9. INSTRUMENT FLYING CORE SKILLS: FULL PANEL

There is nothing incredibly difficult about the individual skills needed to fly in cloud. However, they become difficult when you need to combine them and perhaps very difficult when you need to do so under some pressure. There is also a real need to fly with more precision than is required of a VFR pilot. In many circumstances the separation between aircraft is only 1000 ft. You are sharing airspace with commercial transport aircraft containing passengers who did not opt into any additional risk inherent in your sharing airspace with them. Typically ATC systems will alarm if you are 300 ft. off your assigned altitude. You must aim to never be more than a few feet off altitude without making some action to correct the deviation.

Firstly, you need to have a clear idea of what you want the aircraft to do, with the power setting and pitch attitude most likely to deliver the desired result. The typical VFR pilot's trial and error approach is simply inadequate. If you think about it there are not many flight phases. You take off and climb with full power, you might cruise climb, you cruise in level flight, you cruise descend, hold in level flight and descend on an instrument approach. There are only six or seven combination of power setting and pitch attitude for you to memorise. They aren't going to work exactly in all circumstances. Aircraft weights and outside temperatures may demand a fine adjustment. You will need to take configuration into effect and consider whether you have flaps and gear up or down.

Even with these caveats it's a huge step forward on trial and error. If you want a cruise climb you might reduce Manifold pressure from maximum to 25 inches, RPM from maximum to 2500, you pitch up a little more than 5 degrees and you expect to see 120 knots IAS and about 600 ft. a minute climb. If it's a hot day you might need to add an inch of MP and as you get higher you will need to gradually increase the MP and perhaps the RPM. Nothing is set in stone, but you started out with a clear idea of what power and attitude were most likely to work and subsequent adjustments are fine tuning, based on information from your performance instruments. If the rate of climb is a little high and speed a little low it is likely you have pitched up too much and maybe five degrees rather than seven will be just right. When performance is exactly as you want it you can fine-tune the trim and the aircraft will demand much less of your attention.

So having set the power appropriately, you select an aircraft attitude appropriate for the phase of flight, and you will get the performance you expect.

Power + Attitude = Performance

POWER + ATTITUDE = PERFORMANCE



9. INSTRUMENT FLYING CORE SKILLS: FULL PANEL

The key to smooth instrument flying is making many small corrections very promptly. To do this you need to be able to take in the information from your instruments in a systematic manner. The most important instrument by far is the attitude indicator or artificial horizon. (These terms and their abbreviations AI and AH are used interchangeably). If you want to fly straight and level and AI indicates this is being achieved then other performance instruments, if not quite unnecessary are certainly of secondary importance. The most effective way of acquiring these data inputs is with a radial scan in which your attention always returns to the central AI after a quick glance at one other instrument. It is common to regard the other instruments as having three levels of significance which change according to the phase of flight. The AI is always the master, two others are primary in that their information is important in confirming the desired performance and the remaining one or two are secondary. This all sounds very complicated and there is no need to memorize the combinations. The reality is that your scan will develop naturally. In straight and level flight if your wings are level and the AI bar is on the horizon line you will be level. You need to glance at your altimeter to see that you are level at the desired altitude and your HSI to see that you are flying straight in the desired direction.

In these circumstances your airspeed is unlikely to change much unless your power settings are incorrect so the ASI is secondary. It is surprisingly easy to fixate and especially in the early stages of learning you simply must not do this. For example setting a radio frequency might need three separate actions, setting a couple of digits a time, consciously looking back to the AI between each turn of the tuning knob.

	Master	Primary	Secondary
Straight and Level	AI	ALT, HSI	ASI
Level turn	AI	ALT, TC	HSI, ASI
Climbing & descending	AI	HSI, ASI	ALT, TC
Climbing & descending turns	AI	ASI, TC	ALT, HSI

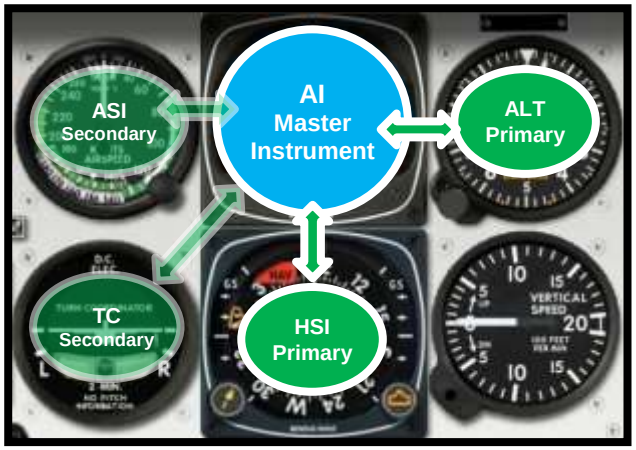
9. INSTRUMENT FLYING CORE SKILLS: FULL PANEL

This seems quite ridiculous to an experienced VFR pilot, used to setting a radio frequency almost without thinking, but it is certain if you do this in the early stages of your IR training you will be dismayed at how quickly you will deviate from your desired altitude and or heading.

If you are fortunate to watch a really skilled instrument pilot hand flying they appear to be making almost no control inputs. The reality is that they are making a huge number of inputs but they are of a very small magnitude and made very promptly. There is never any steady state in instrument flying. If everything is perfect now it will not be perfect in a few seconds. In a sense you are better off being slightly off the desired level or heading but very gently making a small correction. In that situation things can only get better whereas if they are now perfect they can only get worse.

Being in cloud does not change aerodynamics. If you turn you will tend to descend so anticipate this with slight back pressure. Almost everything in instrument flying happens at rate one so get used to the picture the AI gives when the bank angle is exactly right for your aircraft. Remember a rate one bank angle is IAS /10 plus 7 so 19 degrees at 120 knots.

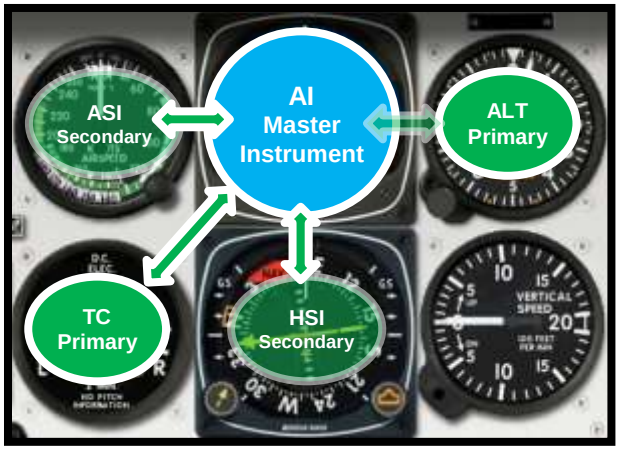
Straight and level flight



Achieving:

- Power as reqd
- Wings level, bar on the horizon
- Direction HSI, Altitude ALT
- Trim

Turning



Achieving:

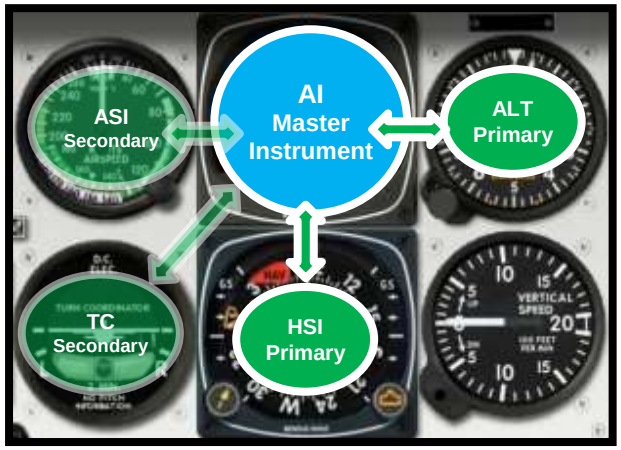
- Power as Reqd
- Roll into turn using AI, gentle back pressure on control column
- Scan ALT, VSI Monitor HSI turn progress
- Trim

9. INSTRUMENT FLYING CORE SKILLS: FULL PANE

For most climbs and descents a significant power change will be required. A good approximation is the I of MP or 100RPM equate to 100 ft./min The exception is on instrument approach procedures in some aircraft where selecting flap and or gear down may achieve the desired performance without any alteration to the engines power settings. It is source of great satisfaction to an experienced pilot if on an ILS. it is possible to be stable in level flight on the localiser waiting for glide slope intercept and the only action needed to initiate the descent is to drop the gear when the glide slope indicates one or half a dot fly up. That pleasure lies in your instrument flying future.

You might reasonably question the split between primary and secondary in the adjoining depictions. One might argue that going so slowly as to stall or so quickly as to enter the yellow arc are both very undesirable and hence the ASI warrants primarily attention. On the other hand it's always desirable to be in balance and for that you need the TC. The VSI is often regarded as a rather skittish instrument and indeed in turbulence it can give false indications. That said it does sometimes give the earliest indication of a departure from the desired path.

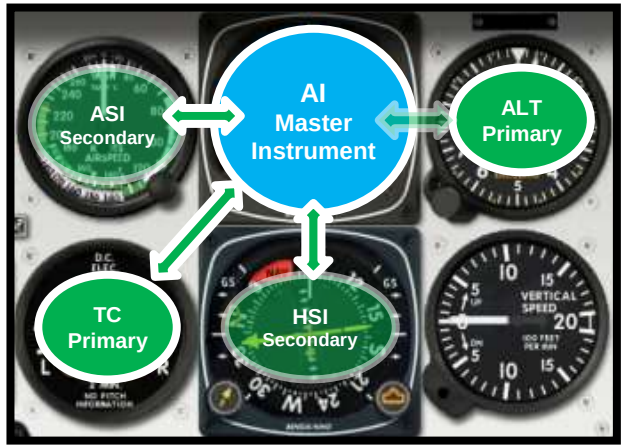
Straight and level flight



Achieving:

- Power as reqd
- Wings level, bar on the horizon
- Direction HSI, Altitude ALT
- Trim

Turning



Achieving:

- Power as Reqd
- Roll into turn using AI, gentle back pressure on control column
- Scan ALT, VSI Monitor HSI turn progress
- Trim

9. INSTRUMENT FLYING CORE SKILLS: FULL PANEL

Really this just reinforces earlier comments that the selective radial scan is a valuable concept but it falls down somewhat at the detail level and the divisions into primary and secondary are to some extent arbitrary. What is absolutely unarguable is that the AI is the master instrument and you must never take your eyes off it for more than a few seconds.

Climbing and descending turns just add a degree of complexity. The ideal in instrument flying is to only do one thing at a time and here we are forced to do two simultaneously or three if you count the power change. Adjust power, change pitch and then bank. Of course as you gain experience the actions will seem almost simultaneous but the order does work best. There is a tendency to overbank so watch out for this.

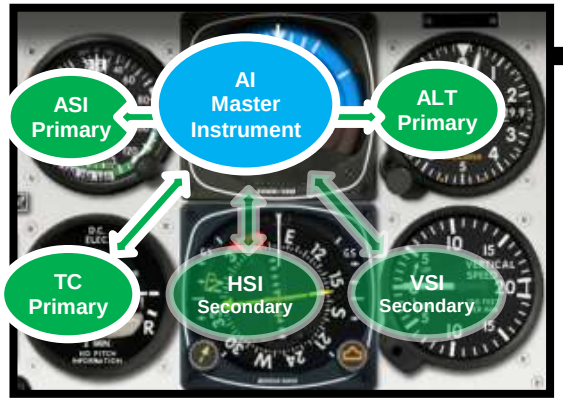
That covers all the basic techniques you need to full panel IF. Now you need lots of practice so you can deliver the skill test standard of ± 100' altitude and + 5° on heading consistently.

It absolutely to basic safe flying to be firm in your mind about whether you are IFR or VFR.

- ***If VFR you look out and avoid hard objects.***
- ***If you are IFR you climb to a safe altitude and fly using your instruments.***

You might be in good visual conditions but in your mind you are IFR and you play by that set of rules. A lot of pilots and their passengers die because pilots think they will be OK on instruments for a few moments while they get through this patch of cloud but their mind set has remained that of the VFR pilot. Just as you cannot be a little bit pregnant you cannot be a little bit IFR.

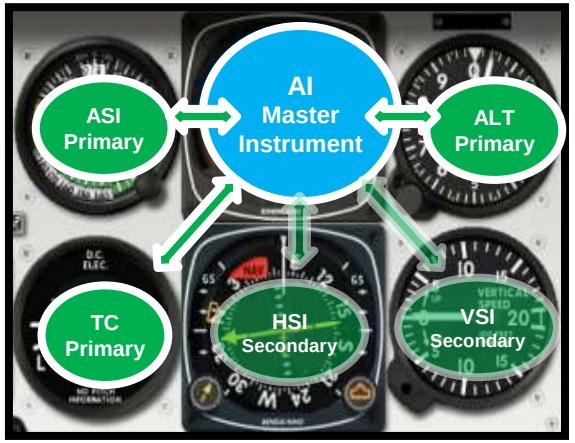
Climbing turn



Achieving:

- As required
- Pitch up just below the normal climb attitude, then roll into a Rate 1 turn
- Primary: ASI, ALT, TC for balance Secondary: VSI and HSI
- Trim Aircraft may tend to overbank, control with aileron

Descending turn



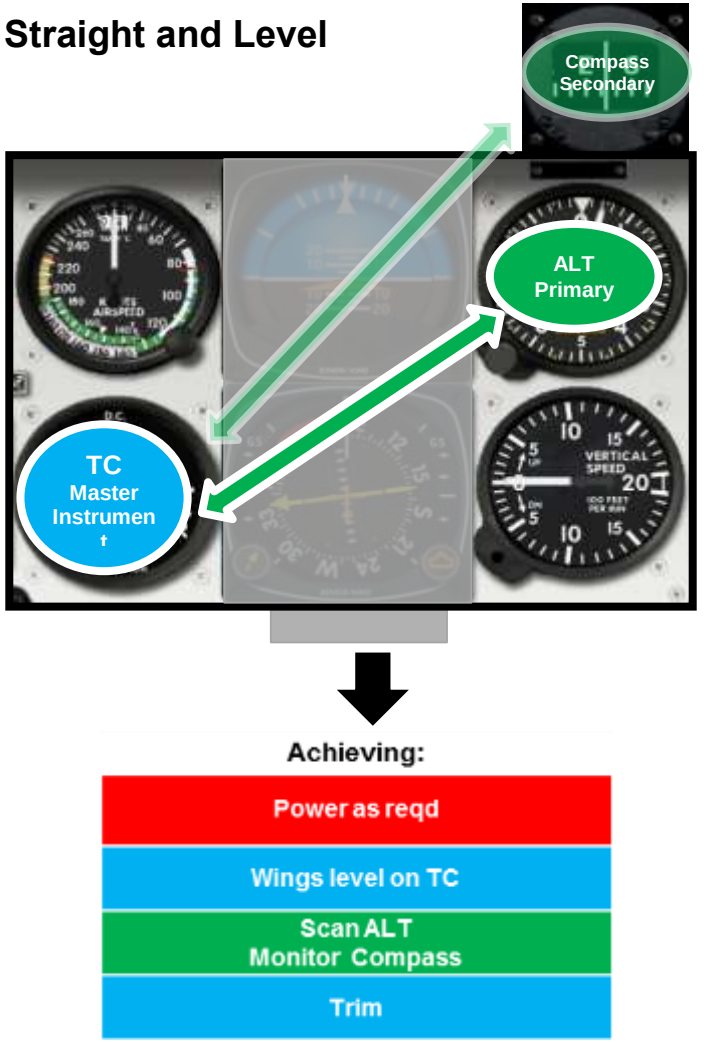
Achieving:

- As required
- Pitch up just below the normal S&L attitude, then roll into a Rate 1 turn
- Primary: ASI, ALT, TC for balance Secondary: VSI and HIS
- Trim

9. INSTRUMENT FLYING CORE SKILLS: LIMITED PANEL

The skill test still features a seriously outdated concept of what constitutes the minimum instrumentation that might be available to a pilot following some sort of technical failure. The premise is that the aircraft has the traditional 6 round dial display in which there is a single AI powered by vacuum. Failure of the vacuum pump or indeed the AI itself will leave you with only the electrically powered Turn Coordinator (TC) with which to keep you wings level or the angle of bank under control. No pilot should fly seriously in IFR without a second attitude indicator using an alternate power source. There are uncertified portable attitude sources that are far superior to any certified TC. Many aircraft have full or partial glass cockpits and they probably do not have a turn coordinator at all. Their failure modes can be quite demanding in different ways, perhaps with the need to initiate some less than intuitive button pushing to activate an alternative display. So for the real world you must know what powers your attitude data source, how it can fail and what you need to do in those circumstances.

However, returning to the skill test, the assumption is that you are left with nothing but the TC, the compass, a watch altimeter and airspeed indicator. If you train on a glass cockpit aircraft then you are required to do some flying in a round dial simulator or aircraft and be tested on limited panel separately from the main test in the glass cockpit aircraft. The first thing you need to do is cover up the instruments that have 'failed'. In a training aircraft there will be small screens designed for this purpose but it worth having a rubber sucker designed for this purpose or some post it notes somewhere in the aircraft or your flight bag in case this happens to you in the real world.

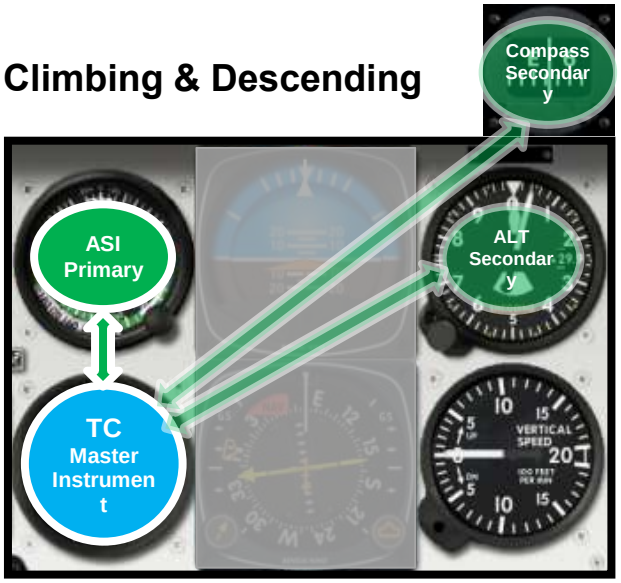


9. INSTRUMENT FLYING CORE SKILLS LIMITED PANEL

With the AI and HSI failed, the turn coordinator becomes the Master Instrument. The TC will indicate bank attitude only if the ball is centred. To control pitch we use the ASI which reacts quickly to pitch changes. Since a typical TC only reads to a maximum turn of rate one you need to ensure you are not overbanked by very slightly reducing bank from time to time and reapplying it as soon as the needle twitches away from the rate on mark. This is one situation in which you really must only do one thing at a time. Never attempt climbing or descending turns.

In theory it is possible to turn in a given direction using the compass and knowledge of compass errors to anticipate or lag the desired heading. In practice timed turns using rate one i.e. 3 degrees a second works better. Start the timer, roll into a rate one turn. Increase back pressure slightly to keep level by reference to the altimeter and VSI. When the time is up roll the wings back level and allow things to stabilise for 5 seconds before looking at the compass. If the heading is incorrect make very small corrections at much less than rate one until you are within 5 degrees of the desired heading. Although calculating the number of seconds needed is child's play sat in your armchair at home it can seem a task that would challenge Einstein when faced with the problem in the cockpit. All is not lost, there is an aid to calculation at hand.

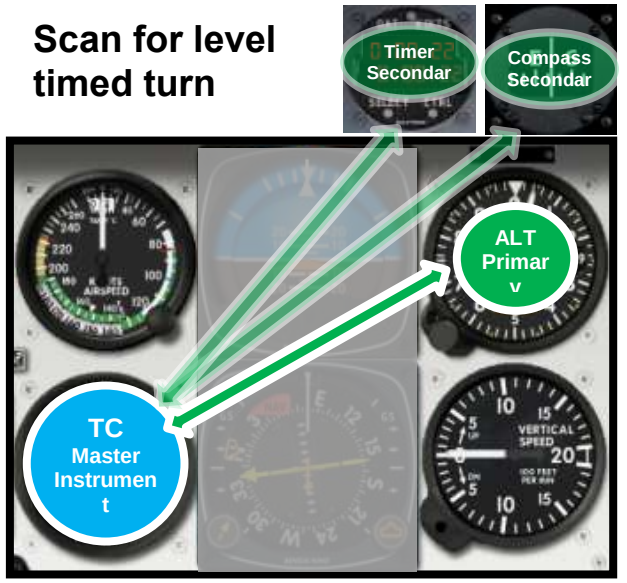
Climbing & Descending



Achieving:

- 2500 RPM, 25" MP
- Wings level on TC
- Scan ASI for Pitch Monitor Altimeter
- Trim

Scan for level timed turn



Achieving:

- Power as reqd
- Rate 1 on TC, ball centred
- Scan ALT Monitor Timing
- Slight back pressure to maintain ALT if reqd

9. INSTRUMENT FLYING CORE SKILLS: TIMED TURNS

Method for Calculating Timing

a 1. Read the compass and set the current heading on the top marker of the RBI or VOR

b indicator card

2. Note the desired heading, shortest distance to it gives the direction of turn

c Count the intervals from the top marker to the

d desired heading

Allow 10 sec for every 30° and 3 sec for every 10°

For example, a turn from 270° to 050°

Select 270 using OBS



c *Count intervals of 30° and 10°*

Identify 050 and note it's a turn to the right

d *Time is 4 x 10sec (30° intervals) plus 2 x 3 sec (10° intervals) = 46 sec*

Use a spare VOR indicator as an aid. Set the current heading using the compass. Then note the desired heading as given by the instructor or examiner. The shortest way to turn will be obvious. Each major division round the indicator is 30 degrees and hence 10 seconds. The small divisions of 10 degrees can be approximated to 3 seconds.

Turn the indicator to the desired final heading and start the turn and the timing as previously described. It might seem unnecessary to put the desired heading on the indicator but given the pressures of the situation it is remarkably easy to forget where you are going especially if the turn is through a significant number of degrees.

The final stage in this cruel and unusual punishment is at hand. Recovery from unusual attitudes while on limited panel. In the skill test these only come in two varieties. Increasing airspeed or decreasing airspeed. In other words you are approaching the stall or a tending towards entering a spiral dive. Since your examiner want to live to ripe old age it is unlikely that these will be very extreme. He may or may not re-trim the aircraft and may or may not precede the final manoeuvre with some confusing climbing or descending. He will certainly do some clearing turns for look out.

The following diagram sets out the correct sequence of control inputs. While you do not need, nor should you slam the throttle open or shut, neither do you want to be tentative.

Adjust the throttle promptly to where is needs to be. Then roll the wings level. The other actions will follow immediately but they must not be simultaneous. In the fairly gentle manoeuvres used here, this may or may not matter. It will matter very much if you are in a really steep spiral dive since pulling back before taking off bank will simply steepen the spiral.

9. INSTRUMENT FLYING CORE SKILLS: UNUSUAL ATTITUDES

1 **Check the ASI**



ASI low and reducing — Approach to Stall

2 **APPLY FULL POWER**



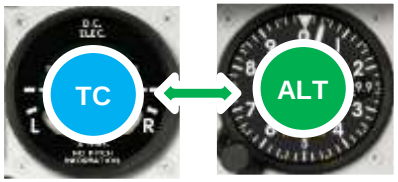
3 **Centralise the ball**
ROLL WINGS LEVEL



4 **Ease control column FORWARD As ASI needle changes direction, check the control column back**



5 **Maintain heading & height**
Re-adjust power
Re-trim if reqd



ASI high and increasing — Spiral Dive

2 **CLOSE THROTTLES**



3 **Centralise the ball**
ROLL THROUGH WINGS LEVEL THEN CHECK BACK

At higher speeds, it may be necessary to roll through to a Rate 1 turn in the opposite direction, hold that for 1 sec, then to roll wings level



4 **Ease control column BACK As ASI needle changes direction, check the control column forward**



5 **Maintain heading & height**
Re-adjust power
Re-trim if reqd

