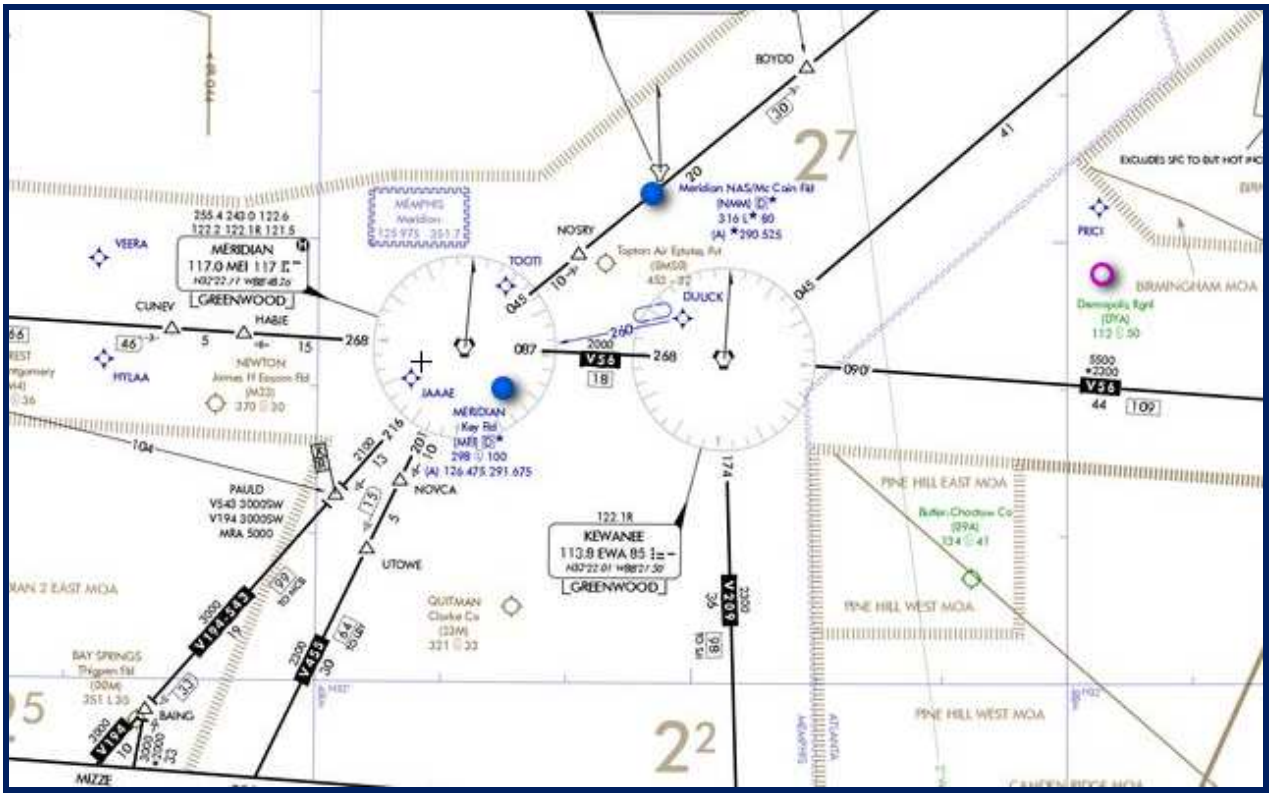
US Navy virtual Basic and Advanced Instruments for FS2004



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Introduction

If you've read "Rampant Raider" by Stephen Gray, you may remember that this former naval aviator describes the instrument stages of his Navy flight training as the most demanding of the entire training period. Gray describes vividly how the so-called "C-stage" in the advanced part of his flight training nearly dropped him out of the training program. He also notes that C-stage was the stage where the number of drop-outs soared. Some quit voluntarily, some were washed out.

This document contains some exercises that hopefully challenge you in the field of FS2004 (but I assume equally usable with FSX) instrument flight.

This document assumes prior flightsim experience!

Marcel Hendrikse, December 2016-January 2017

Resources

Aircraft

Basically, you can use any **training jet** in (former) use by the US Navy Air Training Command. I used the T-2C Buckeye for basic instruments and the TF-9J for advanced, but you can just as well use the T-45 for both stages if you choose to simulate present-day Navy flight training.

T-2C

Aircraft:	http://www.flightsim.com/vbfs/fslib.php?do=copyright&fid=73898 (K. Ito; free)
	Or the RAZBAM T-2C (payware)
Good IFR panel:	http://www.flightsim.com/vbfs/fslib.php?do=copyright&fid=101424

TF-9J

Aircraft:	http://www.flightsim.com/vbfs/fslib.php?do=copyright&fid=167315
VT-25 repaint:	http://www.flightsim.com/vbfs/fslib.php?do=copyright&fid=177732

T-45

Aircraft:	http://www.flightsim.com/vbfs/fslib.php?do=copyright&fid=93193
Repaints:	search for **iris_t*** on Flightsim.com (*FS2004 repaints*)

Scenery

Chase Field:	http://www.flightsim.com/vbfs/fslib.php?do=copyright&fid=180066
NAS Meridian:	http://www.flightsim.com/vbfs/fslib.php?do=copyright&fid=121988
	(Check requirements!)

Additionally

I strongly recommend FSNavigator as a nice navigational help with many functionalities.

Getting started: basic instruments

Training pilots to get accustomed to just fly in Instrument Meteorological Conditions (IMC) does of course not mean waiting for clouds to appear. The flight training as conducted in the 1960's involved the instructor taking place in the FRONT cockpit of the training aircraft, while the student sat in the back. Once lined up with the runway, the student would pull a cloth over the rear cockpit, limiting his vision to inside the cockpit.

In order to simulate this device, set visibility to the absolute minimum: 1/16 mile. Make sure you set that for altitudes between the ground and let's say 50,000 feet (where you will never be). This way, you will never be surprised by a suddenly appearing cloud deck and horizon. At all times should you be forced to look at your instruments.

Now save the flight: you will have a startup mode for all IFR flights in the BASIC stage: lined up and 'blinded', in the trainer of your preference.

Without further adue, we will start with looking at the BI flights for this stage.

Flight sequel: BI

BI, or Basic Instruments, was in the 1960's a 10-flight cycle, ranging from BI-01 to BI-10. BI-11 was the checkride. For the purpose of simulation you can just fly 10 or 11 'hops', that repeat and hopefully sharpen your basic instrument aptitudes

Flights in this stage must be done from NAS Meridian, Mississippi, so create the startup mode described on the previous page from there.

Check your instruments, make sure your flaps are in the T/O position and start your takeoff run. If there is wind, concentrate on maintaining heading by using the rudders. **Make your control inputs small!**

At rotation speed, pull back on the stick. Easy does it! IMC can easily make you overcontrol.

Now you're gonna get busy: you must at the same time

- Maintain heading [check compass and attitude]
- Maintain a climb of 2000 fpm [check VSI and attitude]
- Maintain a maximum of 250 knots [check airspeed indicator]

Keep your scan going! Spend an equal amount of time reading each instrument, quickly switching to the next one. Use elevator trim to maintain the required rate of climb. Remember to adjust throttle to keep at 250 knots.

Level off at 9,000 feet, 250 knots. Spend some trimming the aircraft appropriately to maintain speed and altitude. **IT IS PROHIBITED TO USE THE AUTOPILOT!**

NEXT

Make a couple of 180 degree turns with a 30-degree angle of bank, **maintaining airspeed and altitude as much as possible**. Keep in mind that when rolling out on your new heading, you should trim down in order to counteract the sudden increase in wing lift coefficient.

Likewise, when initiating the turn, you must trim up in order to counteract the decrease in wing lift. Again, do this with SMALL control inputs. Once you get lost in excessive stick movements, you will quickly (and greatly!) veer off your intended direction, speed and altitude!

NEXT (2)

After a couple of turns (left and right!), slow down the aircraft down to 200 knots. Extend the speedbrake(s) and add power to make sure the decrease in speed goes gradual. At 200 knots, extend the gear and allow the speed to bleed off to 150 knots.

At 150 knots, you should be in landing configuration: gear down, speedbrakes out, flaps down. **YOU SHOULD STILL BE AT 9,000 FEET!**

Slow to approach speed and initiate a 1,000 fpm descend to 8,000 feet, where you add power to level off. Retract gear, speedbrakes and flaps and accelerate to 250 knots.

This concludes the exercise. Restore visibility to “Clear weather” or “Fair weather” and return to NAS Meridian.

(Alternatively, end the flight via ESC – “E”)

S-patterns

Open your startup mode.

Take off and climb to 9,000 feet, straight ahead, 250 knots and level off.

Execute a 180-degree turn to the left, 30 degrees angle of bank. Once completed, go to straight and level flight, 250 knots.

Execute a 180-degree turn to the right, 30 degrees angle of bank. Once completed, go to straight and level flight, 250 knots.

That was your warming-up sequence.

We are now going to start flying S-patterns. Throughout these maneuvers, you must maintain 250 knots and a steady climb or descent of 1,000 feet per minute.

A typical S-pattern involves a 250-knot, 1,000 fpm climb, **immediately** followed by a 250-knot, 1,000 fpm descent, on a constant heading. So after 2 minutes precisely, you should be back on your original altitude, at the same speed, flying the same heading.

Remember: when you start the climb, add power to maintain speed and trim the aircraft to maintain the required rate of climb. Once you hit the altitude 1,000 feet above the starting altitude (in this case 10,000 feet), lower the nose, reduce power, set the aircraft in a 1,000 fpm descent and maintain 250 knots.

Level off again at 9,000 feet, add power to hold 250 knots and trim the aircraft to hold the altitude.

The trick in this exercise is to hit 10,000 feet 1 minute after commencing your climb and 9,000 feet 1 minute after commencing your descent

REPEAT THE S-PATTERN A COUPLE OF TIMES! BEFORE DOING SO, FIRST CARRY OUT ANOTHER 180-DEGREE LEVEL TURN TO THE LEFT IN ORDER TO STAY NEAR MERIDIAN OR THE MERIDIAN MOA'S

NUMBER OF BI FLIGHTS TO BE FLOWN: SEE APPENDIX 1

BI flights can be relatively short. The 'a couple of times' mentioned above for the S-pattern can be interpreted as "at least twice".

Repetition is the key to proficiency!

Flight sequel: RI

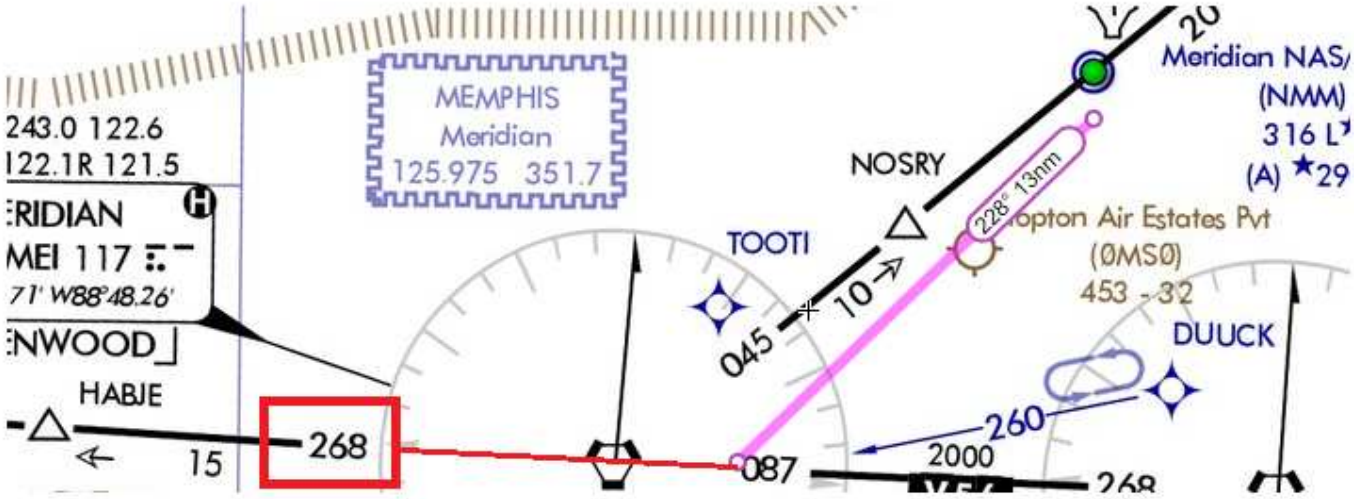
RI, or Radio Instruments, consists of a 5-flight cycle, ranging from RI01 to RI05, with a checkride: RI06. Fly 5-6 ‘hops’, to acquaint yourself with using the radio navigation instruments in low-/zero-visibility conditions.

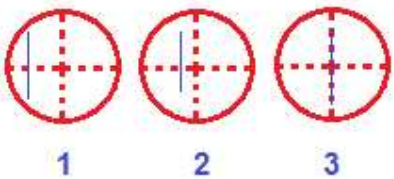
Flights in this stage must also be done from NAS Meridian, Mississippi, so you can just use the startup mode described earlier on.

For the flights in RI, you will really have to concentrate on your radio navigation instruments.

Refer to https://skyvector.com/?ll=32.553480556,-88.555263889&chart=418&zoom=3 for an IFR map around NAS Meridian.

- Set the OBS needle to 268 (degrees) and set NAV1 to 113.20, which is the frequency of the MAGNOLIA VOR beacon (MHZ)
- Take off from runway 19L and climb to 3,000 feet, 250 knots. At 500 feet AGL (815 feet on the altimeter) turn right to heading 228. Level off at 3,000 feet





The pink line represents your track after the turn. You are now flying toward the 268 radial TOWARD the MHZ beacon. Symbols 1 through 3 depict the VOR needle’s movement toward the middle as you arrive on the radial. When the OBS instruments looks like ‘3’, you should roll out on heading 268. At that point, you are flying directly to the beacon on the projected course.

Once you pass the MHZ beacon, turn to heading 274 and fly that heading for 3 minutes. In the meantime, set your OBS to 134.

After 3 minutes, make a 30-degree angle of bank turn to the right. You should again intercept the radial as depicted above (OBS needle moving from left to right), this time on heading 134.

Once you pass MHZ again, turn left to heading 090. Set your NAV1 radio to 117.00 and your OBS to 094. Make a slight left turn to heading 085 and intercept the 094 radial toward the Meridian VOR (MEI).

As you reach MEI, turn left heading 045 and restore visibility. NAS Meridian should be about 15-16 miles ahead. Enter the landing pattern, shoot 2-3 approaches (touch and go's) and end the flight.

This concludes RI01.

For RI02 through RI06 you are expected to plan and carry out similar flight profiles.

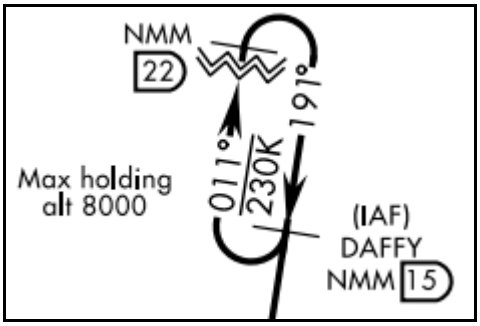
Take a close look at the chart link on the previous page and choose a few VOR beacons to fly to (AND FROM!). When it comes to flying FROM a beacon, you must be aware of the fact that this will invert the required directions to stay on the radial:

Flying TO a VOR requires flying TOWARD the intended radial and TOWARD the OBS needles

Flying FROM a VOR requires flying in the direction you want the OBS needles to move in (left or right), immediately followed by a correction to the required radial once the OBS needles are centered.

Examples of instrument exercises you can do:

I: Fly holding patterns at 250 knots



This pattern, for example. It is the holding for runway 19L at Meridian. So if you take a 30-mile distance from the base and intercept the 191 radial toward the VOR located there (111.90), you should arrive over DAFFY at 15 miles distance.

At that point, turn right, 30 degree angle of bank, maintain altitude and speed, to heading 011 and hold that course until you're 22 miles from the VOR. Again, turn right, this time intercepting the 191 radial TO the VOR until the distance again shows 15. Repeat.

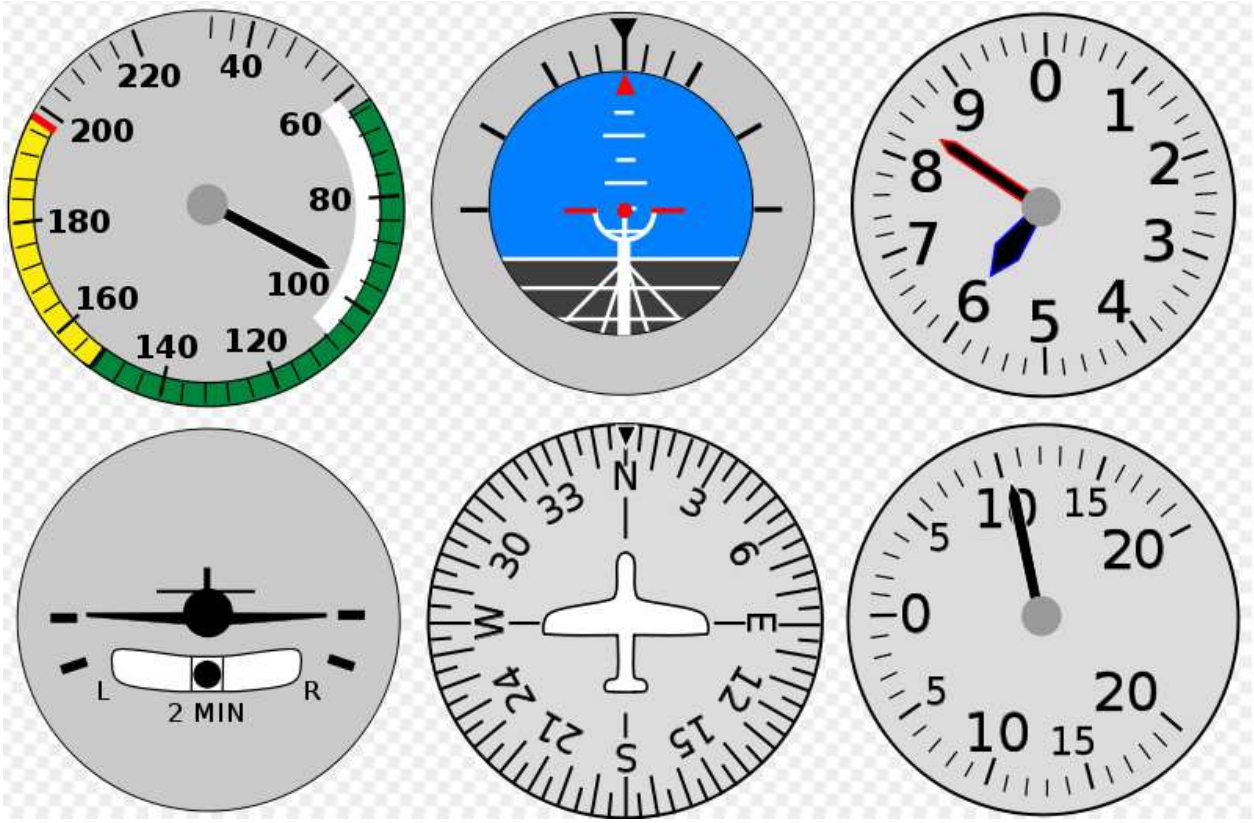
II: Point-to-point navigation. Take off from Meridian and intercept the 030 radial TOWARD the LDK VOR (117.80). At 26 miles from that beacon (intersection ALICE), make a left turn to heading 190. Don't change radio navigation equipment settings (NAV1/OBS) and fly from LDK on the same line by intercepting the needles, this time in the opposite direction. Hold that direction and speed for 5 minutes, then restore visibility and land at Meridian (don't forget the touch and go's!)

Refer to appendix 3 for the basic rules that apply to ALL instruments flights.

Level up: Advanced instrument stage

Basic Instrument stage (in the 1960's) did not have the intention to qualify future Navy pilots to be instrument rated. It was merely a thorough introduction to IMC flight. Advanced Instruments stage, however, took instrument flying to a higher level.

Take a look at this picture containing the primary flight instruments:



(source: Wikimedia)

The most difficult aspect of the Advanced Instrument stage is the fact that the attitude indicator (artificial horizon, top row, center instrument) is taken out of this picture. The instructor in the front cockpit has a switch that enables him to put the attitude indicator out of commission. Of course, the instrument is still there, but as it is deactivated, it slowly sank into the "Off" position:

As you can imagine, the attitude indicator has now lost its use. Moreover, it will be a distraction, as it is usually in a very centered position on the instrument panel, making it a hurdle for the pilot who must now get information from the other instruments. He will be scanning the others, while constantly encountering the 'broken' attitude indicator.

Also be aware that a single attitude indicator can tell a pilot at a glance what the vertical speed indicator (VSI), the compass, the altimeter and (to a lesser extent) the airspeed indicator tell him individually.

For example, if the attitude indicator shows a banking angle, the pilot KNOWS he's changing direction. And when the center point is above or below the horizon, that indicates a climb or descent. With the attitude indicator gone, the pilot is forced to retrieve attitude information by adding up what the others are telling him.

The technical term for flying with the attitude indicator out of order is called "***partial panel***". Stephen Gray describes in "Rampant Raider" how this stage was done, how it nearly kicked him out of the program and how it caused many others to either drop out on their own request or be washed out by the instructors.

First things first

Create a startup flight at NAS Beeville and select a training jet to work with. The Grumman TF-9J is a very realistic choice for a Beeville-based flight!

Visibility set to 1/16 mile. Set your flaps to T/O position and make sure you are familiar with the instrument panel.

Also make sure that you use the "Failures" option in the Aircraft menu to deactivate your attitude indicator.

This must be done prior to starting your takeoff run!

Flights: BI01 through BI06

Takeoff under IMC and setup a climb to 9,000 feet at 250 knots, 2,000 feet per minute. Level off and maintain 250 knots.

B-stage has given you some experience on it, so let's start the S-patterns right away. Concentrate on keeping this order of procedures:

- 1,000 fpm climb to 10,000 feet @ 250 knots, then 1,000 fpm descent to 9,000 feet
- 180 degree LEFT turn, 30 degrees angle of bank, maintain 250 knots and 9,000 feet
- Repeat previous two steps

After the repetition, level off. Check your fuel, make sure the aircraft is nicely trimmed to hold 9,000 feet @ 250 knots. You should now be ready for the next element in the B-flights: level and climbing turns.

Look at your turn indicator. It should have marks to show you the standard 2-minute turn. We will look at this in more depth later. For now, just select a marker on the instrument and use that to maintain the turns. **Remember: your attitude indicator is off**, so the turn indicator will be your only reference for determining whether or not you're in a turn.

IMPORTANT: ATTITUDE INDICATOR = TURN INDICATOR + VSI

This means that in your scan, which no longer should include the attitude indicator, you should derive the information provided by the attitude indicator from the combination of turn indicator and vertical speed indicator. That means you really have to scan quickly between these two instruments.

LEVEL TURNS

Exercise: (maintain 250 knots!)

- left 90 degrees – straight and level
- right 90 degrees – straight and level
- left 180 degrees – straight and level
- right 180 degrees – straight and level

CLIMBING/DESCENDING TURNS

Exercise: (maintain 250 knots!)

- left 90 degrees, climb 1,000 fpm – straight and level
- right 90 degrees, descend 1,000 fpm – straight and level
- left 180 degrees, climb 1,000 fpm – straight and level
- right 180 degrees, desccend 1,000 fpm – straight and level

To conclude the flight, restore visibility and return to NAS Beeville. Practice at least one touch and go, keep an eye on your fuel!

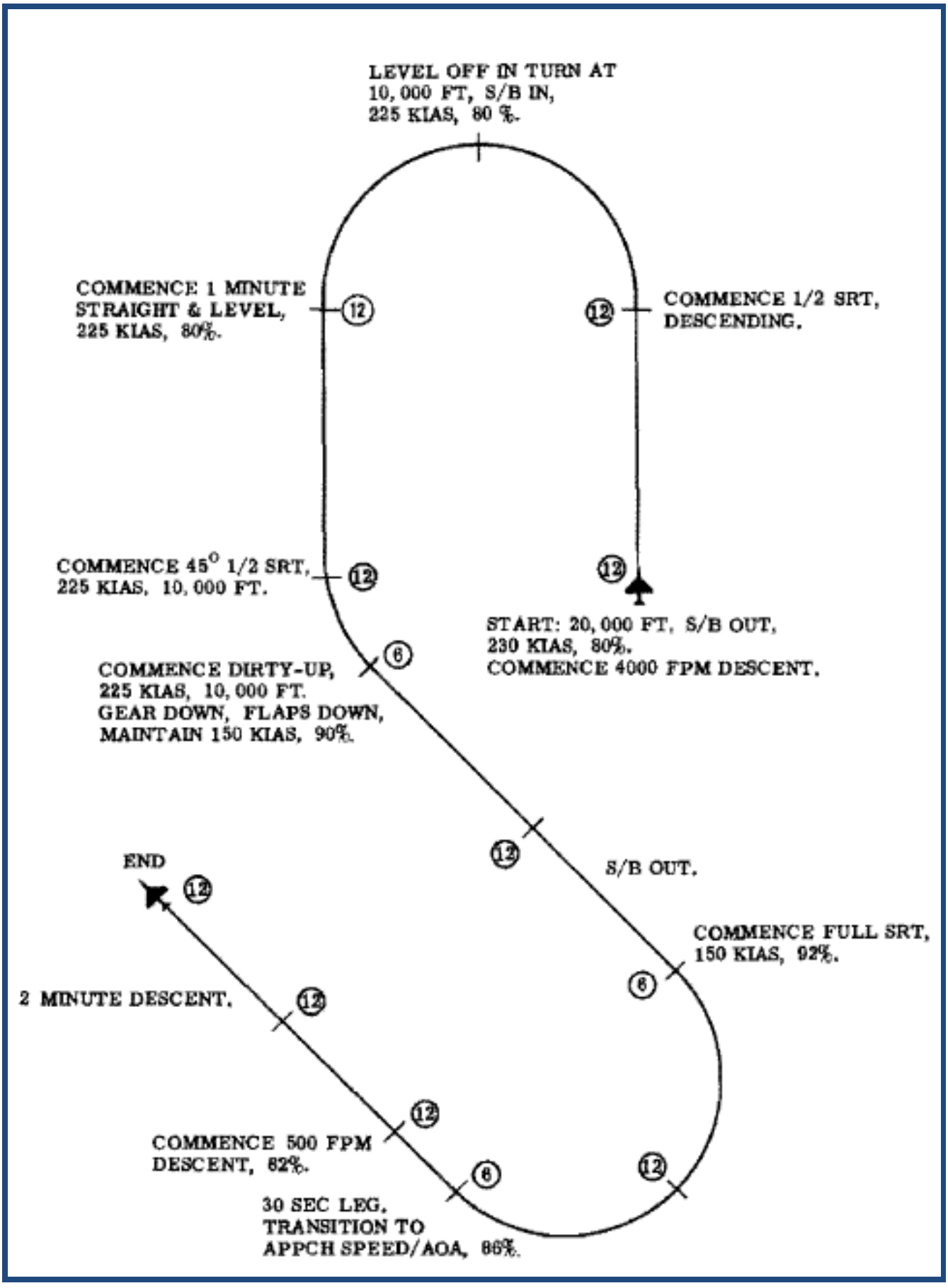
Alternatively, you can end the flight by ESC, then E.

After 6 BI flights without attitude indicator, your scan should have developed sufficiently to be able to face the dreaded C-stage (RI on partial panel).

Flights: RI01 through RI18 – C-Stage

Welcome to C-stage!

C-stage includes the so-called Y-pattern:



First proceed to 20,000 feet and level off there at 250 knots, then review this procedure:

In order to be able to carry out the Yankee pattern, you must be familiar with the word **SRT,** or **Standard Rate of Turn**.

Standard Rate of Turn is defined as a 3^0 per second turn, which completes a 360^0 turn in 2 minutes and a 180^0 turn in 1 minute. The 1-minute turn can also be referred to as '**half standard rate**'.

How may degrees angle of bank (AOB) is an SRT?

That is a valid question and the general answer has a ground rule behind it: take your indicated airspeed, add up the first to numbers and increase the outcome by 7.

Example: at 250 KIAS, your SRT would be 2+5=7+7=14 degrees

Now take a look at the picture on the previous page. Notice the "6" and "12" notations? Those are the clock positions for the second indicator on your onboard analog clock. So you start with the second indicator on the "12" position. As you can see, then next indication is again "12", meaning the first leg of the maneuver takes 1 minute.

The first 180-degree turn again takes a minute. Note the IAS: 230, so 2+3+7=12 degrees AOB takes 30 seconds to get your aircraft to turn 90 degrees and another 30 seconds to complete the remaining 90 degrees. So again, the second indicator on the clock should be at "12"

Start the Yankee pattern at 20,000 feet, flying 230 knots, on a cardinal heading, so due N/E/S/W

- Deploy the speed brake, adjust throttle to maintain 230 knots and start a 4,000 feet per minute descent
- Start a left-hand, half standard rate, still descending
- **In the turn**, level off at 10,000 feet, retract the speed brake and set power for 225 knots
- Maintain straight and level flight at 225 knots for 1 minute
- Turn 45 degrees to the left at a half standard rate turn (calculate!)
- Lower gear and flaps, let airspeed stabilize at 150 knots
- Once stabilized, deploy speedbrakes and adjust power to maintain 150 knots
- Turn right 180 degrees, standard rate turn (calculate!)
- On completing this turn, start timing 30 seconds and decrease speed to approach speed
- After 30 seconds, start a 500 feet per minute descend at approach speed and optimum AOA (Angle Of Attack)
- Hold this descending path for 2 minutes (so you should descend from 10,000 to 9,000 feet; don't go lower than that!)
- After 2 minutes, level off at 9,000 feet, pull in the speedbrakes, raise gear and flaps and add power to go back to 250 knots

You will notice that flying this set of maneuvers will mean a lot of hard work, especially with the attitude indicator out of commission. That is precisely what this exercise serves to achieve: the REAL development of your instrument scan. Pilots destined for the fleet will on many occasions find themselves in a flying environment that has NO outside references. In the middle of the ocean, at night, without the outline of city or landscape lights, the darkness is very deep. Carrier pilots are expected to fly from and to the aircraft carrier with zero outside reference and must therefore be trained to have a very accurate instrument scanning technique to keep them from flying into the water.

Skills learnt in Advanced Instruments have saved many a naval aviator's life while flying for his operational squadron!

In addition to the Y-pattern, C-stage will also involve radio navigation. The general flight plan is on the next page. It is recommended to fly 9 flights with 2 Y-patterns each and 8 flights following the flight plan. Make your last flight ("check ride") a combination of 1 Y-pattern and 1 flight plan .

A typical “round robin” (meaning starting and ending at the same base) flight from NAS Beeville would be:

KBEA – THX (111.40 – R-287/20.8)

THX – SAT (116.80 – R-342/70.1)

SAT – IAH (116.60 – R-079/163.7)

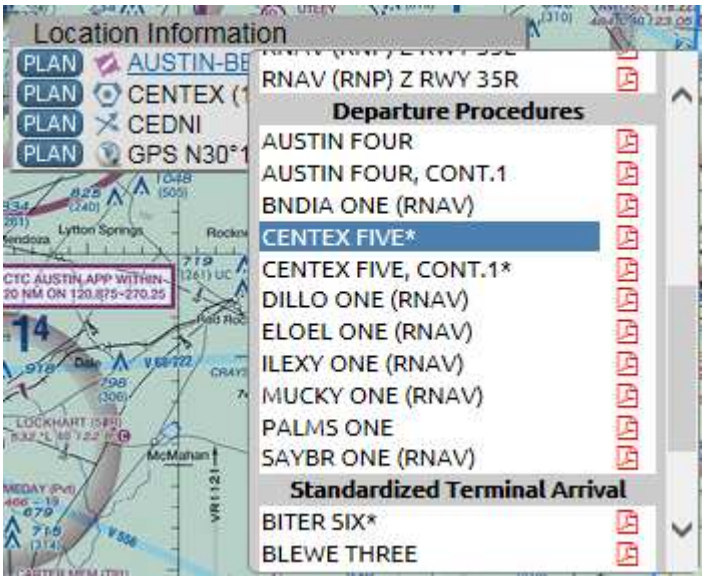
IAH – PSX (117.30 – R-211/87.3)

PSX – KBEA (R-245/82.1)

Fly the round robin flight at 250-300 knots, between FL100-FL190. Practice intercepting the mentioned beacons on the displayed courses. This forces you to work with your OBS1 and NAV1 radio; **GPS (if available in your aircraft) is NOT ALLOWED!**

Alternatively, you can plan (I recommend using Skyvector on the internet!) return trips to other bases, for example Randolph AFB (R-333, about 74 miles), Laughlin AFB (R-284, about 168 miles) and Austin-Bergstrom INTL (R-356, 110 miles).

Skyvector offers you the opportunity to get ahold of departure and arrival procedures, which you can use to sharpen your IFR skills:



The most realistic way of practicing your IFR skills while flying base-to-base flights is to fly a published departure procedure from Beeville and a published approach procedure at the selected airfield. Then reverse this on the way back: departure from the other base, approach to Beeville.

For realism purposes, you should spend some time planning the actual flight and return flight and have the appropriate publications at hand/printed out, so you can use the for reference. It will add to the experience!

Appendix 1: BI/RI checklist (Basic Instruments stage)

BI01	BI02	BI03	BI04	BI05	BI06	BI07	BI08	BI09	BI10	BI11

RI01	RI02	RI03	RI04	RI05	RI06

= checkride

Appendix 2: BI/RI checklist (Advanced Instruments stage)

BI01	
BI02	
BI03	
BI04	
BI05	
BI06	

C01	
C02	
C03	
C04	
C05	
C06	
C07	
C08	
C09	
C10	
C11	
C12	
C13	
C14	
C15	
C16	
C17	
C18	

= checkride

Appendix 3: basic rules for training flights

- Speed to maintain unless otherwise indicated: 250 knots
- At the end of each flight, practice at least 1 touch and go to keep your landing proficiency at a safe level
- **Use of autopilot is PROHIBITED**
- **Use of GPS is prohibited**
- Heading tolerance: +/- 10 degrees*
- Altitude tolerance: +/- 100 feet*

Although there are tolerances, the basic attitude in instrument flying is “don’t accept anything less that perfect or spot-on!”. When flying on instruments, it is just as easy (or difficult) to hold 9,000 as it is holding 8,980!

When you’re flying off the carrier in IMC, precision is paramount. The approach procedure toward an aircraft carrier in IMC involves holding at specified altitudes and descending along a specified path, where changes in altitudes are directly linked with the distance to the carrier.

This means you must be able to turn the aircraft correctly while holding your altitude and speed. You must be able to trim the aircraft into a specific descent path and adjust power accordingly to maintain the published approach speed(s). And at given distances, your altitude should be X and not above or below it.

The intended drill is to make sure you maintain 1,200 feet when required so to do and that you force yourself to adjust when you end up at 1,150 or 1,300; do not settle for less than perfect!

Appendix 4: Advise

Practice, practice, practice if you intend to be good at instrument flying! The first 2,3 flights will be bad probably. Don’t let that grind you down. Try it again and again, adjust joystick settings to your liking and keep your eyes moving at all times. It’s no use trying to fly these ‘lesssons’ if you don’t dedicate yourself to constantly checking the relevant instruments.

Make trimming the aircraft your second nature: trimming allows you to take some slack out of the control stick so that you don’t have to constantly pull back on or push forward on the control stick.

Know the panel! You should be thoroughly aware of the position of the primary flight instruments in order to built up a reliable scanning technique. If you have to search for any instrument, you can’t expect any flight to be a success!

Know the training aircraft! How fast does it react to power changes? Same question in landing configuration with the speed brakes out. What is the roll tendency? Does it have the tendency to roll a little bit further once you center the stick or is the roll reversed on centering the stick? How ‘twitchy’ is it in pitch up and down? How much lifting effect to the flaps generate? How much drag do the flaps, gear and speed brakes produce? That latter will influence the amount of engine power required to stabilize your airspeed when going to landing configuration.

If a flight becomes completely screwed-up, don’t get mad. End it and try it again later on.

Remember: these flights were designed for fun! I have based it on real flight training as much as possible, but I still want you to enjoy it. This is for enjoyment, not for Wings of Gold. For that, you’d have to go to your local Navy recruiter.

Please direct any questions to mba@freeler.nl.

Marcel Hendrikse

January 2017