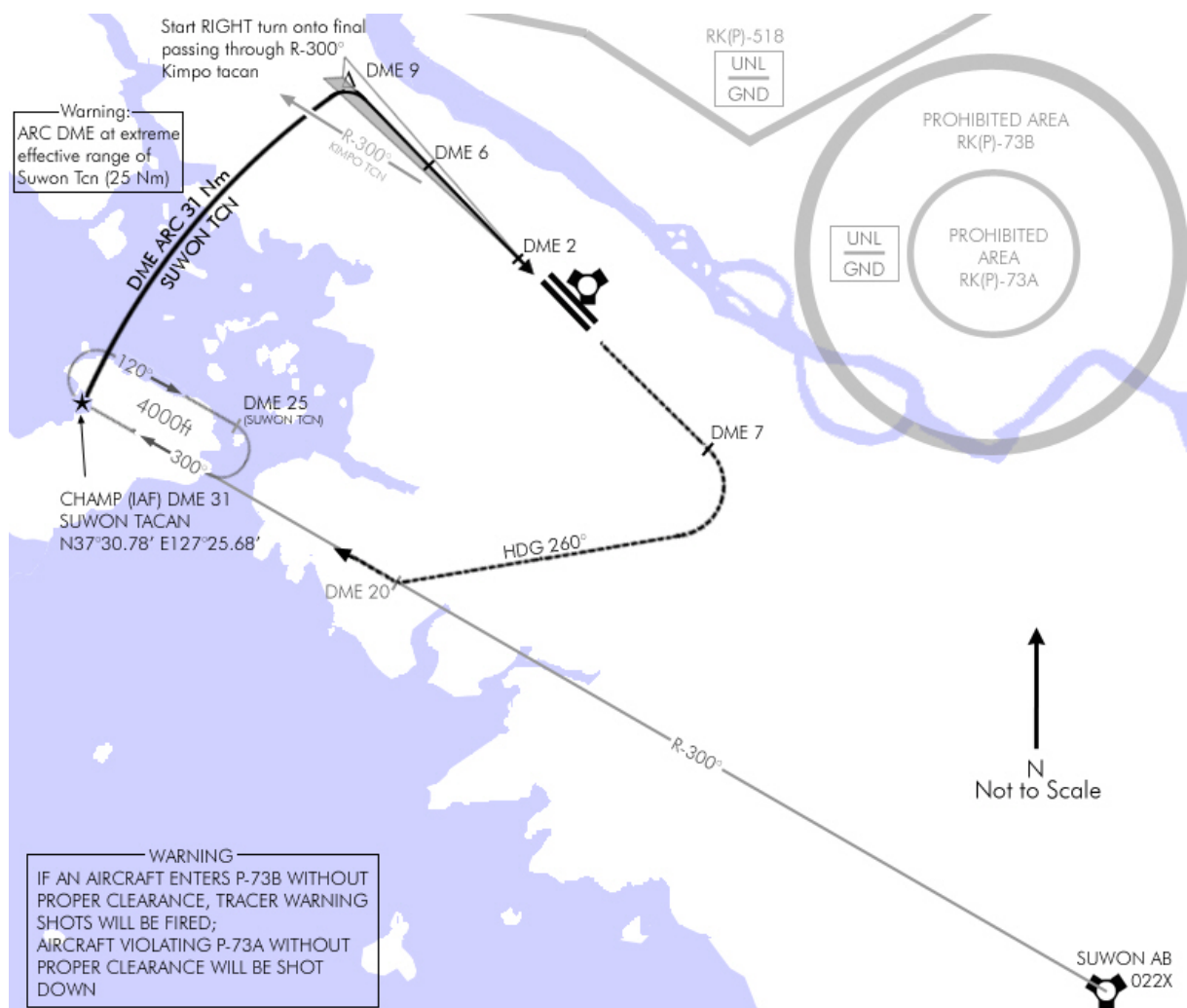
The most obvious one is the approach track pictured in black and finishing with an arrow pointing at the airbase. That track always starts at the IAF (Initial Approach Fix) pictured by a star symbol.

You also see the runway, correctly oriented and the tacan – properly placed from the runway.

The missed approach track is always pictured as a black discontinued line finishing by an arrow.

Relevant radial are dark grey as well as holding tracks and restricted or prohibited no fly zone are in light grey.

In various shades of brown you will find the elevated terrain, the darker brown the most elevated the terrain is. Summits are pictured by a black dot with the elevation in feet MSL. And finally the water is pictured in light blue. You will also find different caution and notice boxes warning the pilot of dangerous items relevant to the approach. And of course the mandatory North pointing arrow will be always displayed with the mention: Not to scale where appropriate.



Before seeing how to follow the approach track, let's talk a little bit about the restricted and prohibited area and maybe some more information about the elevated terrain.

Airspace is always categorized in different zones. For instance, we have class B, C and D airspace around airport in the US (TMA zone in old Europe) – class A airspace above the transition level for jet routes, Class E airspace below the transition level for the Victor airways and finally the class G airspace which is usually closer to the ground for VFR flight.

Amongst all that, and more important to us Falcon flyer (because we don't really care about jet routes and victor airways do we?) we can find prohibited areas, restricted areas and Military Operations Areas. The three concerns us greatly in Falcon – because most often they are military area and although we do explain here a lot of civilian IFR, we after all are flying a military airplane.

Prohibited areas are no fly zones, even for military airplane. They are put in place to protect national interest items such as a city, a presidential palace or a secret airbase for instance. They usually are named with a P. RK(P)-73B as in the example above. RK stands for Republic of Korea. (P) means Prohibited and 73B is the number assigned to that prohibited area. Some prohibited area may be so sensible that you may be fired upon if you enter it, as it is the case here with RK(P)-73A since that airspace is protecting a very high national asset. They are often always active from Ground to unlimited altitude, unless otherwise noted.

Restricted areas are zones where flight operations are subject to certain limitations. You need to be cleared by ATC before being allowed to enter such an area. They may be a firing range or a zone where safety of flight is not assured continuously. They are labelled R such as RK(R)-14 near Kwangju. They may be limited in altitude from Ground to a certain Flight level. For instance Kotar range in RK(R)-110 is from Ground to FL250.

MOA are military training areas where you and I go hone our dogfight or mud moving skills, we at least in the Falcon terrain! So we can go there without really bothering. Just be on the lookout for other shit hot pilot trying some new trick on you. Usually active MOAS are specified on the

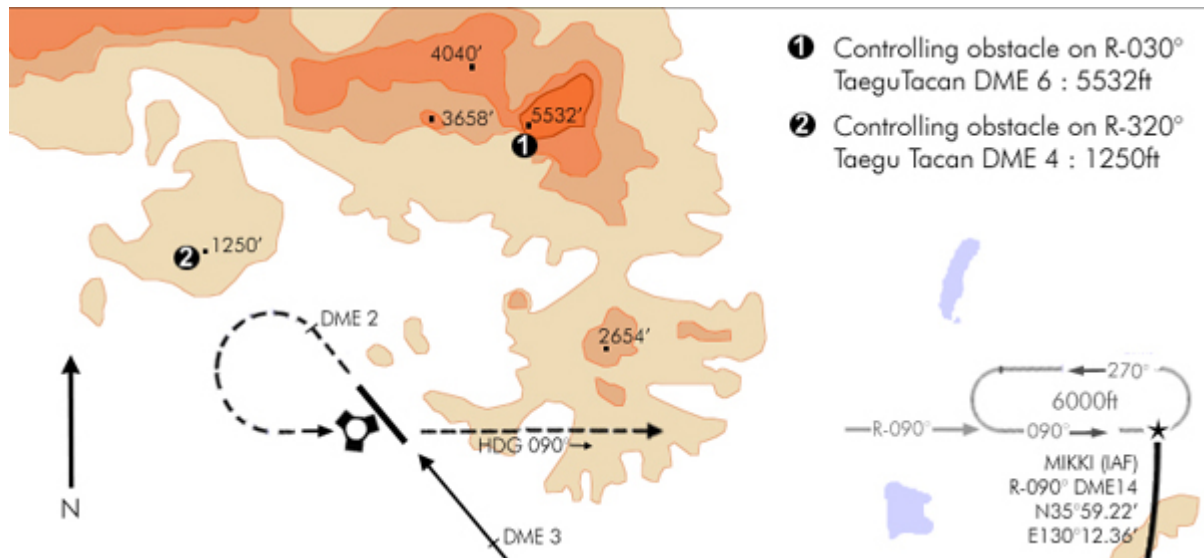


All of those airspaces might be limited in altitude. That information is stated on the charts. The lack of altitude box means that the airspace is unlimited from ground to as high as you can go – scratch that, it's because I couldn't find the relevant information, but there are many less than 2 years ago.

If there is a box such as illustrated on the left, it means the airspace is limited from ground to FL200. So if you are on FL 250, you can overfly it without any restrictions.

Another item of interest as far as airspaces are concerned are the ADIZ or Air Defence Identification zones. Those are buffer zones where any aircraft coming in from abroad needs to be properly identified before being granted access. Once again, this has no interest in Falcon, but it's somehow nice to play the game, especially when coming back from Indian country or even when crossing from Japan to South Korea. Bear in mind that air defences may make mistakes and shoot at you if they haven't identified your flight correctly. To avoid that comply with proper procedures for ADIZ and FIR crossing.

The charts also display the elevated terrain in different shades of brown and water obviously in blue.



White area pictures terrain up to 999 feet. The lighter brown pictures elevations between 1000 and 1999 feet. The next shade between 2000 and 2999, and so on. The darker the shade, the higher the terrain.

The contour of the terrain and water might not be 100 percent representative of the F4 world. They are for the most of them based on real charts. But doing this I realized the elevated terrain in BMS installed was indeed very close to the real world. ☺

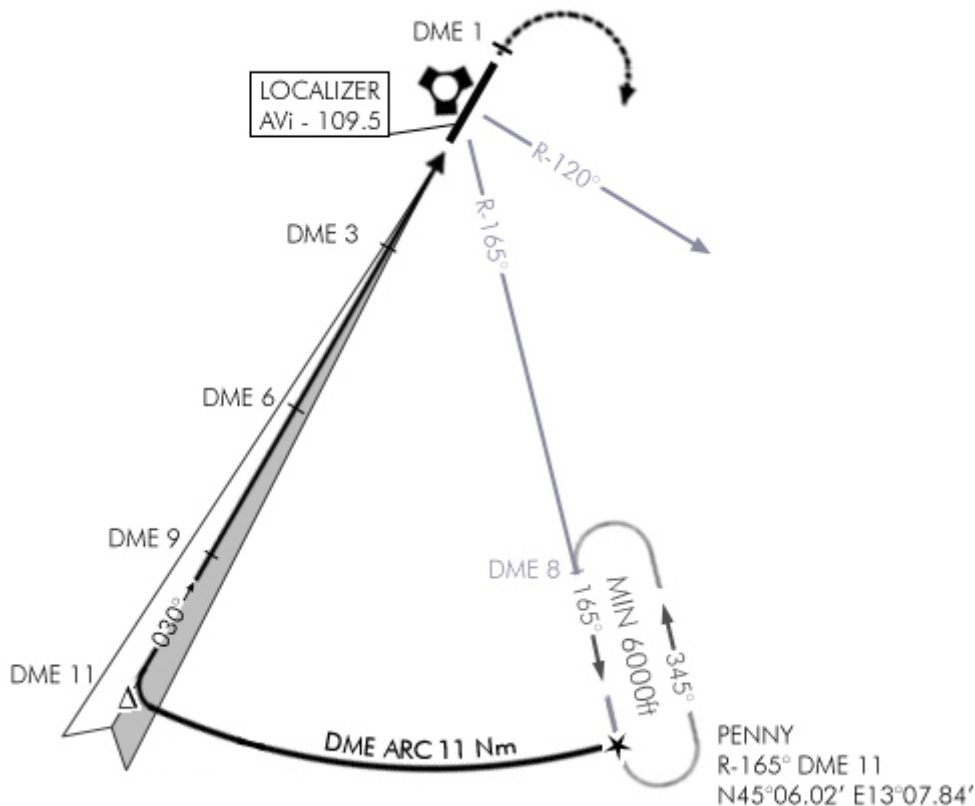
Highest summits are also displayed as a black dot with their respective altitude in feet next to it. Once again, those numbers represent the BMS terrain for Korea.

Dangerous terrain is also mentioned on the charts by numbered black circles. Usually a radial and a distance from a known tacan are given so you know exactly where the obstruction is.



Let's get back to the approach track:

Here's an example for the ILS approach on Rwy 03 of Aviano, Italy, Balkans.



The approach track always starts at the IAF which stands for Initial Approach Fix and marked with a star on the chart. It is named as a fix, usually with a 5 letters name (here PENNY). Its position is given both in GPS coordinates and with a radial from a known tacan and the distance from the station (DME).

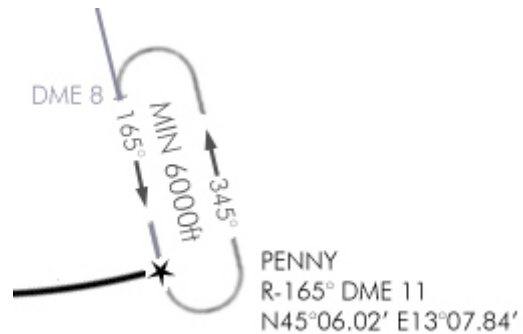
R-165° DME 11 means that Penny is on the 165° radial at a distance of 11 Nautical Miles. To get there, the pilot has two choices, the first would be to intercept R-165° and get to DME11, by flying INBOUND the station if the intercept is done further than 11 DME or by flying OUTBOUND if the intercept is done before 11 DME.

The second possibility, and by far the most used when returning from a mission would be to take the last waypoint of the flight plan before landing and change its coordinates so it is set at the IAF. That is quite easily done with the INS system of the aircraft computers. Then all the pilot has to do is to fly to the IAF as he would do for a simple steerpoint by selecting the STPT page (ICP #4) and select the waypoint to be changed by placing the asterisks over its number, then dobber down to the latitude and enter the new Latitude coordinates followed by the enter key and repeat the process for the Longitude coordinates.



The altitude at the IAF is the minimum altitude of the holding pattern. You may deconflict altitudes by holding higher but try to leave the IAF with the correct altitude.

Usually, there will be a fixed holding pattern on the IAF. That racetrack pattern in grey in the chart allows a pilot to hold while the airport is busy launching or recovering other aircraft. Leader may also need that holding time to regroup their flight before impressing the brass, landing all together. Usually there's only one aircraft per thousands of feet, but I guess that a leader might fly the holding with a wingman glued to his wing. If more than two aircraft are in the flight, it might be best to send the element a thousand feet higher, which of course is only possible flying with other human pilots.



As you know, the Falcon ATC will not stack you in the holding; it will thus be the leader responsibility to deconflict the airplanes holding. It becomes tricky when more than a flight are using the pattern at the same time – but that's where a Common radio frequency shines.

As a rule of thumb, the first to get there should take the lowest altitude and other elements should stack by thousands feet increments.

You don't have to fly the holding necessarily when flying the approach. If there's no need to regroup or if the airport is not so busy, you can simply proceed on the approach without holding.

See the advanced radio-navigation section to see how to enter and fly a holding pattern. It's not easy and a lot of practise will be required before you can fly it precisely. Bear in mind that holding areas may be quite filled with airplane at different altitudes, so fly it safe by remaining on track and assigned altitude. Speed control is also an important aspect of holding. Obviously you will want to conserve fuel and since you already are quite low, it is even more important. On the other hand, flying fast will give you less time to make a perfect holding pattern and the turn will also be wider. So pilots should try to fly at a comfortable speed. Unless otherwise noted, the airspeed is at the pilot discretion. In some airspace, airspeed below ten thousands feet needs to be lower than 250/300 KIAS. I honestly don't know if that rule applies to military fast jets? Personally, I try to fly at maximum 300 KIAS throughout the approach until established on the glide where I adjust my speed to fly the correct AOA.

Solo fliers should contact the AI ATC when leaving the IAF. If the wind is correct, there is a good chance the active runway will be the same as the one you're landing on, since the AI ATC will vector you towards the ILS, the headings calls should be quite close to the headings given by the charts. Just ignore those stupid 2000 feet calls; you don't need to be so low as long as you haven't intercepted the ILS. If it bothers you, simply call abort to make the ATC silent.

When there's a human controller in the game, just bypass the AI ATC and wait for the controller to clears you on the approach before leaving the IAF. Usually such calls should be given in the following way:

Controller: "Sting flight, Aviano approach – cleared for ILS 03 approach, report established"

Pilot: "Aviano approach, Sting flight – cleared ILS03 approach, will report established"

Once again, making the approach is usually done single plane and in this case, Sting 1 should leave Sting 2 alone for another holding turn. Still, we do like to fly the approach in flight of two, landing together is much more fun, but I highly doubt it is realistic on the ILS in weather. It is done in VFR as formation landing, but certainly not using the ILS. ☺

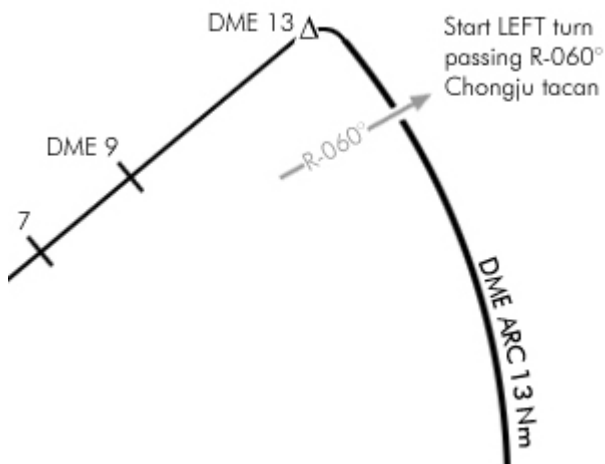
Most often, the transition between the IAF and the line up is made by an ARC DME. Performing these might seem pretty complicated but with the HSI, it's actually pretty easy. The idea is to remain at the same distance from the station by flying a fixed arc around it. It means you can turn in increments of do a very gentle turn around the stations by lowering the wing pointing towards the station. Correct procedure for flying an ARC DME is explained in the advanced radio-navigation section.

Bear in mind that leaving the holding pattern, you will need to turn usually 90° which takes time and might push you out of the required distance. Again the formulas to calculate your lead are given in the advanced radio-navigation section.

While flying the arc you will also need to descend to a lower altitude. It adds another aspect to keep in check and you will need not only to check the HSI to fly the arc but continue your scanning so your speed, attitude and altitude remain within limits... which are rather small wouldn't you say?

The same lead will be required when leaving the DME ARC to line up on the approach track. You usually have plenty of time to line up properly before intercepting the glidepath, but the sooner you're on the correct track, the better. Remember that one, because it's really the key to a correct approach. The sooner you have the proper attitude and speed, the easier the approach will be.

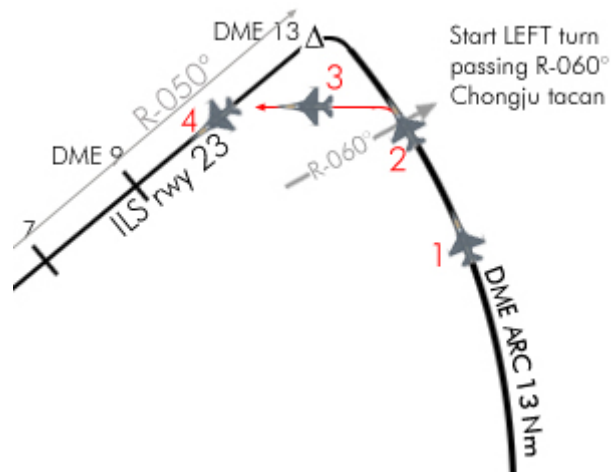
Usually, I would start the line up turn passing the approach radial minus (or plus) 10°. From there, the line up turn doesn't have to be a perfect curve. It can be a hard turn to get a 30° interception on the line-up radial and then intercept it smoothly. Let's take an example.



You will land on ILS Rwy 23R of Chongju airport. You just passed NOSONG IAF and are flying the DME ARC 13 NM, descending to 3800ft. You know you will need to turn left to intercept the ILS. The ILS will also be near the 050° radial of Chongju tacan – although just before since the tacan is offset to the north of the runway.

Your HSI has been set to TCN/ILS mode so you get both tacan and ILS information. The tacan 042X as well as the ILS have been set in the UFC. All you would need is to have a reference point to start your lining up turn on the ILS. That

point is given by the intersection of the DME ARC and the 060° radial. And to visualize that point with the HSI, you just need to set the course arrow on the 060° radial. At the beginning of the DME ARC, the CDI will be on the side and as you near the radial, the CDI will centre. When it is centred, you're passing through the radial and you can start a left turn to 270° to have a 40° attack angle on the ILS which is 230°. That interception heading will bring you on the ILS well before DME9. Once the localizer starts to move in the HSI, line up as you would do with the CDI but remain at the published altitude which is 2600ft for DME 9 on this approach as the chart side view tells you.



A short while after leaving NOSONG, the aircraft is slightly banking left so the red station bearing pointer remains on the 9 o'clock position – to remain at DME 13 from the station. The mode is set to Tacan and radial 060° is set in the course arrow. Note the heading which is 015° - the departure heading from Nosong was 030° ( $300^\circ + 90^\circ = 030^\circ$ ) so we already turned 15°



At point 1, the CDI started to centre. The station bearing pointer is still maintained on the nine o'clock position but I drifted a little toward the station since the DME is now reading 12 Nautical miles. The heading is now 330°. It's important to check the heading leaving the IAF, during the DME arc and certainly the exit DME ARC heading which here would be  $230^\circ + 90^\circ = 320^\circ$  if we were to continue the DME ARC to the ILS localizer. It's good practice to commit these reference headings to memory.





At point 2, the CDI is centred, it is now time to turn left to a 270° heading and switch the mode selector to TCN/ILS so the CDI displays the localizer instead of the tacan radial. This is really a step not to be missed because it induces some confusion as you will see on the next picture.



We are at position 3; although we still need to level out. Heading is 270° and the mode switch has been switched to ILS/TCN. The glideslope is displayed in the ADI (horizontal yellow bar) and it's above it which is fine. The localizer is displayed in both the ADI and HSI. (Vertical yellow bar on the ADI and CDI in the HSI.) The problem is that the CDI of the HSI is on the other side than the localizer on the ADI. It is because the course arrow is still set to 060°. Switch it to 230° (ILS track) and the CDI will be on the right as in the ADI. If you look back at position 3 on the image on the previous page, you will notice that the ILS track is indeed to the right of the small F-16 on position 3. Changing the Course arrow on the HSI is not mandatory; you can rely only on the ILS indications on the ADI. Still taking the time to set correctly the HSI may salvage your approach later on. The image on the left shows the



HSI with the course arrow set correctly on the 230° radial and with the CDI a notch to the right. Indeed, while setting it up, the aircraft got closer to the ILS (we are now at DME11) It's high time we make our final left line-up turn to get properly on the localizer. Luckily, we don't have any passenger on this flight.



We are now at position 4, lined up properly with the localizer and waiting for the glidepath to come down on us. We are at DME 9 and should then be at 2800 ft as the side view of the chart instructs us. We should now start a descent of 800ft to pass DME 7 at 2000ft until glide interception.

It is thus very important to keep a good speed awareness throughout the procedure because even though the speed will not really impact your flight path (short of giving you too little time to sort the intercepts) your approach will be spoiled at this point if the speed is too high. As you aim to be on speed AOA as soon as getting on the glideslope, you want to avoid being at point 4 showing 420 indicated airspeed. More like 200 – 220 kts before gear extension.

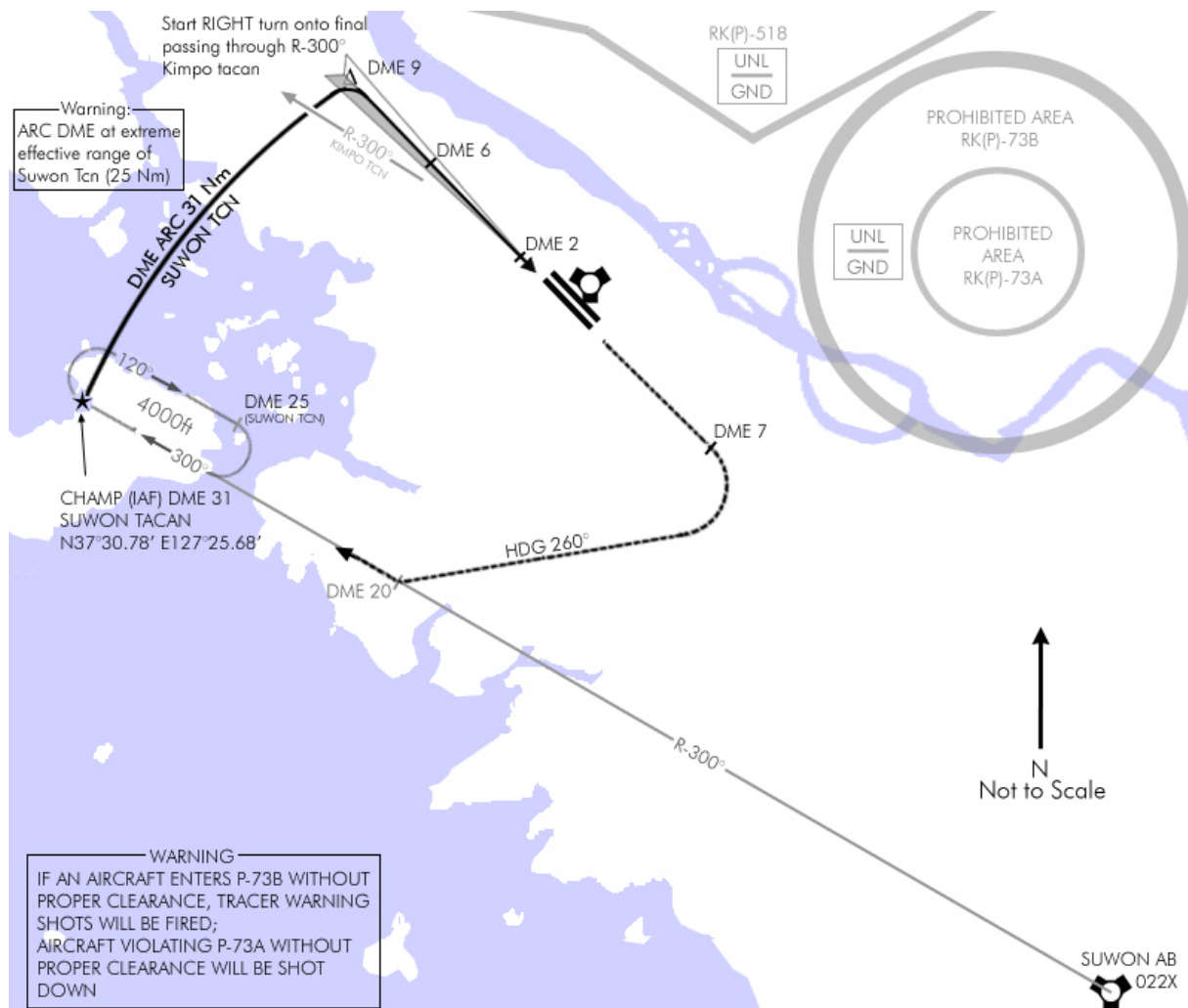
Once at DME 6-7 and 2000ft, all we have to do is wait for the glideslope to centre on the ADI and at that precise time, lower the landing gear and get on the correct speed for landing which usually is around 140 kts but depends on your weight. So concentrate on the AOA indicator. Increase speed if the red triangle is lighted, decrease speed if the yellow triangle is lighted. On speed AOA is attained when the green circle is ON.

Most glideslopes are pointing 3° down so push the stick so the flight path marker is halfway between the horizon line and the -5° reference line in the HUD and you should be fine. Remember, AOA is

maintained with throttle inputs, no pitch inputs. From there you need to remain heads down on the instrument, carefully following the glideslope and localizer with minimum inputs until reaching the minimum. For this ILS approach on Chongju runway 23R, the minimum is set at 287 feet which is 200 ft above ground level. Reaching 287 feet on the altimeter, you need to look outside for the runways lights and commit to the visual final approach if you can see the runway or declare missed approach and going around if you can't see it. Don't miss the minimum – unless you want to buy the farm.

Of course, you don't really have to keep inside the cockpit for so long on a clear day - when visibility is good. Just remember to train for it because one day you might need the experience to land safely. Still looking up at the minimum and finding your aircraft perfectly aligned with the runway with the correct speed is quite an accomplishment and something you can be proud of!

In case you need to go around, the missed approach track is displayed in the main view as well. Usually it is a direct route from the runway back to the IAF but in some busy airbases, you might have to follow a specific route back to the IAF. Let's consider the example for Kimpo:



You just looked out of the cockpit; searching for the runway at DME2 but for whatever reason you can't see the runway. So you have to increase power, get a positive attitude and retract the landing gear – overflying the unseen runway. The discontinued line on the chart gives you a gods' eye view of the missed approach track and the text explaining the procedure is in the header of the chart:

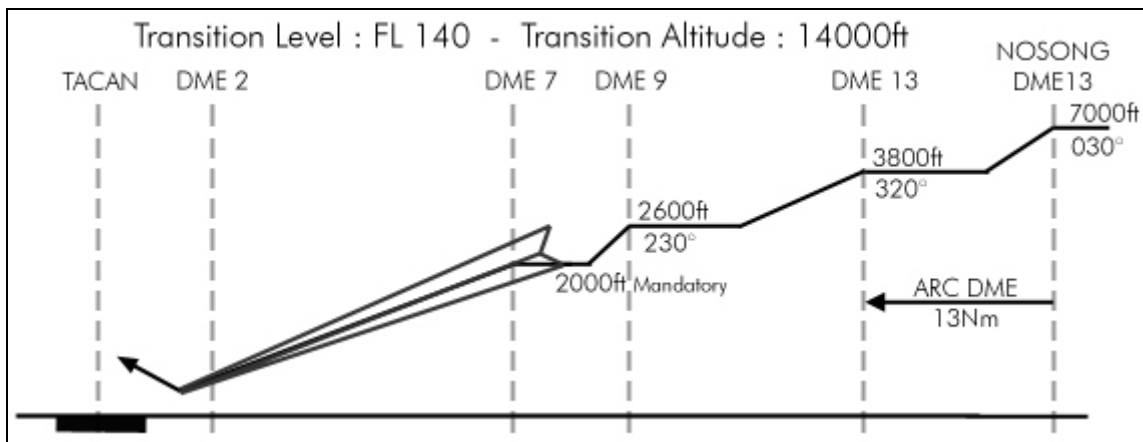
**MISSED APPROACH:** Climb straight ahead outbound via R-140° Kimpo tacan until DME 7. Then turn RIGHT 260° to intercept and proceed outbound via R-300° Suwon tacan to CHAMP fix. Hold at 4000ft.

So your first priority is to get away from the ground and get away from the busy airspace around the airport. The procedure calls for a climb straight ahead to 4000ft (which is the altitude at which you will need to be at the holding point) – using R-140° of Kimpo tacan

(which should already be set) but just don't forget to toggle back the instrument mode from TCN/ILS to TCN. As you see on the chart, there's a prohibited area just left of the missed approach track so care should be taken to avoid drifting there, especially with a southern crosswind. At DME 7, a right turn is required to heading 260°. During that leg, the tacan needs to be reset to Suwon 22X because we will need to intercept R-300° outbound from that station which should be reached at DME20. From there, you will just need to track outbound the R-300° until reaching the CHAMP IAF at DME 31 which is at extreme range of the Suwon tacan. Then you can simply fly the approach if cleared by the ATC or enter the holding pattern.



#### 4.2.4. Side view



This view is the same as the plan view but viewed from the side which give the pilot the required altitude at specific points of the approach. Let's get back to the Chongju approach we used as an example for the DME ARC transition to the ILS.

At Nosong (IAF) the altitude reads 7000 ft which is the minimum holding altitude.

Between the two vertical grey lines at DME 13, the black arrow displays the DME ARC and its distance: 13Nm. Also of interest near the NOSONG line is the departure heading for the DME ARC: 030° (as we calculated earlier:  $120^\circ - 90^\circ = 30^\circ$ ).

At the end of the DME ARC, the aircraft should be at 3800 ft and with an exit heading of 320°. At DME 9, altitude should be 2600 ft and heading 230° already lined up on the ILS localizer.

A descend to 2000ft is then required, maintaining alignment with the localizer until intercepting the glideslope which should happen between 6 and 7 DME.

We always intercept a glideslope from below to avoid diving to chase it. So the goal is to flight level and let the glide slowly come to you from above. Once established, pop the airbrakes, lower the landing gear, add a notch of power and pitch 3° down to follow the glide.

The altitudes displayed on the chart are not mandatory – if you can plan your descent to be at the required altitude at each point by flying a constant descend, that's very fine... and actually easier – The levels are just there to emphasize the required altitude at specific DME points.

Between DME 7 and the runway, the 3° glideslope will bring you the minima, where the arrow pointing upwards displays the missed approach track in case you can't land.

The text line on the top of the window gives the transition altitude and transition level. The transition altitude in Korea is 14000feet. The transition level is FL 140.

In the Balkan, the transition altitude is 7000ft; the transition level is FL 070. See 2.9 transition altitude page 27 of this document.

### 4.2.5. Minimum

MINIMA:
<b>ILS:</b> 620'(202'AGL)* Vis: 200-800m
<b>LOC:</b> 820'(402' AGL)** Vis: 300-1600m
<b>Circling:</b> 920'(502'AGL)*** Vis: 600-2000m
*When ALS inop, increase vis to 1200m
**When ALS inop, increase vis to 2000m
***Circling not authorized North of RWY 03/21. Remain within 5Nm of AVI.

The minima window just gives the minimum altitude of the approach. When you reach that altitude you should look up outside and have a visual on the runway to be allowed to continue the approach. There are usually 3 minima for an approach:

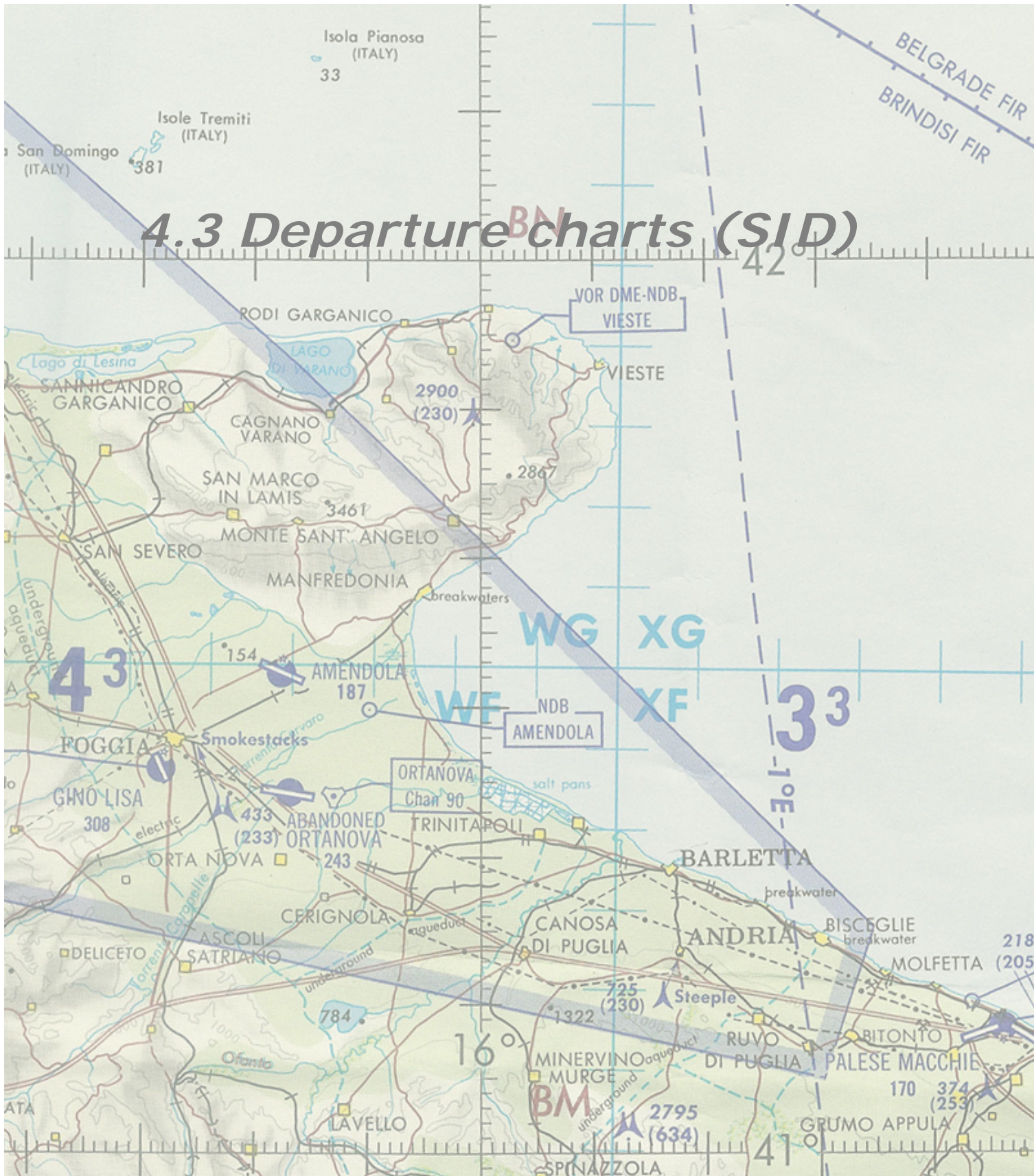
The first one is the minimum when the ILS is fully working: 620 feet MSL which is 202 ft AGL.

The second one is when you perform an approach based on the localizer only (no glideslope information) which may happen in falcon on some airports where the glideslope does not provide enough obstacle clearance. The third minimum is applicable to the circle to land.

Each minimum has also a notion of visibility that needs to be met as well for the approach to be completed.

Plus some extra information about the ALS (which basically are the runway lights) that require an extra visibility distance in case they are inoperative

Some supplementary information might be given there as well. In this case, circling is not authorized north of Rwy 03/21 and aircraft should remain within 5 DME in case of circling the airport because of the restricted area (firing range) east of the airport.



SID stands for Standard Instrument Departure. It's a published departure procedure from an airport. It decreases the load of communication between ATC and pilots since each know what to do to get to the exit point. In real life, its purpose is also to deconflict traffic and provide noise abatement by avoiding populated area whenever possible. Since the F4 ATC just gives a take-off clearance, it will be the leader responsibility to decide which SID to use, according to the take-off axis. Once again, the lead may elect not to follow any procedure at all and dash towards the flot or simply follow his flight plan.

The advantage of the SID in F4 is to provide a time for the wingman to take off (and we know AI are sometimes slow getting in the air). Usually, the time required for the lead to fly the SID will make a rejoin very easily since the wingman will not need to use afterburner following their leader in a long tail chase. If the flight is not complete at the exit point, the leader may use the published holding point to wait for the rest of its flight. In multiplayer, the SID is also great to provide a common route for member of a flight which can then be sure to rejoin easily and concentrate on flying their airplane without the stress of a complicated rejoin after departure. If all follow the same route at the same speed, then the rejoin will be natural at the exit point. Just think about radar departure where the aircraft in front is locked on radar to provide correct spacing and thus deconfliction. Please note this may sound simple but care should be taken NOT to all lock the leader which is a hi risk of collision for the wingmen. #2 is tied on lead; #3 is tied on #2 and #4 is tied on #3. When going through the top of the clouds, if spacing was correct, all flight members should easily gain visual on the front aircraft.

As you may have noticed – and quite logically – the SID don't necessarily point to the North in Korea and you may fly southbound to the exit point before starting your northbound flightplan. Some may say that it is consuming fuel and I would of course agree. But once again, according the fuel load and planning, pilots can elect to discard the SID totally.

The reason is that most of these procedures are done for peacetime and we don't want aircraft upsetting the North Korean by coming too close to their airspace. From a fighter point of view, although it increases the flight time, it may also provide a mean to penetrate North Korean airspace from a vector not direct from a known military airbase... because clever tacticians will wait for you right there!

Another consideration is the TOT (Time over target) Flying the SID will certainly push your flight out of your assigned TOT, so care should be taken to adapt the TOS (Time over steerpoint) at waypoint 2 to have plenty of time to fly the SID.

Usually, a good idea would be to place waypoint 2 on top of the SID exit point. That can be done during flight planning in a general way, and refine its placement once in the cockpit with the GPS coordinates of the exit point or directly from the planning map if you use the ONC UI map. (Which features the exit and IAF points)

And finally, such departure procedures might be an easy way for AAA servants to deconflict friendly from enemy aircraft. If you're on the SID at the required altitude, you're friendly. Any other aircraft might be fired upon without warning. Sure it's not like this in F4... but with a little imagination ☺

Flying such a departure procedure involves a lot of preparation in flight planning. First you need to be aware which of the runway will be likely to be active. For that you need to check the wind in the briefing. Then you should review the procedure before entering the aircraft and know what radionavigation as well as radials to set in the cockpit. If you stay behind the airplane once in the air, by checking the chart constantly to see what you need to do next, you will probably get out of the published route. Some SID are very easy to follow, other are much more complicated and involve a lot of tacan switching.

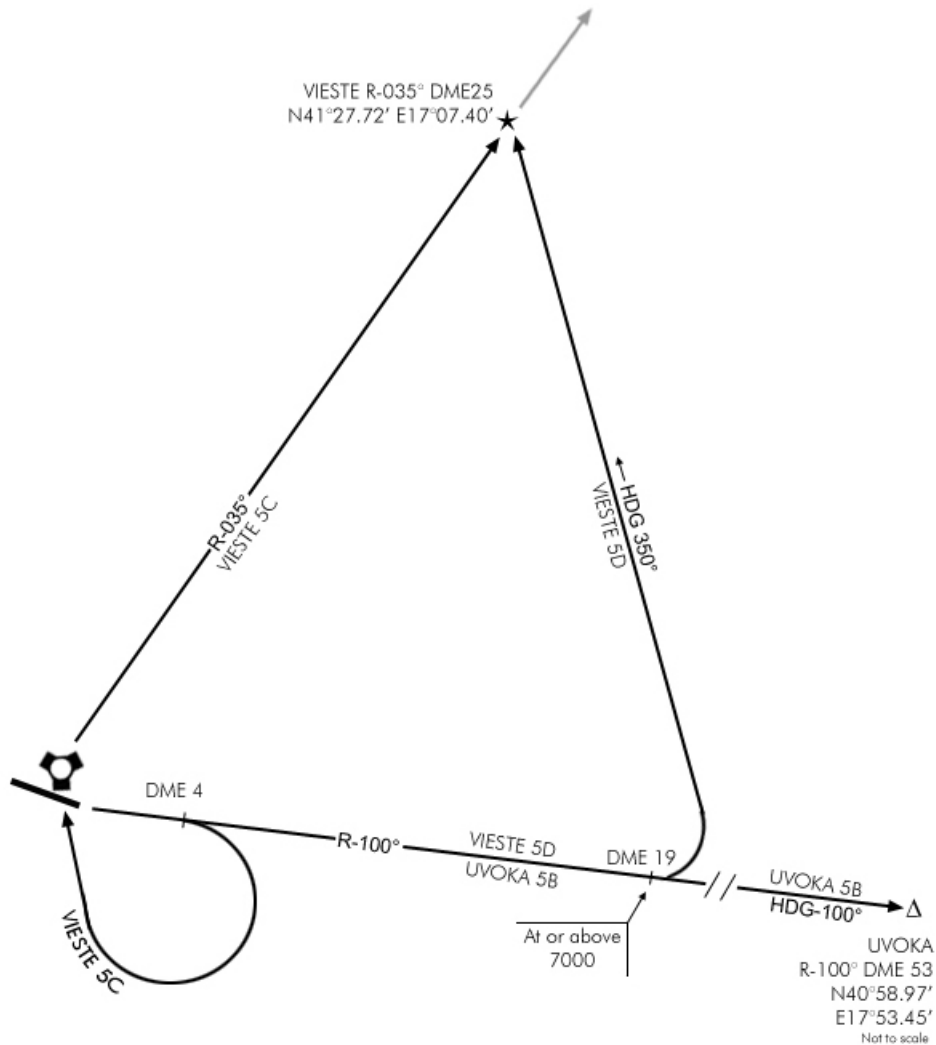


### 4.3.1. SID Review

As the other charts, the SID starts with a title section and a header section. Those two sections are quite similar to the ones we explained on the approach chart chapter. So I won't cover them again here. The main difference is that the missed approach has been deleted and there's no mention of ILS or Tacan for the approach and these are replaced by the Transition altitude and transition level, more important here since we are likely to use it while climbing out.

TACAN:	TWR:	TRANS ALT:	TRANS LEVEL:	GPS:	ELEV:
054X	250.2/118.2	7000ft	FL70	N41°07,44' E16°47.02'	160'

The remaining of the chart is a plan view of the departure route and a written description of the route. There is no side view for altitude. The required altitudes are mentioned on the plan view at key point along the departure.



Let's consider Amendola departure. Amendola is an 11/29 runway and there are three different routes for each runway. Two different exit points in total. One to the North, on a

direct route to the Balkans, and the other to the East.

Our first example is for the runway 11 departure. We have the choice between Vieste5C, Vieste 5B and Uvoka5B routes. As you see the Vieste routes share the same exit point obviously named VIESTE to the North. Uvoka5B route share part of the way with Vieste 5B and leads to UVOKA, the easternmost exit point.

The procedure is explained in plain text in the Departure route description. The first thing to do is to read that the section relevant to the departure you will be flying.

#### DEPARTURE ROUTE DESCRIPTION

UVOKA 5B: Climb on R-100° outbound Amendola tacan. Proceed inbound UVOKA to be reached at (RWY11) assigned FL. Thence...

VIESTE 5C: Climb on R-100° outbound Amendola tacan. At DME4, Turn RIGHT DIRECT to the station. (RWY 11) Intercept R-035° outbound amendola tacan to VIESTE to be reached at assigned FL. Thence, ...

VIESTE 5D: Climb on R-100° outbound Amendola tacan until DME19 to be reached at or above 7000ft. (RWY11) At DME 19 LEFT climbing turn to heading 350° and proceed direct to VIESTE (R-170° inbound VIESTE Waypoint) to be reached at assigned FL. Thence,...

In this example, the runway 11 is active and we will fly Vieste5C. Prior to lining up, the tacan is set to 054X and the course arrow is set on the 100° radial. The instrument mode is obviously in TCN position. Check waypoint 2 coordinates and adjust them to the GPS coordinates of Vieste if necessary.

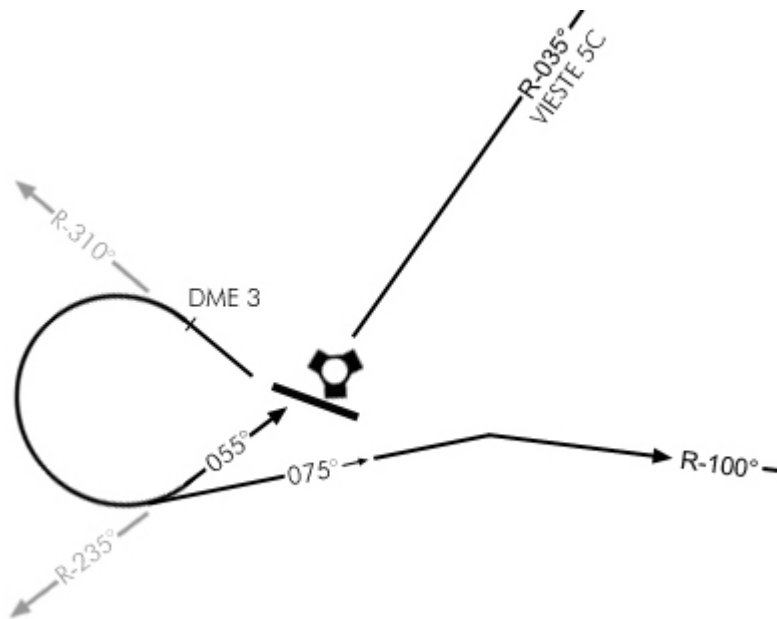
Once airborne, a climb on R-100° is required until reaching DME4. As the F-16 is accelerating and climbing fast, you should take care to get out of AB as soon as possible and don't climb like a rocket. 8° pitch up is usually more than enough, showing a speed of 300 kts indicated.

Passing 4 DME, turn right gently back direct to the station. You don't need to track a radial back to the station, simply placing the red station bearing pointer on the 12 o'clock position on the HSI will do.

Since you don't need the course arrow on the 100° radial, you can already switch it to the 035° setting so you're ready once overflying the station.

Turn right again overflying the tacan to a new heading of 035°. As we saw earlier in the basic radio-navigation section, you need to let the tacan at least 2 Nm behind you before getting on the radial. Since you turned right above the tacan to a 035° heading, there is a good chance you're very close to the radial, so once the CDI stopped moving towards the centre of the course arrow, simply make a tiny adjustment in angle to get on the radial. In the meantime, you probably reached your assigned flight level for waypoint 2 (which you set at the VIESTE GPS coordinates) level out. Finally track the 035° outbound till reaching VIESTE exit point, trying to get a visual on your wingmen joining up on you. Past Vieste, switch to your INS route and go on with your mission.

The other routes are self explanatory. And in the event runway 29 is active, the same routes apply, except the initial part of the route is slightly different.



Vieste 5C will happen quickly and the pilot will be able to switch radials quickly on the HSI. Start by selecting R-310 and follow it to DME 3, then gently turn left – selecting R-235° or already R-055°. I advise the later since it will be easier to track it. Once set, observe the CDI and make sure you intercept the 235° inbound before overflying the tacan. For that you will need to make sure the station bearing pointer remains on your left while the CDI centres on the course arrow. Once it's centred, fly a heading of

055° until overflying the station where you would need to turn a further 20° to the left to fly a heading of 035°, once again setting the course arrow to 035° while overflying the tacan.

It's obvious that you can't do all this in HUD view; you will need to fly on the HSI view, keeping a constant visual scan of the other main instrument.

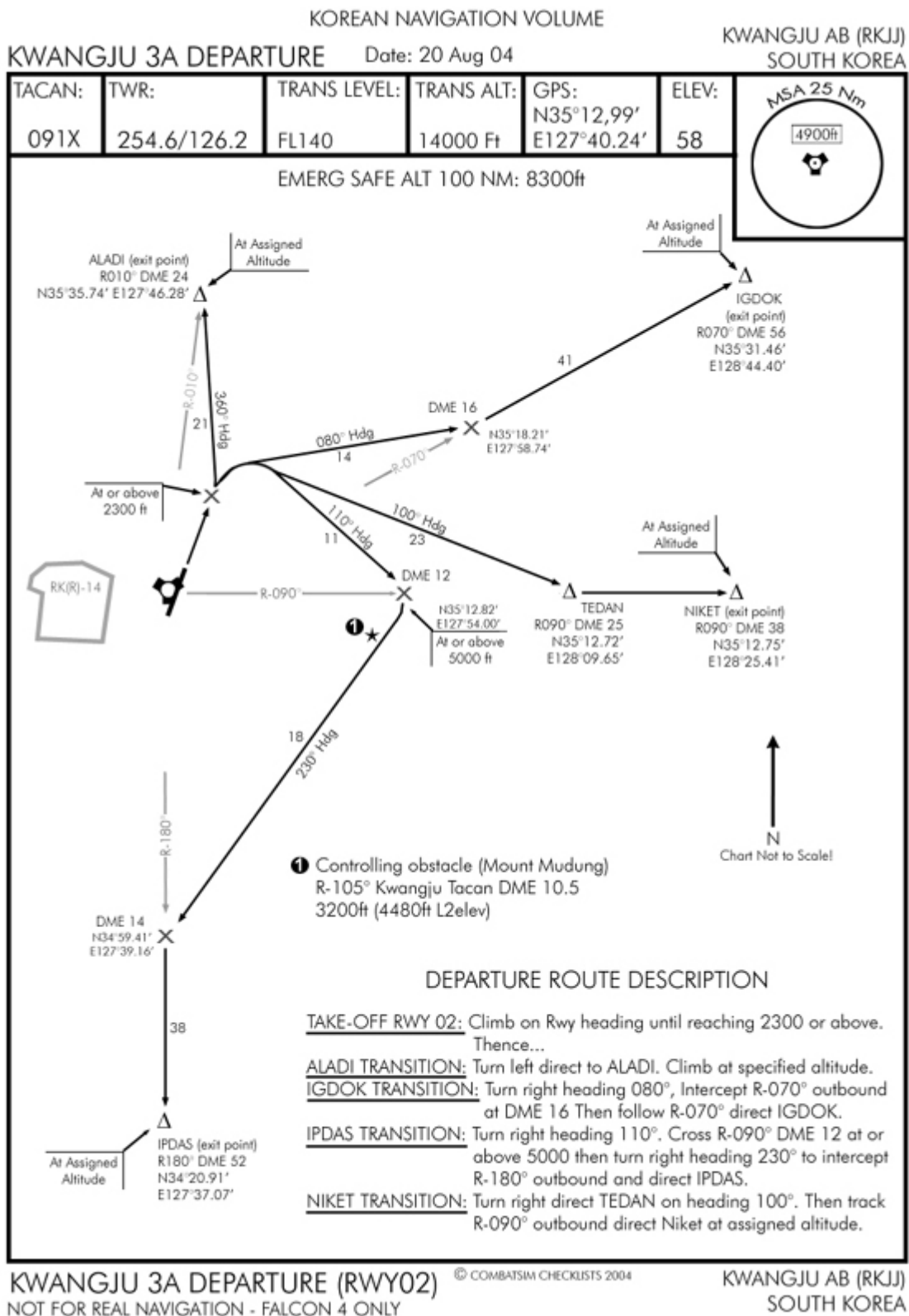
The Vieste 5B and Uvoka 5B are somewhat easier, just fly a heading of 75° levelling after the initial left turn and set the course arrow on the R-100° radial. Since you're pretty close from the station the intercept angle of 25° (100°-75°) will be more than enough to get on the radial soon after the bearing pointer drifted on the rear left quadrant.

Flying SID is not overly complicated as long as only one tacan is concerned. The trick is to plan the procedure properly before departure. It gets trickier when more than one tacan station are necessary to follow the route and when you have multiple transitions like on Kimpo and Kwangju. Transitions are different routes leading to different exit point of the same departure.

(See next page)

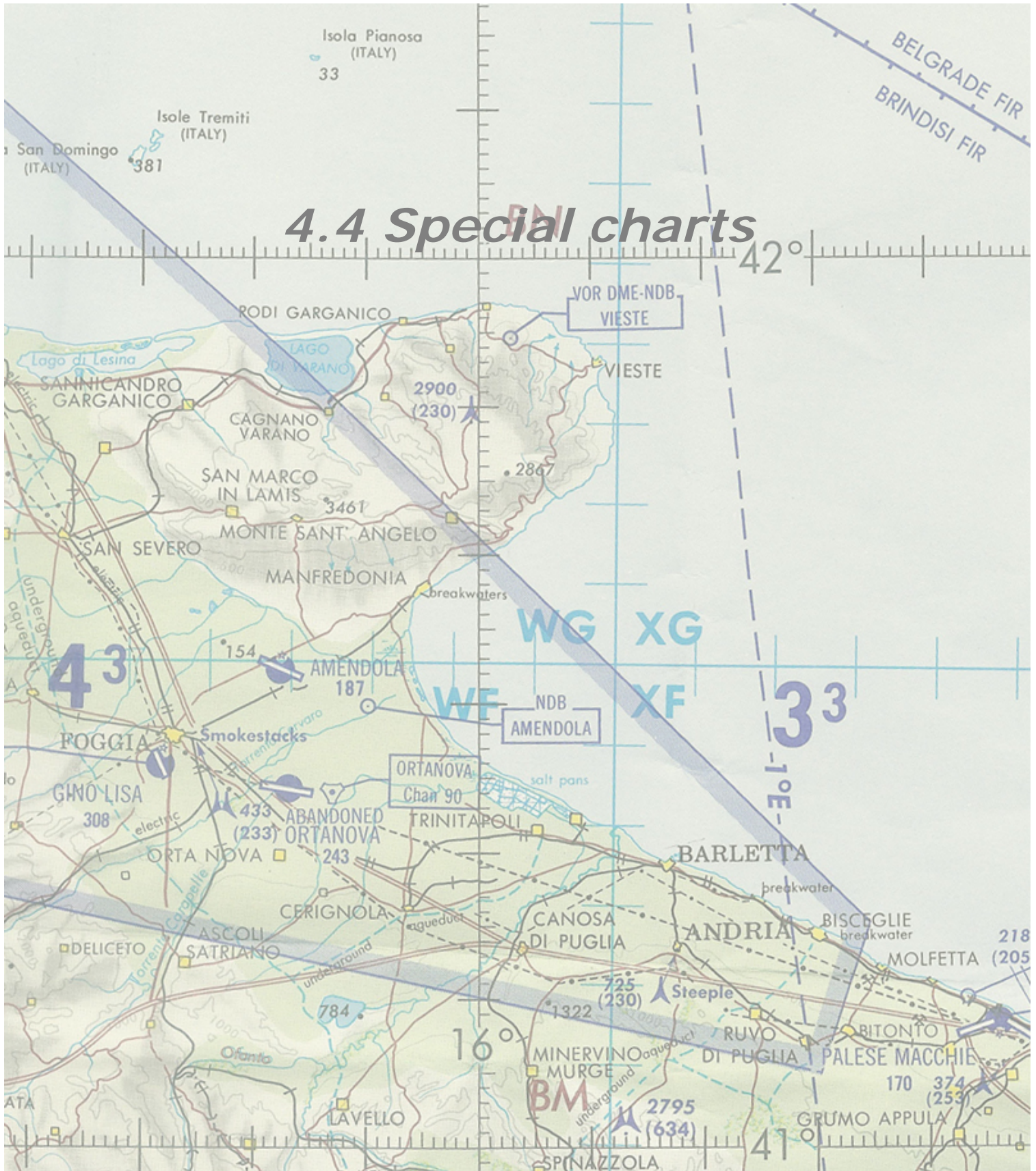
The SID itself says to climb on runway heading until reaching 2300 feet. Then the pilot has 4 transition routes at his disposal, depending on which direction his flight plan goes: ALADI to the North, IGDOK to the North East, NIKET due East and IPDAS due South.

Also of interest is the black circle with a 1 inside. It gives the position of an obstacle near the route. In this case, a mountain with a highest point at 4480ft. Since you're supposed to pass DME12 at or above 5000ft continuing your climb, you should be safe. But it does point of the importance of altitude control throughout the route. Since you're heads down in the cockpit you won't see the mountain that will spoil your mission ... and reputation.

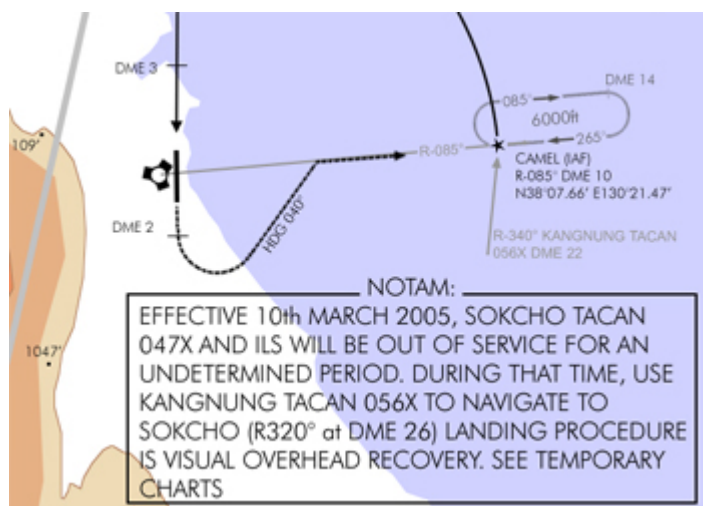




## 4.4 Special charts



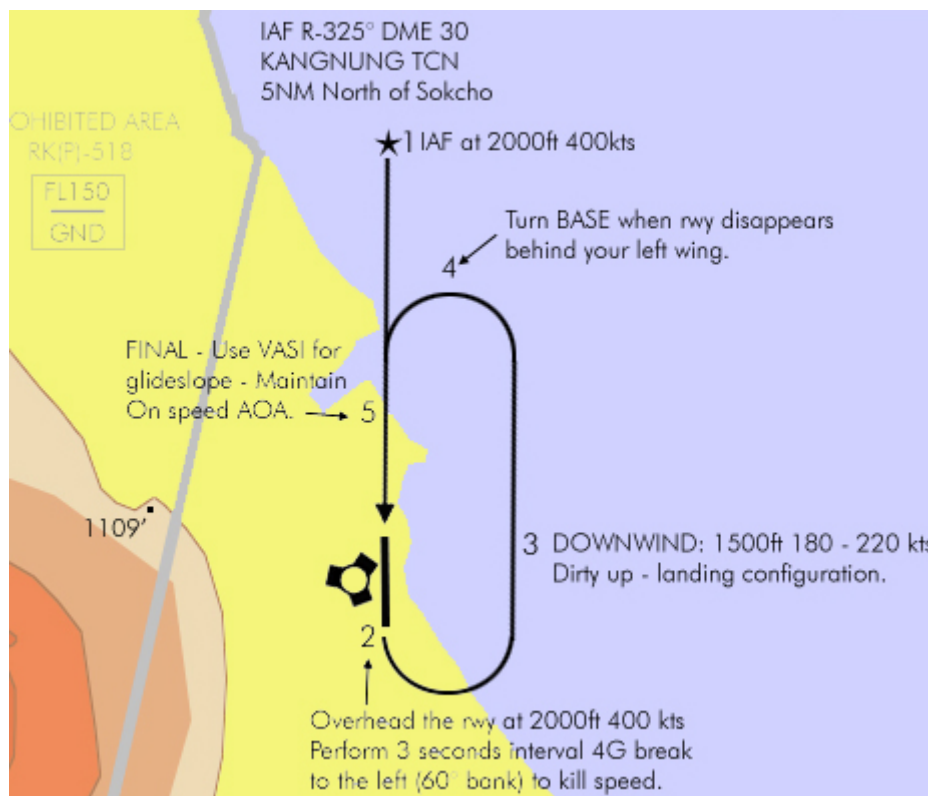
Some airbases have additional special charts. Those are sometime required to document special or temporary procedures. The most obvious one are the NOTAM charts for Sokcho and Hoengsong. These two airports actually are airstrips upgraded to airbase status during the airbase update done for SP2. Since there is no ATC code nor tacan code for airstrips, the assigned tacan and ILS allocated to Sokcho and Hoengsong are not working with current F4 version – although I'm almost certain they worked with the SP series. I don't know what happened in the meantime but the fact remain, the tacan and ILS are unusable. So I decided to make a NOTAM about it on the ILS chart and create a temporary landing chart explaining the Visual procedure to land. Visuals landing pattern should not need to be explained on a chart but I thought it might help beginners, so I decided to do it anyway. The temporary charts should be printed on yellow paper.



Since the tacan is inop. You need to use another tacan in the vicinity to pinpoint Sokcho. The chart tells you that Sokcho is on the R320° radial of Kangnung tacan at DME 26. So to get there, just intercept the 320° radial outbound Kangnung and at 26 Nm, you should be overhead Sokcho.

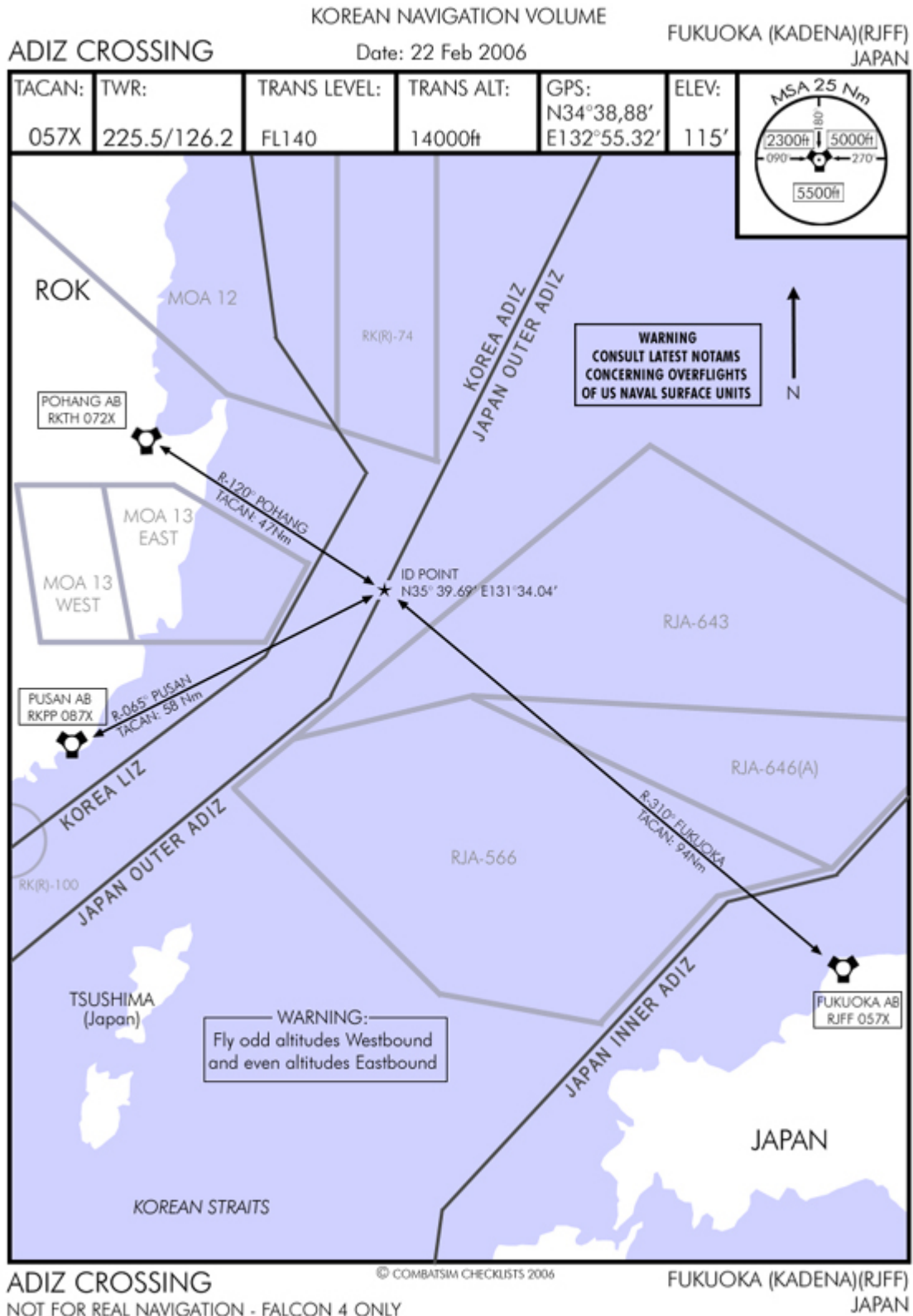
To land, switch to the temporary chart for landing on runway 18. The 5 steps of the visual approach are explained on the temporary chart while the altitude profile is displayed in the side view at the bottom of the chart. That's all you

need to perform a visual overhead recovery at the airstrip. Beware it's quite short and short field landing techniques are required.





Fukuoka (Kadena) also has its special chart. It's a chart I did for documenting a safe route to cross the Korean straits. During the crossing, aircraft will need to enter the respective country's ADIZ and the aircraft needs to be properly identified at the ID point.

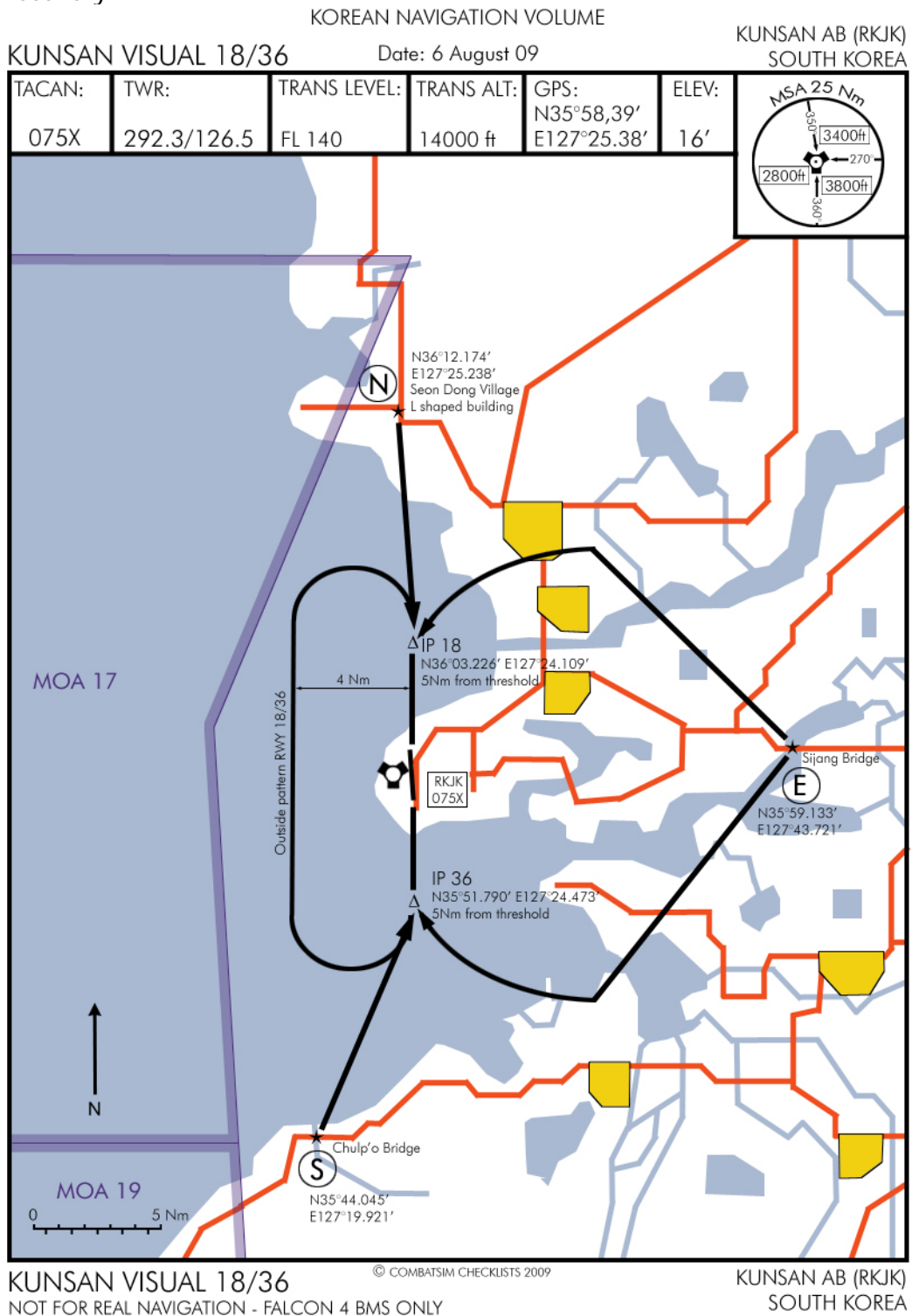


The relevant radials from three main tacan are displayed on the chart: R-120° from Pohang, R-065° from Pusan and R-310° from Fukuoka.

Since all aircraft are likely to be on those corridors, westbound aircraft needs to fly at odd altitudes while eastbound traffic needs to be at even altitude in thousands of feet. That will provide at least a thousand feet separation between crossing flights. But don't worry too much. The AI flights will not follow this route. So the chart is mainly for large multiplayer campaigns.



Another chart type I'm still working on is visual charts for airports. A kind of VFR chart where pilots can see the landmarks necessary to pinpoint the 4 cardinal entry point for a visual recovery.



The purpose of those VFR charts is to provide visual reference entry points for each airport. Returning flights in VFR should contact the airport at the entry point and state intentions for landing. The tower will then give the active runway and confirm the altimeter setting (if asked). That's where we usually call abort so the ATC stops giving vectors calls to all flight members. We don't need them.

Lead then brings his flight to the relevant initial point – usually 5 Nm within the parameters for the overhead break for instance (we use 300Kias, 1500feet AGL) lined up on the runway centreline. From there the wingman have a short distance to close up the formation so the break impress the ladies on the ground.

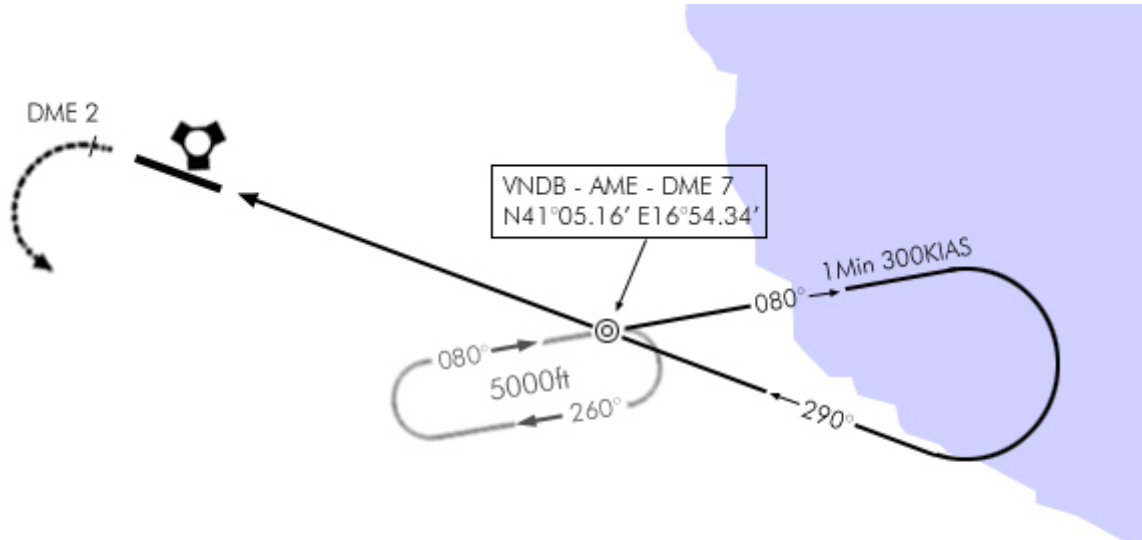
The direction of the break is illustrated by the outside pattern – which as the name implies is a safe pattern wider than the overhead that is used if one aircraft has to re enter the downwind because of an abort at some point. In this case, patterns at Kunsan are always LEFT (sea side) to avoid overflying the city.

Since we actually use landmarks for those VFR charts, they have to be F4 compliant. This means that the road and rivers and cities are exactly displayed the way you see them in the Falcon 3D world. The entry points specifically are visual falcon landmarks such as a bridge, a building, a city, etc etc.

The roads are in red. Cities are yellow and rivers are blue. The entry points are named according to the 4 cardinal points N, E, S and W. Each entry point has its own GPS coordinates.

Not all airbases have that chart already but it is my intention to add these as I progress.

In real life, fun approaches to fly are NDB approaches. Unfortunately we don't have these in Falcon. Although we can simulate them by placing a waypoint where the NDB should be – we just need to know its GPS coordinates. That's what I tried to do with the VNDB approach on RWY 29 of Amendola airport.



The VNDB point is placed along the runway centreline at a distance of 7 Nm from the airbase. As you noticed, the GPS coordinates of this specific point are given. This is good because with that information, we can set the VNDB as the last waypoint of the flightplan for instance. Through the UFC, select the last waypoint before landing and enter its new coordinates. Having done that, the waypoint can now be used as a virtual tacan if two conditions are met:

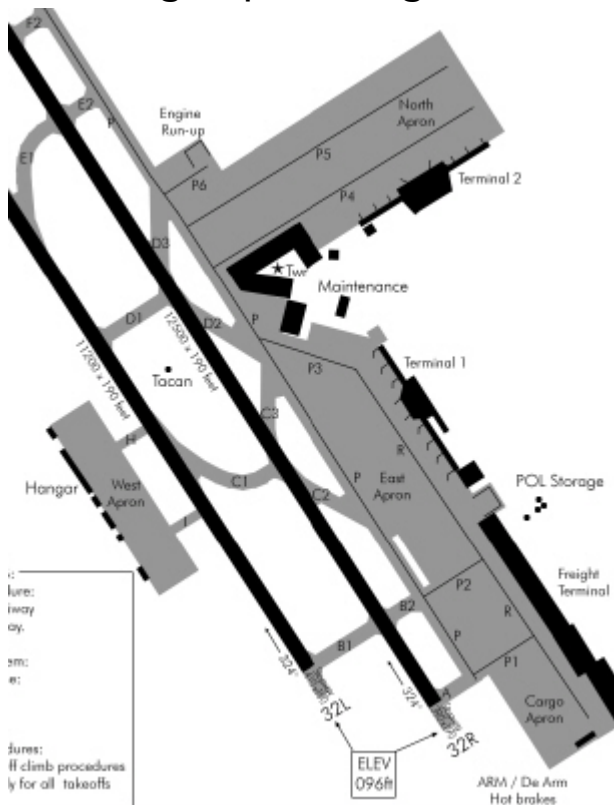
- The waypoint must be selected as the steerpoint of interest
- The Instrument mode switch must be in NAV position.

You can now use the waypoint as a reference point to fly the above published procedure, as if it were a tacan or a NDB. You can track radial from that point, execute a procedure turn as pictured above and fly racetrack patterns on it.





## 5.1. Flight planning



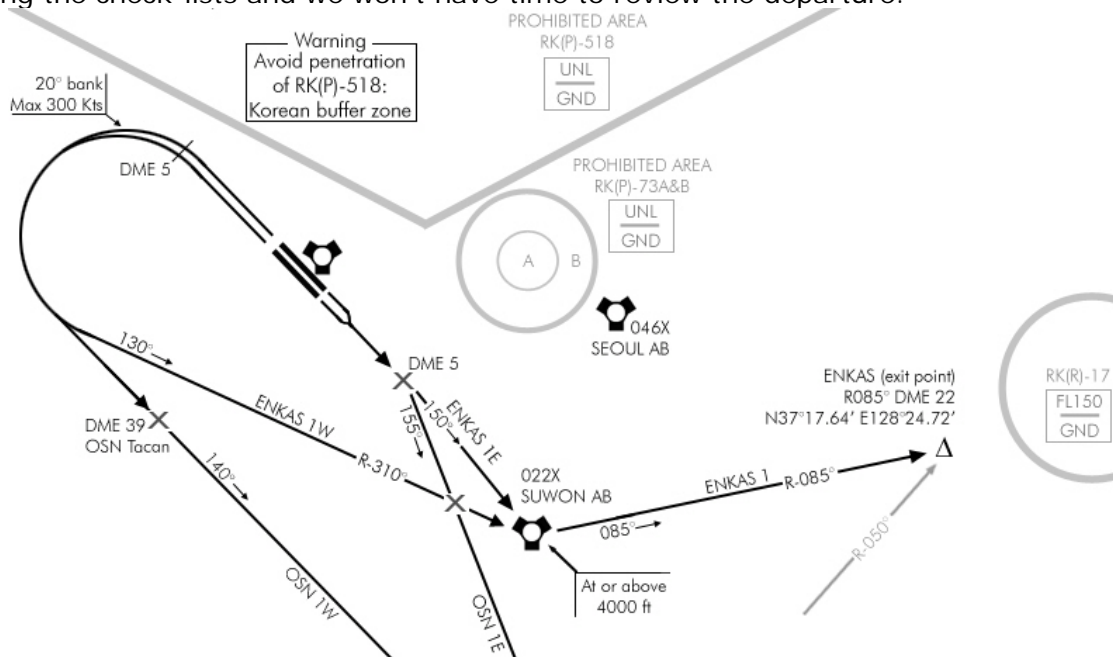
You just arrived in Korea at Kimpo and you have been tasked to an orientation flight in the area. You start at mission planning and have gathered all your charts. At this time, we don't know yet which runway is active, but a quick glance at the weather report on the briefing tells us the wind is at 280°; 5 kts so we can expect a departure on either one of the 32 runways. (Since the DED can't show winds on the ground anymore in BMS, you better check the wind in the briefing screen, which is now correct)

We will have a 40° crosswind component, but luckily the wind speed is quite low. Getting to the runway won't be a problem thanks to the airport chart. We know we will have to take Taxiway P3, P2, P1 and F to get on the last chance holding point. The true heading of the RWY 32 are 324°, so our take off will be done rolling on the 324° mark and we will drift right once airborne due to the crosswind.

An important information beside the tower frequency is the field elevation which is

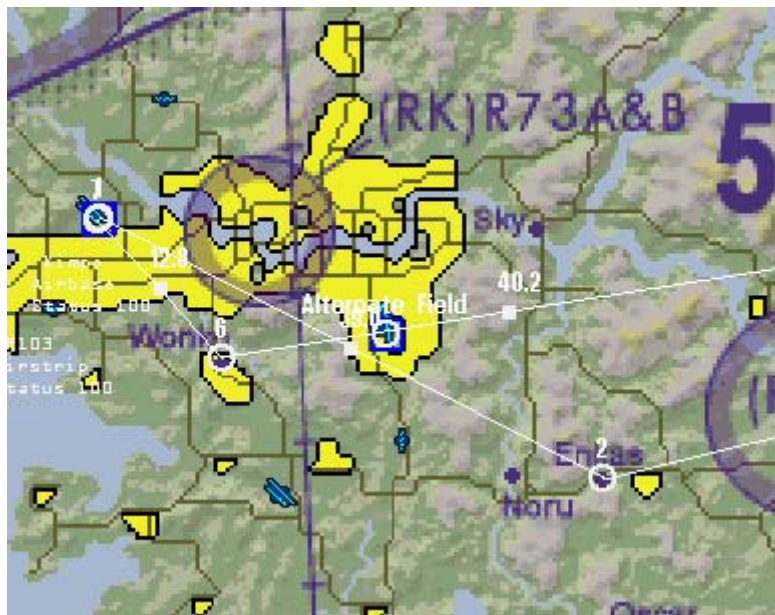
96ft. Not very high but we still need to commit it to memory. We also have a quick glance at the MSA – no sweat here we will be fast above the safe altitude.

We will fly the ENKAS 1 WEST departure, probably from runway 32L but it might be 32R depending on the ATC today. The important thing here is to review the procedure and commit it to memory before going into the cockpit as once there, we will be very busy doing the check-lists and we won't have time to review the departure.



Enkas 1W, calls for a climb on runway heading to DME 5 or reaching 2500ft where a LEFT climbing turn max 300 kts 20° angle of bank is required. We will roll out still climbing on radial 310° inbound Suwon Tacan which is 022X, heading 130°. Passing Suwon should be done at or above 4000 ft which will not be a problem for us, we will be much higher already.

Overhead Suwon, we will need to track R-085° outbound till reaching Enkas at our waypoint two assigned altitude. Enkas is checked against R-050° OSAN tacan (094X) Since Enkas is our SID exit point, we will need to assign it's coordinates to INS steerpoint #2 once in the cockpit, if it wasn't done at preflight. As you see below, the UI map was updated and the exit points are now easily found there, which makes it quite easy to place the steerpoints on specific SID exit points.



Let's have a quick review of the no fly zones and we notice we need to be careful not to drift into the Korean Buffer zone just after take-off. There is a risk that the 280° wind will push us in that direction, so let's be aware of that possibility. There is also RK(R)-17 after n reaching the exit point but since that area is topped at FL150 it shouldn't be a concern even if we could not avoid it.

Finally, in case of emergency requiring an immediate landing at Kimpo, the tacan station is 083X and the active runway will be either one of the 32 (In Falcon, there is no way to know exactly which parallel runway is active before contacting the ATC for take-off.)

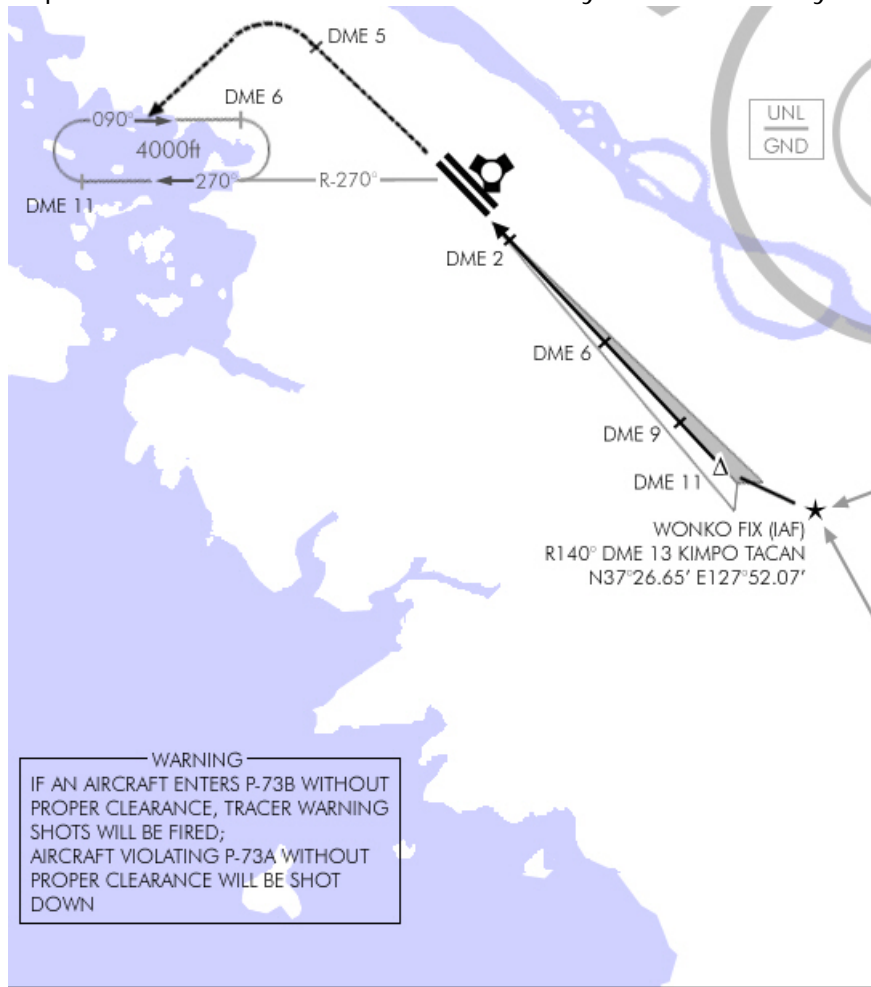
With the new UI, it is not quite necessary anymore to modify the GPS coordinates of the exit point and the IAF (in this example STP #2 Enkas and STP #6 Wonko). They can be placed correctly straight on the planning map. Just take into account the TOS for those steerpoint in planning since you will need more time to get to waypoint #2 flying the SID than flying the straight line of the flightplan, so don't hesitate to give enough TOS margin.

Let's have a short discussion about alternate landing site. Falcon by default often select a small airstrip close to the original airbase should an alternate be required. I often choose one of my own according to specific considerations:

1. Select an airbase with different runway orientation than the planned airbase. That would prevent a crosswind component making the landing unsafe at both airbases.
2. Select an airbase not too close to the planned airport so significant weather cannot prevent landing at both site. Actually, the weather in BMS does not change according to location but according to time. Si in the timeframe required to fly from planned airbase to alternate airbase, the weather might change. (But you could as well hold and wait over the planned airbase)

Note that according to the distance required to reach alternate (or hold), careful fuel planning is required as well. You don't want to run on fumes trying to reach the alternate...

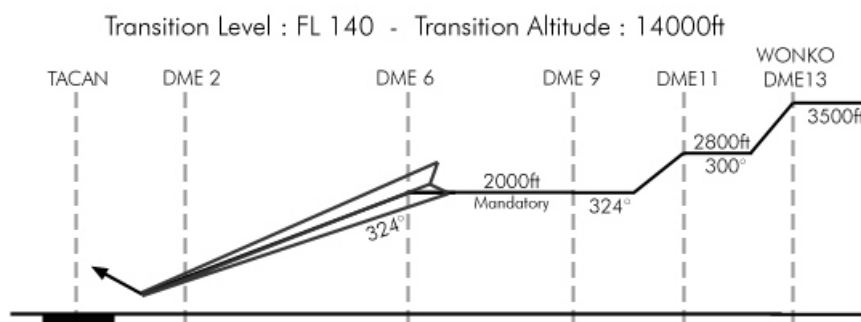
In the above example, Falcon assigned R103 airstrip as the alternate. It's quite close to Kimpo. I selected Seoul instead for its totally different runway orientation and since the



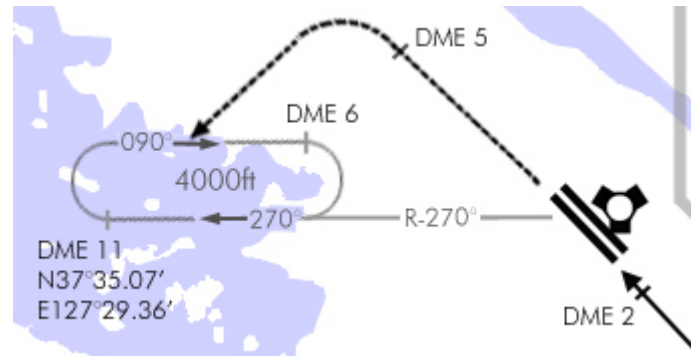
return leg happens to overfly the airport, it should be very convenient. Granted it's quite close to Kimpo.

Since Seoul has been selected, proper procedures for that airport should be reviewed and the respective charts should be checked and taken along in the flight kneemap so they are readily available, should they be required.

The flight between waypoint #2 and #6 is a simple INS route and we will not cover that aspect of the flight, so let's go back to the IAF: waypoint #6. As we see on the side view, we need to hit Wonko at 3500ft. The chart MSA says 3500ft for that sector so we will need to remain no lower than 3500ft getting very near Wonko fix.



The approach will be on 32L or 32R and will be an ILS. ILS frequency is 110.7 for 32R and 108.3 for 32L. Decision height is 200 ft AGL (296ft MSL) and if we have to hold, we will need to go to the holding fix which is at DME11 on the R-270° radial from Kimpo tacan.



In that case, we will maintain 4000 feet and fly to KIMPO and then turn left to intercept R270° and perform a direct entry on the racetrack pattern.

In case we go missed approach, we will need to climb on runway heading to 2500ft and turn left to the holding fix while continuing the climb to 4000ft. We should still good enough on our arrival to fly a direct entry as well.

As for the SID, we need to take care not to enter the prohibited area RK(P)-518 while climbing out.

As you just read, using the charts induces a lot of preparation, especially at flight planning. You should review correctly all procedure and be prepared for anything that may happen during the IFR flight. If you are well prepared and know correctly the relevant procedures, you will be more ready if something unforeseen happens.

## 5.2. Starting engine

The briefing is done, we are all suited up and the aircraft has been preflighted. We are



now sitting in the cockpit and since there is no clearance delivery in falcon, we made our own during flight planning. Since we are assuming the leader position in a flight of two, we need to coordinate with our wingman.

The checks are performed and the engine is started according to the check-lists. Once the INS is aligned, we check the GPS coordinates of ENKAS for steerpoint #2 and WONKO for steerpoint #6. If they are correct, leave them alone, if the flight plan does not take them into account, here is how to update them: Select waypoint #2 from the UFC STPT page and place the asterisks (DCS down) to the LAT line, then enter the correct latitude as given by the chart, then hit the ENTER key. Dobber down again to select the longitude and do so again. Then repeat the whole process for waypoint 6.





The above picture shows the change of coordinates for waypoint 6. The left part of the image shows STP#6 before the change and the right part after the change. Note that the selected point in the MFD didn't change a lot because the general placement was almost spot on. The only way you could tell it changed would be by reading the waypoint bullseye bearing.

We also set the HSI on R-325° in TCN mode. The tacan is set to Kimpo, and the 325° radial will give us a reference point to counter the drift on the climb out. Indeed, since it's on our right and we want to avoid drifting right, passing on the other side of the radial will warn us that we are drifting off course.

When we are ready to taxi, we light up the taxi light. As soon as number 2 lights his, we contact the tower to let them know we are ready and request the QNH for the altimeter calibration.

As planned, the ATC guy clears us to RWY 32L and since we prepared our route, we exactly know how to get there. But for good measure, we tell our wingman.

*-Sting 1-2, Sting 1-1, taxiing to RWY 32Left via Papa4, Papa, Bravo2, Bravo1..*

*-Two.*

Our take-off time is 0545 so we should get on the runway holding area a while before to make the final runups and checks. With the UFC clock displayed we taxi to the holding point. We stop before crossing RWY 32R just to be sure nobody is landing – the ATC won't warn us if it was the case.

At 0542 we are holding short with 3 minutes for the last minute checks. Very quickly we are ready to go and the ATC clears us to take off. While lining up, we do a quick review of the departure:

135 kts raise the nose, airborne at 148 kts. Positive climb, gear up. 10° climb – retard throttle a notch not to accelerate too fast. Remain close of the 325 set radial. 2500ft (or 5DME), LEFT wide turn 20° bank angle. Speed max 300 kts while climbing–

Set the Tacan to Suwon 22X after leaving the runway heading – set course 310° and intercept R-310° inbound Suwon on heading 130°. That should cover the initial manoeuvre.

A quick check at the HSI lined up on the runway with a few seconds to spare tells us we are on the 324° heading, selected course is 320° but the CDI is offset to the right, so we are LEFT of the radial. That is confirmed by the station bearing pointer at our five o'clock and the dme reading 1Nm. Kimpo tacan is behind right of us so it's normal the radial is to our right. By flying the runway heading on take-off, and remaining this side of the radial, we will be sure that we will not enter the Korean Buffer Zone, so that's perfect.



We will take off at 15 seconds interval and the wingman will follow the same route, as briefed (hope he's human in your flight)

### 5.3. Flying the SID

0545, we are releasing brakes and rolling, the wingman will follow suit. The take-off is routine as usual, once airborne the wind pushes us slightly of course and we correct the heading into the wind to avoid drifting. The 2500 ft are reached very quickly with no serious drift and we start the left climbing turn towards Suwon tacan. Careful on the bank angle, we set 20° and we keep the speed close to 300 kts. At this stage, the tacan needs to be switched to Suwon (22X) and course set to 310°. We will need to intercept that radial inbound Suwon. We don't expect to smoothly curve our way to the radial from the first time. By checking the CDI during the turn, we can decide to tighten the turn to avoid overshooting the set radial or to flatten the turn to keep a decent interception angle on the radial. Since our roll out heading is supposed to be 130° on the radial, we will fly a 160° heading if the CDI isn't moving thus keeping a nice 30° intercept angle on the radial. You always want to plan ahead and consider both options of the intercept. The tightening of the turn doesn't require calculations, but you'd better set the 160° intercept heading before getting to that point. Not doing so will certainly spoil the SID.



The left picture is taken during the turn, the tacan has just been switched to 22X (Suwon and course set to 310°. We are 30Nm from the tacan. We are passing through 280° with a 20° bank angle, altitude is passing through 3100ft with a 10° climb, speed is 300 kts. Spot on the procedure. We concentrate on keeping these settings. The next step is the radial interception. Since we set 310° course, the CDI will point backward (yellow arrow) and our reference heading will be 130°.

If the wingman is human, he will follow in trail, flying the same IFR procedure. He will lock his lead on radar and call tied. In that scenario, speed control has to be closely monitored to avoid a mid air collision. But since airspeed below 10000 feet should be limited to 300Kts, it shouldn't be a problem for both aircraft to fly the same speed. The rejoin will be made on top once or at the exit point, once the visibility allow cancellation of the IFR and return to VFR flying. When that happens, the wingman will call Visual and rejoin his lead in the prebriefed formation.



The turn continues with the same settings and reaching the 160° heading (here turning through 170°) we check the CDI which started moving inboard. Should we stop the turn and fly the 160° radial till interception? No, since the CDI is moving, it tells us that we are nearing the radial and we can continue the turn and fly a smaller interception angle to the radial (since we are quite close already) proof that the situation is dynamic and needs to be monitored constantly. From this point on, we will place the aircraft projected flight path (white line) between the CDI and the course arrow (the green lines – remember? See page 22) to fly a smooth interception. Actually, the reason the procedure calls for a 20° bank angle and a speed of 300kts is to provide a roll out very close to the 310° radial of Suwon tacan. So the closer the settings are flown, the closer of the radial you will be on roll out, making the interception easier.



The picture at left shows the radial intercepted at 19 Nm out. Speed is 300kts, altitude is passing 9800 ft, climbing with a 10° angle. The CDI is centred and all we need to do now is to remain on the radial until overhead Suwon. Passing through 14000 feet, we will need to call transition altitude and set 29.92 (or 1013) in the altimeter.

As we are nearing the station, the CDI will become more sensitive and care should be taken not to overcorrect the heading. Think in small correction headings to keep the radial centred. Instrument scanning also needs to continue to ensure you keep all the parameters in control. It may look like a simple phase of the IFR flight, but it's very easy to screw it, so let's concentrate on the next step still in the idea to keep ahead of the airplane.

The next step will be station passage. The CDI will start to drift to one side, a bit before DME zero, we should turn left heading to 085° and set course to 085° outbound Suwon tacan. Slowly after station passage, the CDI will close to the centre of the dial and final adjustment on the 085° course will be done. To add

another dimension to the manoeuvre, we will probably reach FL200 just above the station, so we will need to plan for the level out.





As pictured above, we are now 2 Nm past Suwon tacan. The course is still set to 310° but we are already flying heading 085°. Altitude is level at FL200 and speed is 280kts. Note the selected steerpoint in the right MFD dead ahead, it's waypoint #2. So at this time we could simply follow the Hud tadpole to fly to Enkas. But let's first check that we navigate along the 085° radial. Set course to 085° and centre the CDI.

Getting closer to Enkas, we will make a quick check of the accuracy of the navigation system. We know Enkas by 3 different systems:

1. The GPS coordinates of the fix entered as waypoint #2
2. The position relative to Suwon tacan: R085° DME22
3. The position relative to Osan tacan: R050° DME not specified on the chart.



Since we have the hud tadpole somehow picturing the Suwon 085° radial, we can switch the tacan to the OSAN channel 094x and set course to 050° in the HSI. Since we are not over Enkas yet, the CDI will remain on the side but moving inboard to reach the centre of the instrument right at Enkas.



The centred CDI on R-050° Osan tacan tells us we are overhead Enkas fix. That is confirmed by the HSD that shows us above waypoint #2. That would also be confirmed if we were to switch back to Suwon tacan that would show us on the R-085° at 22 DME.

There you go, having completed your first Standard Instrument Departure. Congratulations.

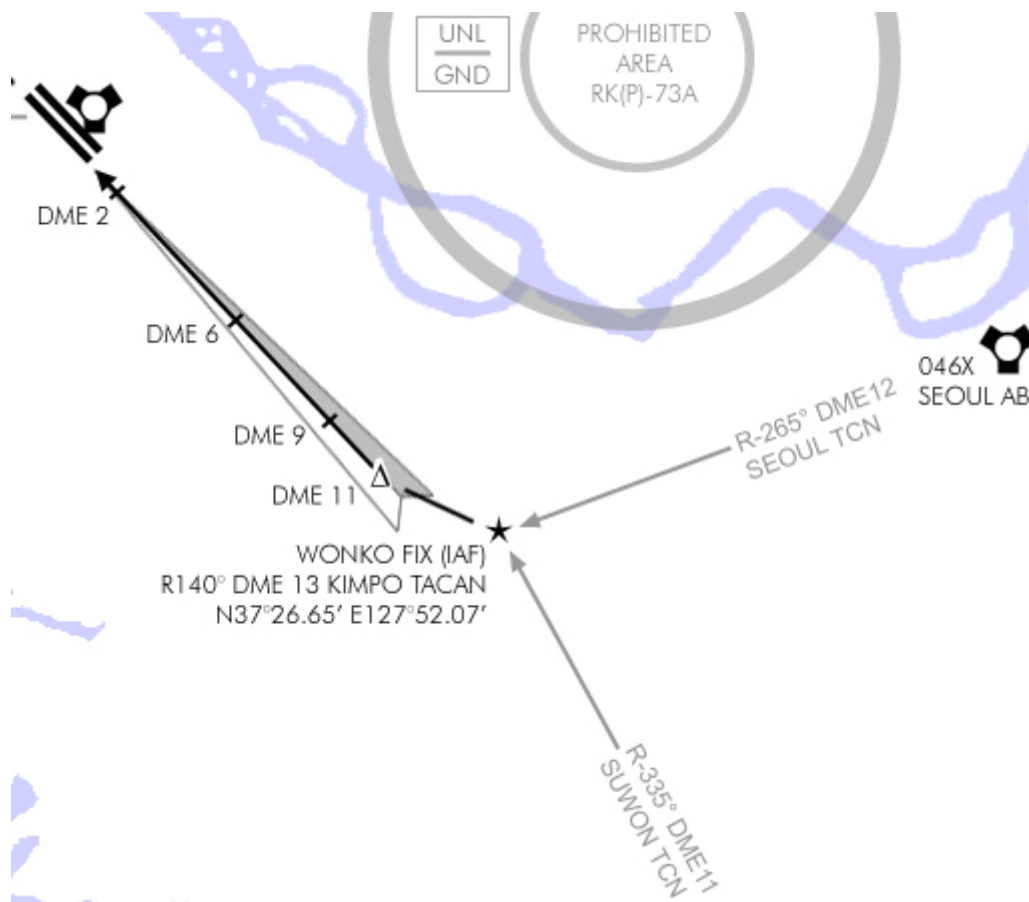
## 5.4. Transition to normal flight

At Enkas, you resume your own navigation as inputted into the INS system, that's where I wish we had the resume own navigation from the tower (and not right after taking off as currently implemented. But that's where we call our status report (as fragged) for the mission commander

From there on, you're free to go on with your mission objectives. Depending on the conditions you might need to fly on the instruments, but you will probably fly mainly with the HUD along your waypoints.

## 5.5. The approach

On the return leg of our flight, still at FL240 we start to concentrate on the approach. If the wind didn't change too much while we were away, we expect landing on either of the two 32 runway. The 32 Left and Right approach plates are taken out and placed on the top of the kneemap stack. Since we are approaching from the East, we will descend to 4000 ft in a while so we can hit Wonko, set as waypoint #6 in the INS, at 3500ft. Since localizer intercept is just 2 Nm from Wonko, careful speed and altitude planning will be required.



At this time, you need to decide what to do with the ATC. We all know it's screwed most of the time but sometime, they just go along the chart procedure very well. I tend to use them as much as I can and when they start to become annoying, I declare aborting the approach and land on my own. The reason I call them initially is to see if the runway they say is in use is the one I expected according to wind conditions and eventually the presence of an ILS. Well apart from wind we have no real control on, they don't follow any specific guidelines ☺ The good stuff about them is when they instruct us to hold for traffic. Now that one I like very much because that's why I created the holding patterns in the charts. So when they tell me to hold, I directly go to the holding point and hold as published until they release me ... usually before I start my first racetrack!

Anyway, back in our flight. We are at FL240 heading due West straight to waypoint #6. We start a gentle descent to FL140 where we should switch the altimeter to local setting, then continue the descent to 4000ft. Speed is reduced to 300kts abeam Seoul tacan. The HSI is set to TCN/ILS mode and the course is set to 320. Strictly speaking setting the



course is not really required, but it helps getting a clear picture of the approach. The TCN/ILS mode is chosen because it gives DME reading relative to the selected tacan.

First, let's see what the tower has to say:

- Kimpo approach, Sting 1 flight of 2 ,inbound for landing.
- Sting flight, Kimpo approach, descend to 2000 ft, expect vectors Runway 32L...



As expected! Note that the AI wingman will get on his own and receive direct instruction from the tower, so beware, he might become a hazard to your approach ☹ Human wingmen can stick to their leader performing a formation landing or go on their own, depending flight conditions.

We disregard the altitude calls and set the ILS to 108.3 in the T-ILS page by inputting 10830 in the scratchpad. CMD STRG is enabled. The approach on 32L is very easy since the IAF is almost the point where the ILS command steering cue will start to guide the pilot on the ILS track. So even if the charts call to first descend to 2000ft to wait for glide interception, we can simply follow the command steering cue in the HUD from Wonko fix to ensure a safe ILS approach.



The three pictures show the arrival at Wonko on a 272° heading. Speed has been reduced to 300 kts while descending and although wonko is some 4Nm ahead, we are at 3850ft. The HSI is set correctly and ILS bars are already displayed in the HUD and attitude indicator (not shown)





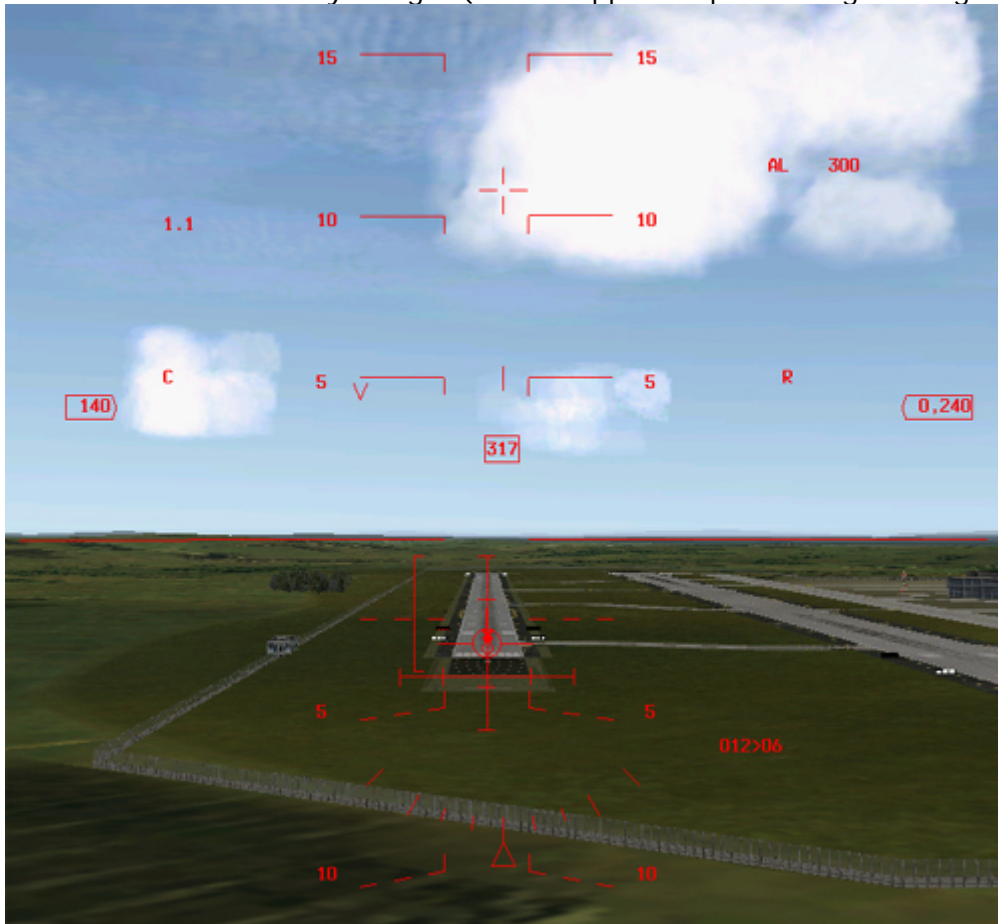
We are passing Wonko fix at 3500ft, 300 kts. The ILS vertical bar (localizer) started moving inboard and the ILS command steering cue just started to move right, calling a right turn to intercept the ILS, just as the chart says. Although the chart calls for a descent, we remain at 3500ft since we already have a valid glideslope signal which is above us. We will start our descent as soon as glideslope is intercepted.

We start a level right turn to superimpose the flight path marker with the ILS command steering cue. At DME 9, we are aligned on the 32L runway and descending with a 3° along the glideslope. We pop the airbrakes and let the speed decrease to 250 kts.



At DME6, we fly over the outer/middle marker, lower the landing gear and while continuing to align the ILS command steering cue and the flight path marker, we concentrate on getting to on speed AOA by placing the FPM in the middle of the HUD vertical bar, this lighting the green AOA doughnut.

The minimum for this ILS approach is 296 feet. Reaching that altitude, we call minimum and confirm we have the runway in sight (which happened quite a long time ago anyway)



The FPM is on the runway threshold, speed is on speed AOA, VASI confirms, final landing checks are complete, we might be cleared to land depending on the ATC efforts! Let's do it.







The picture on the left illustrates our approach on the 300° radial from Suwon tacan. Note that we are not yet abeam of the station (red pointer) so the interception will take another while. While we close on the radial, we check the notes & warnings of the charts and review the holding procedure if necessary. The warnings tell us an interesting thing: We need to be careful NOT to overshoot the ILS to avoid penetrating the prohibited airspace North of Kimpo. Looks like we will be busy!

By the way, check your instruments while you're studying the charts – aviate, navigate, not the other way around.



In the meantime, the CDI centred and we turn right to intercept. Once we are established on course, it's time to contact the tower.

- *Kimpo approach, Sting 1 flight of 2 ,inbound for landing.*
- *Sting flight, Kimpo approach, Hold for traffic...*

So we will enter the holding pattern then. Easy enough since we will perform a direct entry arriving perfectly on the inbound leg of the racetrack, hence the importance to get on the 300° radial well before the fix. Tracking the 300° radial for a while before entering the holding will also give us the opportunity to set the required wind correction angle. That WCA will be handfull

in the racetrack. Since the wind is from the North, we need to fly a 305° heading to remain on the 300° radial, the WCA is 5°. On the outbound leg of the holding, the required heading will thus be  $120-5=115^\circ$ .

There's no point holding at high speed, so we decrease speed around 250-300 kts to conserve fuel since we are already at low altitude.

We set the UFC to the clock page through the time button. Since a DME indication is given on the outbound leg, we will not fly a one minute outbound leg but start the outbound turn at DME 25 from Suwon tacan. Still, I like to time my racetrack turns.





Reaching CHAMP as pictured above, we hit the hack time on the UFC and start the turn right with a 45° bank angle 1.5g to heading 120°. The turn should take one minute. Then we fly heading 115° for wind correction until the DME window of the HSI tells us we are 25NM from Suwon. During the outbound leg, the hack time is reset. At DME 25, start the clock, right turn 45° bank, 1.5G back on intercepting the 300° radial. Here it is more than a one minute turn, it's a radial interception. Luckily, the HSI settings are still on the 300° Course so we don't need to change anything. (Picture at right illustrates the interception out of the racetrack outbound turn)



If the holding was done correctly, the interception should be easy enough. If on the other hand you drifted toward the centre of the racetrack, there is a good chance that you will overshoot the 300° radial on the second turn. Leaving you with a very short time to re intercept the correct course before reaching the FIX.

Established back on the inbound leg on course 300°, we call the tower again to see if the traffic has cleared:  
 - Kimpo approach, Sting 1 flight of 2 , inbound for landing.  
 - Sting flight, Kimpo approach, descend to 2000ft, expect vectors runway 14L

Fine, no holding required anymore. We set 109.9 as the ILS frequency in the UFC and if still possible we plan on leading the 90° right turn by 3 Nm to enter the ARC DME. The initial heading into the DME ARC will be 030°. Since we are at the extreme range of the tacan, the HSI goes off for some seconds but always return to a valid information.

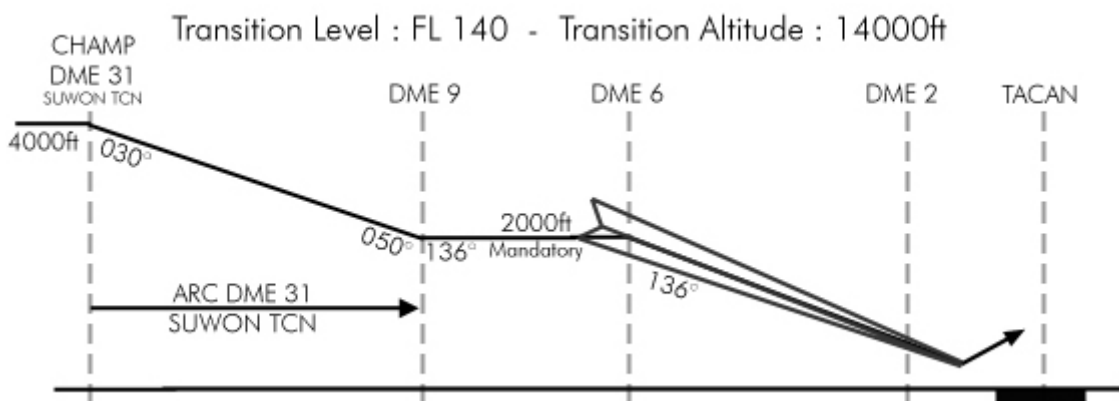


The hard part of this procedure is that we need to be tuned to Suwon tacan for the DME ARC and need also Kimpo tacan since radial 300° will be the reference point to lead the turn out of the DME ARC to the ILS track. Furthermore, the 320 radial from Kimpo tacan is the radial not to cross over since it pictures the proximity of the prohibited airspace. Having two NAV radio would clearly help here but we unfortunately have only one – so we might need to switch tacan from Suwon back to Kimpo during the DME ARC, thus losing the necessary information to continue flying the act without error. Nevertheless, there are workarounds:

The first one would be not to consider Kimpo tacan but instead the Kimpo waypoint (#7). Selecting that waypoint in the INS and switching the HSI mode to NAV will consider wpt #7 as a virtual tacan and navigation data are provided relative to that waypoint. Granted a minimal error will occur but it's easier to switch only the instrument mode than actually switching tacan stations (the course required is 300° - so it remains unchanged.)

The second one is to simply use the ILS command steering cue at the end of the DME ARC to time the turn out of the ARC into the ILS track, completely disregarding the reference 300° radial from Kimpo. For that to work, the HSI needs to be placed in TACAN/ILS mode. In this mode, it will provide DME capability relative to the tacan selected (Suwon) but the Kimpo 14L ILS guidance will be enabled. The downside of this method is that it may lead to late LOC interception if the initial angle is too great (as it is the case here since we are getting out of a DME ARC with a 90° angle off.

I usually follow option 1, if switching tacan channels is too much of a hassle .



One last thing, don't forget that you are supposed to descent from 4000 ft to 2000 ft AGL during the DME ARC ☺



Getting over CHAMP fix for the second time, we lead the 90° right turn by 3Nm to enter the DME ARC. Remember the rule to lead the turn pending your speed and DME in page 34. Initial heading into the DME ARC is 030° and through there, it is only a matter of keeping the red bearing pointer on the 9 o' clock of the HSI throughout the ARC – as pictured on the left (although I overshot the DME ARC by 1 Nm) Since we know the exit heading of the ARC will be 050°, we can switch to waypoint #7 when turning through 40°, that will give us ample time to continue the ARC and not miss the reference point given by the 300° radial from Kimpo airbase.



First, select waypoint #7 in the UFC through the up and down arrows on the ICP. Then, make sure the Instrument mode is switched to NAV so the HSI take wpt #7 as the reference point. In the right MFD, we confirm visually waypoint 7 is the selected steerpoint and the HSI bearing pointer matches the MFD. Course 300° is still set so we don't need to change anything. Altitude is 2000 ft, level. Speed is 320 kts (should be 300). We are in a slight right turn and DME reads 10 Nm from waypoint #7. The CDI is still offset meaning we are not on the radial yet. All we have to do is continue our slight right turn until the CDI centres, telling us we are passing through the 300° radial.

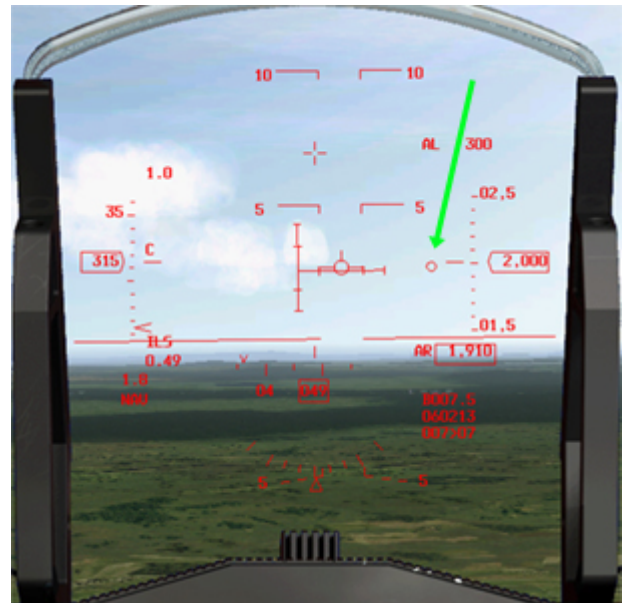
We don't need to intercept the radial, mind you. It is just giving us a reference point to start following the ILS command steering cues. So once the CDI centres, we switch the instrument mode to TACAN/ILS or NAV/ILS and transition to the HUD to intercept the ILS.





There is the CDI centring on 300° radial, we switch to ILS/Tacan.

The HSI switches to ILS tracking as the ILS bars are displayed into the attitude indicator. In the HUD, the ILS bars are displayed as well and the ILS command steering bar is offset to the right (green arrow) calling a right turn to intercept.



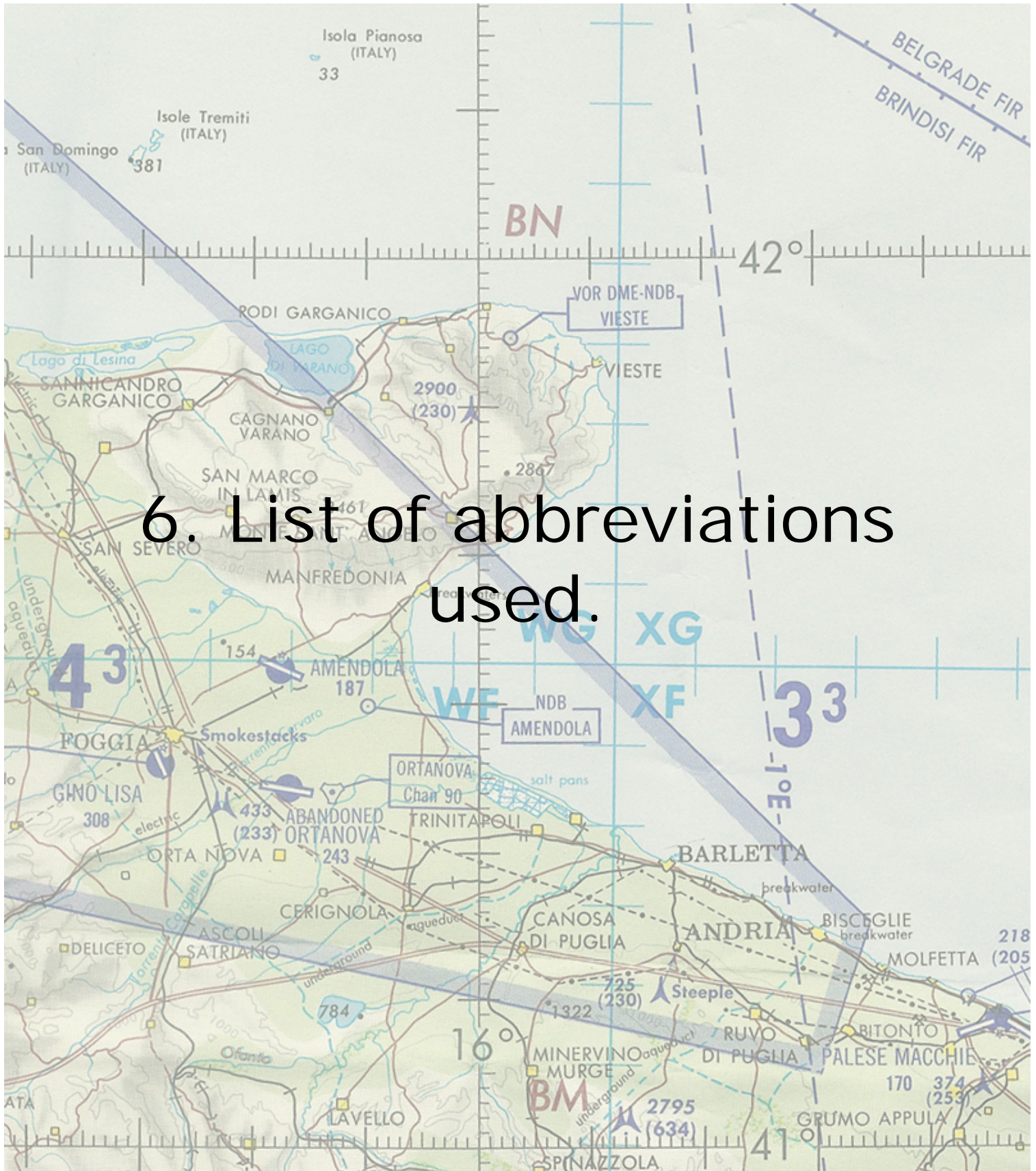
Note we are already on the glide so we better start our descent.

Normally, we should first intercept the localizer and then the glide should descend on us. Kimpo approach, due to

different factors such as the extreme range of Suwon tacan in the DME ARC and the prohibited airspaces North of Kimpo makes the approach a little rough. Anyway, follow the ILS command steering to line up, reduce speed now by popping the airbrakes and lower the landing gear as soon as you are on glide, on LOC. the rest is ILS as usual and you will be at minimum (296ft AGL) at the inner marker with the runway in sight.





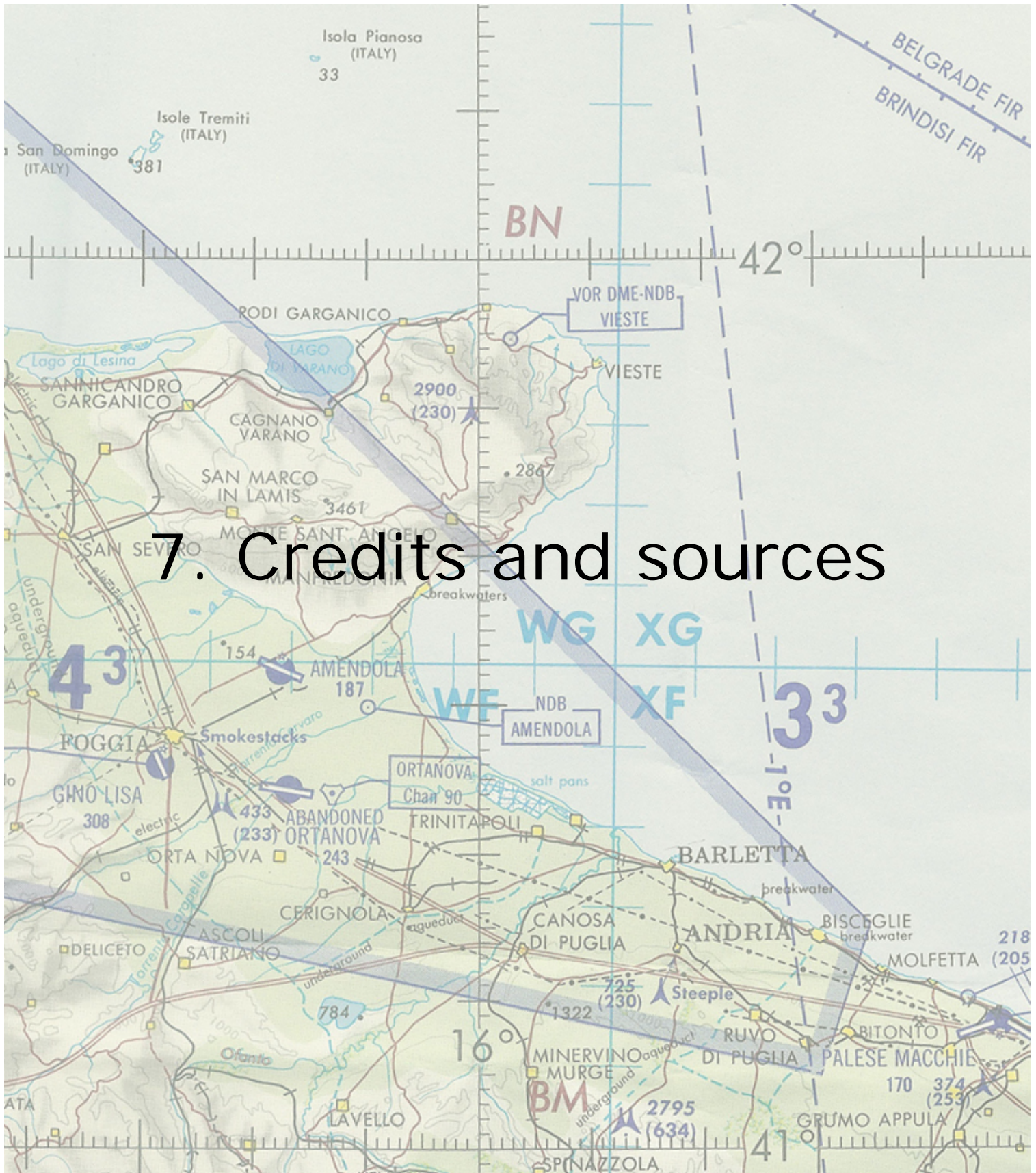


MSA:	Minimum Safe Altitude. For a given radius, the minimum altitude a pilot can fly in zero visibility and stay safe from terrain and obstructions.
ELEV:	Elevation – The height of the terrain above sea level (airports, structure)
GPS:	Global Position System: A system allowing precise navigation using 3 navigation satellites
TRANS ALT:	Transition Altitude: The altitude where local altimeter setting is switched with universal altimeter setting (29.92 inch of mercury – N.A. in Falcon). From ground to Transition altitude, we refer to altitude in feet.
TRANS LEVEL:	Transition level. Above the Trans Level, we refer to altitude in flight level (20000ft = FL200) Descending from FL150 to 3500ft with a trans level of FL70, we will switch universal altimeter setting from 29.92 to local altimeter setting at FL70 (7000ft)
MSL:	Mean Sea Level: Generally referring to altitude above sea level.
AGL:	Above Ground Level: Altitude given above the ground.
POL:	Petroleum Oil Lubricant tanks or depots. Basically, something you want to protect or destroy.
TWR:	Control tower.
ILS:	Instrument Landing System. A radio beam to help pilots land on a specific runway in bad visibility conditions. The beam is made of a horizontal radio wave to guide pilot on the glideslope and a vertical wave to guide the pilot on the runway centreline (localizer)
ILS DH:	Instrument Landing System Decision Height. The height (height is always referring to altitude above ground) at which the pilot needs to transition from instrument flight to visual flight. At that point, the pilot needs to have visually acquired the runway to be allowed to continue the approach.
LOC:	Localizer: the vertical beam of the ILS allowing the pilot to align his aircraft with the runway centreline
GS:	Glideslope: The horizontal beam of the ILS allowing the pilot to fly the correct slope (usually 3°) to the runway threshold.
DME:	Distance Measuring Equipment: gives the distance between your aircraft and the selected radionavigation station.
TACAN:	TACTical Air Navigation. Radio Navigation station usually used by the military. Its emission can be protected and range usually varies according to the power output.
IAF:	Initial Approach Fix. Any given point at which the pilot will start the published approach procedure
RWY:	Runway
SID:	Standard Instrument Departure. Heavy traffic airports need to despatch outgoing traffic in an orderly way. As such different routes are published and pilots are instructed by ATC to follow one or the other. That decreases the volume of communication between pilots and ATC during departure.
FIR:	Flight Information Region – airspace category around an ATC center
ADIZ:	Air Defense Identification Zone. A forward limit of national airspace.
TACAN RAD:	Tacan Radial.
TACAN DA:	Tacan Decision Altitude.
APRON:	Airbase parking.
NOTAM:	Notice to Airman. Procedures are published for a certain period of time. Punctual hazards to navigation (and other) are mentioned in the NOTAM. Each pilot needs to give NOTAM proper consideration.



HAS:	Hardened Aircraft Shelter.
VMC:	Visual Meteorological Conditions (as opposed to IMC = Instrument Meteorological Conditions)
MOA:	Military Operation Area: a limited zone where military training exercise occurs (live firing, dogfights, artillery ...)
VNDB:	Here's one of mine ☺ Virtual NDB. A NDB is a Non Directional Beacon that is not implemented in Falcon but quite useful for approach. By setting a known INS point in the system, we can use that waypoint as a Virtual NDB.
ICP:	Integrated Control Panel. The small keyboard you have right in front of your face in the F-16 cockpit.
UFC:	Up Front Controller.
DCS:	The 4 way switch on the ICP.
VASI:	Visual Approach Slope Indicator: A Visual aid to gauge glideslope when landing visually. In Falcon, it's made of two rows of lights each side of the runway. The lights turn white to red depending on the aircraft position on the glideslope. Mnemonic: Red over white is alright - red is dead. I guess you get the picture.
T/R:	Transmit/receive. In falcon, the Tacan needs to be set in T/R to track ground emitter
AA T/R:	To track air emitter such as refueller, the tacan needs to be set to Air-Air track and receive
HSI:	Horizontal Situation Instrument. The main navigation instrument allowing to track radials.
NDB:	Non Directional beacons (N.I in Falcon – see VNDB)
VOR:	VHF Omni range: A directional beacon allowing radio navigation.
DED:	Data Entry Display. The small LCD on the right glareshield.
STPT:	Steerpoint. An INS waypoint entered in the flight computer.
G:	Well, do I really need to explain that one?
VORDME:	A VOR with a distance measuring equipment capability. In Falcon, we assimilated real life VORDME and VORTAC to TACANs since tacan are the only navigation aid we have available
IFR:	Instrument Flight Rules.
VFR:	Visual Flight Rules.
CDI:	Course Deviation Indicator: The arrow in the HSI that can be set to a specific Course.
CRS:	Course. The rotating knob allowing to set a Course in the HSI.
HDG:	Heading.
OM:	Outer Marker
MM:	Middle marker.
IM:	Inner Marker
MRK BCN:	Marker beacon. Along the ILS track, we often find 3 markers (outer middle and inner) that are limited radio emissions emitting vertically at set distance from the runway threshold. They are seen in the cockpit through the MRK BCN green light, next to the HSI that blinks at a specific frequency according to the overflown marker. (in civil aircraft, each marker has its own coloured light but in the F-16, the light is always green). An aural code is also emitted when overflying the marker.
NM:	Nautical Mile.





## Credits:

- I want to thank first and foremost all the individuals having devoted their time to the flight sim we love most. It has been sometime rough but you guys made a terrific sim.  
Whatever the group or version you have been working on, thank you .
- This document has been written with different Falcon version, mainly BMS based. The cockpit used for the pictures is Stopworks block50 cockpit.
- I want to thank Aragorn who asked me to write such a tutorial. A project I had for a long time, feeling the need for such a document because the charts looked nice but most of you couldn't use them by lack of documentation.
- Snake122, a real world instructor, provided insights of real world IFR procedure and corrected my English. (a daunting task)
- Thanks also to all the guys taking some time to send feedbacks on the chart set.

And finally I don't want to forget the proof readers. None of them ever got back to me. I guess the task was too harsh ☹ Apologies guys – I hope you didn't quit the hobby because of this document ... ☺

This is not true anymore with revision 2.0 of this document as I got at least a group of guy helping correcting the document, so thanks go to Shane "Turner" Sigley, seconded from the 62nd Fighting Falcons Air Combat Simulation Club.

## Sources:

- Falcon 4 handbook
- RPx/SPx handbook
- F4-BMS\_2.0-Manual
- CombatSim Checklists Navigation charts for Falcon:  
<http://www.combatsimchecklist.net/>
- Jeppesen Airway Manual Initiation.
- Jeppesen Instrument and Commercial Manual.
- Multi-Command-Handbook 11-F16.pdf
- ONC charts for Korea and Balkan
- Jeppesen charts for Korea and Balkan
- Flight Information Publication (terminal) for Korea and Balkan.
- afman11-217

## Feedback:

I do hope this document helps you to understand the charts for Falcon and gives you the goal to master them. Sure falcon is a combat flightsim but it can be a very complete hobby when doing ramp starts and taking the time to fly the proper procedures. The experience is very rewarding and some of us can't do it any other way. It does certainly increase the learning curve!

This document might be updated in the future, don't hesitate to send constructive criticism so it can be taken into consideration in the next reviews.

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