Partial Panel Description and files

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This article will give you a basic understanding of how to fly the plane with less than a full complement of instruments. I think anyone, no matter what their skill level is, will enjoy reading about Partial Panel flying. I suggest that only those pilots with reasonable IFR (Instrument Flight Rules) skills try the included flight.

If you want to increase your Partial Panel skills, fly a normal setup in VFR (Visual Flight Rules) conditions. Use sticky notes to cover the Attitude Indicator and the Directional Gyro. Then graduate to full panel IFR with the sticky notes. It takes concentration and you need to be thinking ahead of the plane, e.g., when I turn, I lose lift. During that turn, I'll need back pressure on the yoke and may need to add power. If I'm in level flight and I add power, the nose will tend to rise, etc. Practice, drill and rehearse and you'll be flying Partial Panel in no time.

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What is Partial Panel?

If Partial Panel (PP) isn't the ultimate challenge, it runs a darn close second. In the U.S. we call it Partial Panel, you may be more familiar with the term Limited Panel -- both are referring to the same condition.

PP means flying the airplane with less than all of your instruments. Later you'll see that I've set up a flight for FS2002 and FS2000 that you can load and fly. In these setups, I've failed both the DG (Directional Gyro) and the AI (Attitude Indicator).

In the "olden days," we called it flying the Needle, Ball and Airspeed (AS). The needle and ball are part of the Turn and Slip Indicator (T&S) instrument. Of course, you do have a couple of instruments left, Altimeter and Vertical Velocity indicator (VVI, sometimes called the VSI - Vertical Speed Indicator) as well as Airspeed and Altimeter.

If you've never tried to control the bird using only the VVI, AS, T&S and Altimeter, you have a real treat coming. Using my preset flights that are part of this package, gives you an advantage - you know some instruments have failed. The worst part of PP in the real world is the insidious way it creeps up on you. Flying along, fat, dumb and happy, you notice the AI shows you've left straight and level flight. You make an adjustment, and nothing happens. In fact, things seem to get worse. By the time you realize the AI has failed, you are probably in what is called an Unusual Attitude.

Unusual Attitudes Defined

It's exactly that -- an attitude you didn't intend. There are two types: (1) Nose low, increasing airspeed and (2) Nose high, decreasing airspeed.

(1) Nose Low - indicated by VVI showing a rate of descent (may be hard to read if it's pegged against the maximum rate), AS increasing and Altimeter unwinding showing a loss of altitude.

Correction Technique: Check the T&S, if it shows a turn, return to a wings level attitude. If AS is increasing, reduce power. If you are near maximum airspeed, you may need to reduce power to idle. Now bring the nose up to the horizon. This is the tough part. The VVI will give you the **first** indication, but it has a built-in lag. If you're not familiar with this error situation, read the "Errors in the Vertical Velocity Indicator" article on the Technical Editor page in the "General" section. The best way to use the VVI is to remember that when it **reverses** (in this case from a negative figure and starts up toward zero rate of climb), you are near level flight. Also use the Altimeter to see if the loss of altitude is slowing or stopped. You probably over corrected using the VVI, so check it again to watch for another reversal. Reset power to cruise setting.

Be careful not to aggravate a nose low attitude by entering what is referred to as a Death Spiral. With the nose low in a banked condition, pulling back on the yoke doesn't raise the nose. It aggravates your predicament by tightening the turn and causing more altitude loss. That's the reason rolling wings level first, is vital.

(2) Nose High - indicated by VVI showing a rate of climb (may be hard to read if it's pegged against the maximum rate), AS decreasing, and Altimeter showing an increase in altitude.

Correction Technique: Begin adding power and check the T&S. If you are wings level, roll into a small bank. If airspeed is decreasing to a dangerous point (near stall), you may need maximum power and you may

need to increase your bank angle. Increasing the bank angle will help the nose drop toward the horizon since you are losing lift in the turn. As the nose nears level flight, roll the wings level and reduce power.

Above all, whichever position you find yourself in, be smooth on your recovery. If you are rough, you may well recover from the first Unusual Attitude only to find yourself in a second one. Avoid the Death Spiral (nose low) or stalling the plane (nose high).

Partial Panel Aircraft Control

If the airplane is under control, or you noticed the instrument failure(s) or you just recovered from an Unusual Attitude, use slow, smooth control inputs to maintain control.

Longitudinal Control (pitch) - the best indicator that you are not in level flight attitude, is the VVI, but remember the instrument lag -- you know which direction you are going, but not how fast until the VVI settles down (6 to 9 seconds). A secondary indicator is the Altimeter. Airspeed is the primary pitch control instrument, nose low - increasing; nose high - decreasing. Use the AS to control pitch during climbs and descents.

Lateral Control (turn/roll) - the T&S indicator is the best instrument to tell you the wings are level. The Magnetic Compass (MC) is the secondary indicator. Yaw is also part of lateral control. The "Ball" in the T&S tells you whether you are in coordinated flight. Do your best to always make coordinated turns.

A final word or two: trim, Trim, TRIM.

Keeping the bird in trim simplifies aircraft control. If you want to practice, take old N1776 (TR1 or TR2) up and trim for level flight. When you think you have her under control, hit the "R" key on the keyboard and then hit the "+" (plus sign, in the typing area) twice. You are now flying at 4x accelerated time. Can you still control the plane, keep it level and make turns? If not, hit "R" again and the "-" (minus sign in the typing area) twice to get back to normal rate and try trimming again. You still need to watch yaw (left torque) which will drag you off heading. It's fun, give it a shot.

Below is an image of all the primary flight instruments. To conserve space (file size), this is a composite including the Magnetic Compass. You'll just have to take my word that the entire image is from a single screen shot.

Check the AI. Looks like I'm in a big hairy climbing turn to the left (the artificial horizon is barely visible in the bottom left of the instrument). But look at the T&S - wings level, no turn. The VVI indicates no climb; on the contrary, I was in a shallow descent (about 200 feet per minute). How about the DG? Are we really heading 120 degrees? Not if you believe the MC, it reads around 175 degrees. Since I am in nearly straight and level, un-accelerated flight, I'll put my money on the MC. Conclusion: both the DG and the AI have failed. It's time for Partial Panel flying.

This image of the R4D instrument panel is from the flight I've included in this package.

Magnetic Compass

Due to the construction of the Magnetic Compass (MC), it is not a good indicator unless you are in un-accelerated, straight and level flight. The MC tilts in its case during turns and during acceleration or deceleration. It also lags and leads the actual heading in turns to North and South. That's why they call it a "back up" instrument. And due to its construction, it always appeared to work backwards to me, just like the DG in the R4D. If you find it confusing, read the article on the Technical Editor's page titled "Directional Gyro (DG) - Which way to turn" in the "General" section.

Turning to North, the MC leads so you need to rollout early - usually 30 degrees is a good rule of thumb. Example: turning from 270 to 360, you would rollout when the MC reads 330.

Turning to the South, the MC lags, so you roll out late (again by 30 degrees). Example: turning from 270 to 180, rollout on a MC heading of 150 degrees.

Of course, these instructions only work in the Northern Hemisphere. If you're south of the Equator, you'll need to reverse the North and South directions given above.

Turning to East and West, roll out on the desired heading.

What about headings other than the four cardinal compass points? Time for interpolation. Example: turn from 090 to 045, use a 15-degree lead. Since you're turning toward North, you would rollout early at about 060. But this could get weird real soon. Instead of using the MC for turns, think Timed Turns. Use the MC to maintain your desired heading.

Timed Turns

First, know that there are two basic turn rates. The Standard Rate Turn (SRT, sometimes known as a Rate 1 turn) means you are turning at a rate of 3 degrees per second. That means a 360-degree turn will take 2 minutes. See the images below for examples of these turns

The Half Standard Rate Turn (HSRT, sometimes known as a Rate 2 turn) is just that - one half the rate of the SRT. That means at 1 1/2 degrees per second rate of turn, and it will take you 4 minutes to turn 360-degrees.

Both the HSRT and the SRT times, assume you are flying a coordinated turn. That is, the "ball" is centered during the turn.

Turn and Slip Indicator images showing (from left to right), T&S needle centered, no turn; Half Standard Rate Turn to the left, Standard Rate Turn to the left. Note that the Ball is centered in all three examples.

Here is a table to help you compute your Timed Turns.

Degrees to Turn	SRT - Time	HSRT -Time
360	2 minutes	4 minutes
180	1 minute	2 minutes
90	30 seconds	1 minute
30	10 seconds	20 seconds
15	5 seconds	10 seconds

Typically, use a SRT for turns of more than 30 degrees and use the HSRT for turns of 30 degrees and less.

You could make this chart as large as you like covering more and more different degrees to turn. In fact, you could make it 360 lines long and cover the gamut, but how many reams of paper would that take. If you find yourself in a Partial Panel situation, have the Copilot (the Pause key) jot down the basics. The five I listed above should do the trick. Now you have to turn 120 degrees, how much time would that take? Answer: 90-degree turn (30 seconds) plus 30-degree turn (10 seconds) and 40 seconds should do. How about 80 degrees? Well that's a bit shy of 90 degrees, so my guess would be around 26 or 27 seconds. You can't fly so accurately that a second or two will throw you way off course. In actual practice, you are going to find that you turn, roll out, check the MC, and turn again to get closer to the desired heading.

To make smaller turns, maintaining final approach heading, etc., count the seconds to yourself. Say you are 5 degrees left of heading. It will take you part of a second to roll into the bank and another part of a second to roll out of the bank, maybe one second total. How much is 5 degrees at 1 1/2 degrees per second. The math gives me a headache ☺ It's probably about 3 seconds, so roll into the bank, count: one, one-thousand -- two, one-thousand -- three, one thousand and roll out. Check the MC to see how you did. Turn further or turn back if you missed the heading.

I've flown No-Gyro approaches with a ground controller using radar guidance. Once near final approach heading, the controller usually gave a roll in command -- "Start turn, now" and a roll out command -- "Stop turn, now." It's amazing how close to the runway they can put you.

Timed Turn Practice

Try making turns without the DG with a full panel of instruments. Put a Sticky Note over your DG and practice turns. See how close you come to 2 minutes for a full SRT of 360 degrees. Next go to turns of fewer degrees using

times. Check the MC on rollout to verify you are hitting the mark (heading). Continue your practice making HSRTs.

Files in this Package

1) Basic Partial Panel Document (this file) te_real_ultimate.pdf
A Word document saved in Adobe PDF format

2) Microsoft Flight Simulator Setup files - the default aircraft is the NATS R4D (50819)

FS2000 "Partial Panel-2000.WX"
"Partial Panel-2000.FLT"

Installation -
For a default installation, these two files should be copied into this directory:
C:\Program Files\Microsoft Games\FS2000\Pilot\

FS2002 "Partial Panel-2002.WX"
"Partial Panel-2002.FLT"

Installation -
For a default installation, these two files should be copied into this directory:
C:\Program Files\Microsoft Games\FS2002\flights\myflts\

Now when FS2000/2002 is started, the flight setup name should be listed as "Partial Panel-2000 (or 2002)" in the your list of saved files.

Premise (Setup) of Flight

When you select the "Partial Panel-2000" (or 2002) in Microsoft Flight Simulator, you will find yourself at 2,000 feet on downwind at Meigs Field (default airfield), USA. Your heading is 180 degrees.

The flight is Paused; so hit the "P" key to un-pause. The weather is set to 1/2-mile visibility; you'll find you are immediately on instruments. As you scan them, you note that the Attitude Indicator has failed and you also suspect the Directional Gyro is gone as well. Good guess ☺

Radios are set, VOR 1 (110.5), ILS O'Hare (KORD) Rwy 27R (OBS is set to 270 degrees).
VOR 2 (113.9), O'Hare (use for DME information)
ADF, NDB (414), Outer Marker for Rwy 27R

Cockpit settings - many times the NATS R4D (50819) airplane starts with cockpit switches OFF. Make sure the Lights (Landing, Beacon and Nav) are ON. Check the Fuel Boost Pumps are also ON.

Your Job - get the plane on the ground

✓ Get the plane under control on Partial Panel (Airspeed, Vertical Velocity Indicator, Altimeter, Turn & Slip Indicator and Magnetic Compass)

✓ Turn left to 090 degrees. Climb to 2,500 feet

✓ Turn left to a heading of 360 degrees. Fly north until you intercept the Localizer for Chicago O'Hare (KORD) Rwy 27R.

✓ On the glide slope, descend to 1,500 feet (Rwy elevation, about 670 feet). Hit Pause (P) and reset the weather to 5 miles visibility.

✓ Land Rwy 27R.

CONGRATULATIONS - you've just conquered one of the toughest challenges in flying.

A situation that mirrors real life more closely

If you'd like to simulate a real life situation set up another flight similar to this one, using the R4D in IFR conditions. This time instead of failing the instruments, "Arm" the failures.

In the menu, use: Aircraft | System Failures. In the resulting dialog box, on the "Instruments" tab, be sure that the Radio Button for "Single Instrument Failures" is set. Then put an "X" in the "Arm" column for both the Heading Indicator (DG) and the Attitude Indicator. As you enter the "X's," note that the "Fails in:" column defaults to: Zero to Five (5) minutes. You can accept that default of enter other numbers in the "From" and "To" columns. Click on the "Checkmark" (FS2000) or the [OK] (FS2002."

Now when you return to the cockpit, all the instruments will function properly. Keep a sharp eye on them -- they will fail sooner or later.

Remember: When one engine fails on a twin-engine airplane you always have enough power left to get you to the scene of the crash. (from a list of items sent in by Jim Marion)

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Created September 11, 2002