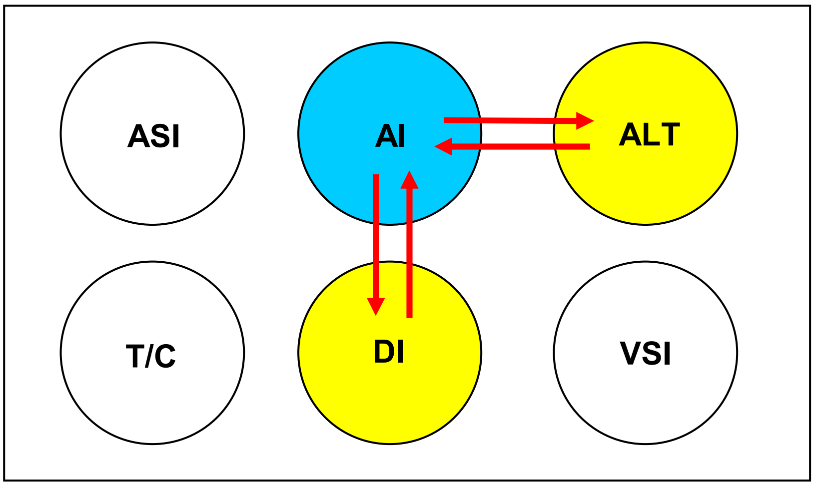
# SCAN TECHNIQUE

Good instrument flying comes from a good scan of the instruments. Only when this has been achieved can attention be diverted for other areas of flight such as navigation and RT. These notes will look at the scan technique involved for normal full panel flying, and for using partial panel scanning because of instrument failure.

The **attitude indicator** is the master instrument for flight control. It gives the pilot information relating to pitch and roll, and indirect information regarding heading and balance. It is therefore essential that this instrument is the primary focus of our attention. All corrections to attitude are made on this instrument. Should anything go wrong and an unusual or unexpected attitude develops then the aircraft should be positioned with the nose on the horizon of the attitude indicator, with wings level.

## Full panel straight and level

*Figure 1 – selective radial scan*



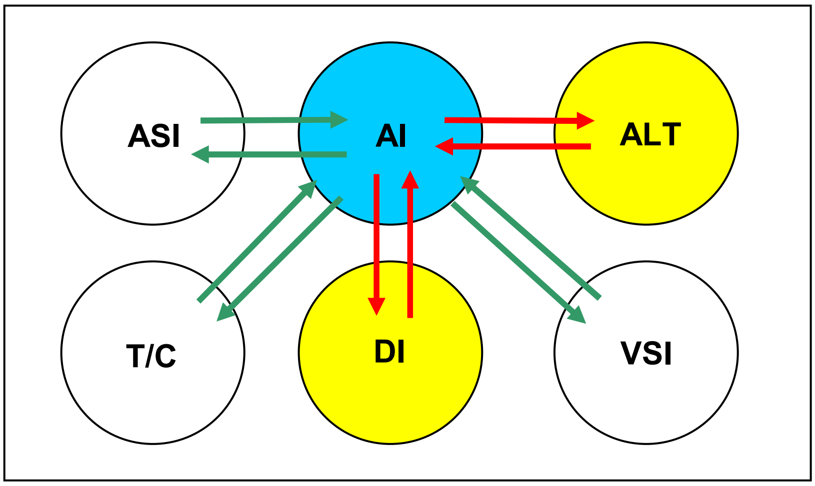

The basis of a good scan is the selective radial scan, as this provides the building blocks for accurate flight. It is selective because only three instruments are used, and radial because it radiates from the attitude indicator. The sequence is as follows:

AI – DI – AI – ALT – AI

This is one cycle of the scan, with the eyes constantly moving in a disciplined manner. If a problem is detected with direction, then a heading adjustment is made on the attitude indicator until the problem is fixed. Similarly any problems with altitude are fixed with a pitch correction on the AI.

Using this technique allows for small errors to be corrected accurately and in a timely manner. We can however be even more accurate using a full scan technique.

*Figure 2 – full scan*




The full scan involves one cycle of the selective scan with a further instrument introduced after each cycle:

AI – DI – AI – ALT – AI – ASI – AI – DI – AI – ALT – AI – T/C – AI – DI – AI – ALT – AI – VSI

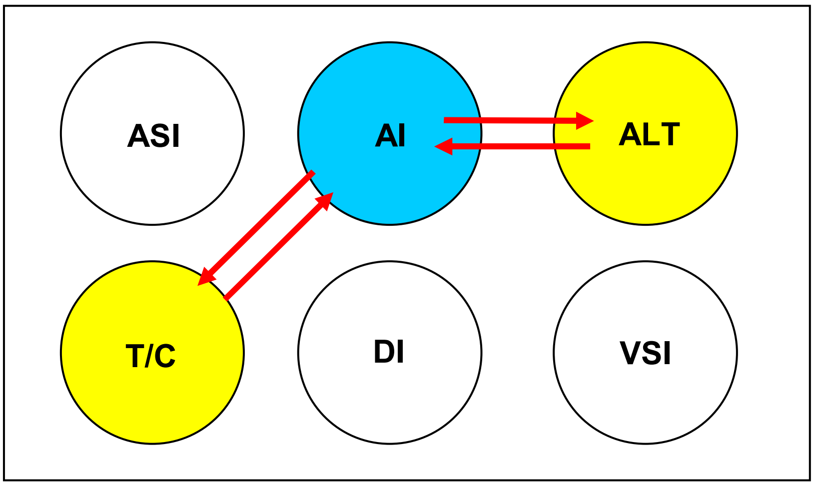
Using this method we can correct errors before they happen:

- Any change in speed may well be a pitch problem, correct on AI.
- If the balance is out heading will change, correct by returning to balanced flight.
- Changes on VSI will show before altitude changes, correct on AI.

### Scanning during a turn

During turning flight the DI is of little use to us, as it is in a period of transition. We do however wish to maintain a rate 1 turn (3 degrees/second) and keep the aircraft in balance. We therefore substitute the DI with the **turn coordinator**. The turn is initiated on the AI.

*Figure 3 – selective scan during a turn*

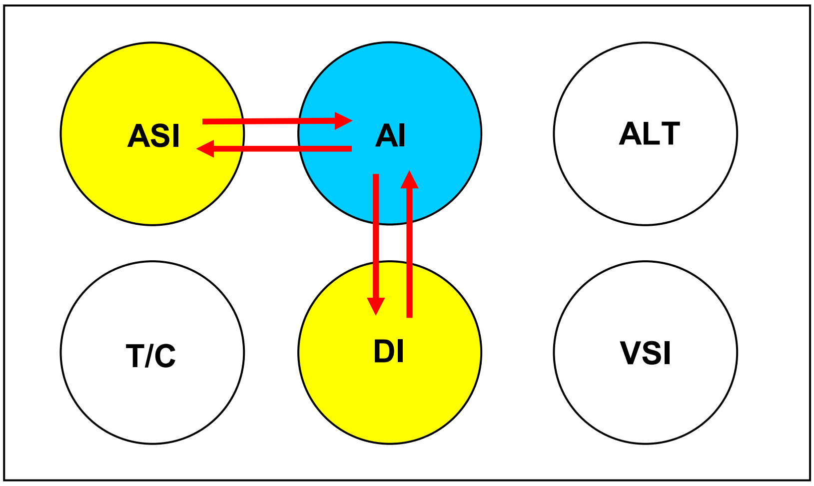


As we approach our desired heading (within 20 degrees) we return the DI to the selective scan and place the T/C back into the full scan.

**Scanning whilst climbing and descending**

Whilst changing altitude the altimeter is in a state of movement, so is of little use in the selective scan. When climbing we do so using a specific speed, so the airspeed indicator replaces the altimeter, until we reach 100' to go, at which point we return the ALT to the selective scan. The climb is initiated on the AI (with any required power changes having been made).

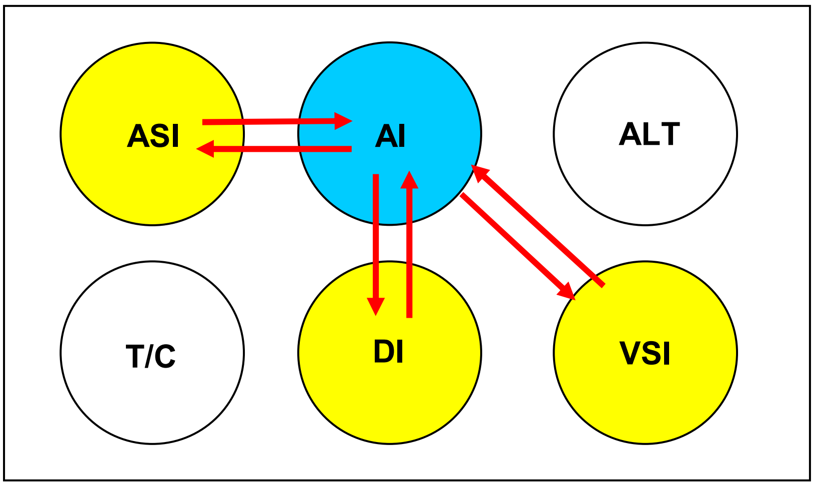
*Figure 4 – selective scan for climb*




It needs to be noted however that the ASI will take a while to change from cruise speed to climb speed. The initial scan should therefore be just AI – DI – AI – DI until the speed has settled. Once in the climb any speed changes are corrected with changes of pitch on the AI.

Descent involves both speed and rate of descent. The selective scan must therefore include the ASI and the **vertical speed indicator**.

*Figure 5 – selective scan for descent*



The descent is initiated on the AI (making any power changes required). However, if a specific speed is required then attitude should be held level until the speed is achieved. Once in the descent use pitch/power or a combination of the two to correct any errors of speed or ROD.

**Carrying out checks whilst scanning**

It can be seen that a good scan requires constant attention. For this reason a different technique must be adopted whilst carrying out in flight checks. If we wish to carry out a FREHAI check for example, turning our attention from the scan to carry out the full check WILL result in deviations from our intended flightpath. We therefore break the check up into sections, with our scan continuing all the time:

**F** (check fuel) – SCAN –
**R** (check COMM1 frequency in use & standby frequency) – SCAN – (check COMM2 frequency in use & standby frequency) – SCAN – (complete check of each radio aid with scan between each one) – SCAN –
**E** (engine check) – SCAN –
**H** (HSI/RMI/compass) – SCAN –
**A** (altimeter) – SCAN –
**I** (ice)

Carrying out checks whilst flying on instruments therefore takes longer than when flying visually. Consequently greater forethought and planning are required in order to carry out all checks in a timely manner. Checks will often be interrupted by other actions, but should always be finished when time permits. If in doubt, commence the check from the beginning again.

**Partial panel scan technique**

Any number of instrument failures could be looked at, but the most critical is the loss of the attitude indicator and the direction indicator. This could result from a suction pump failure if both were air driven gyros.

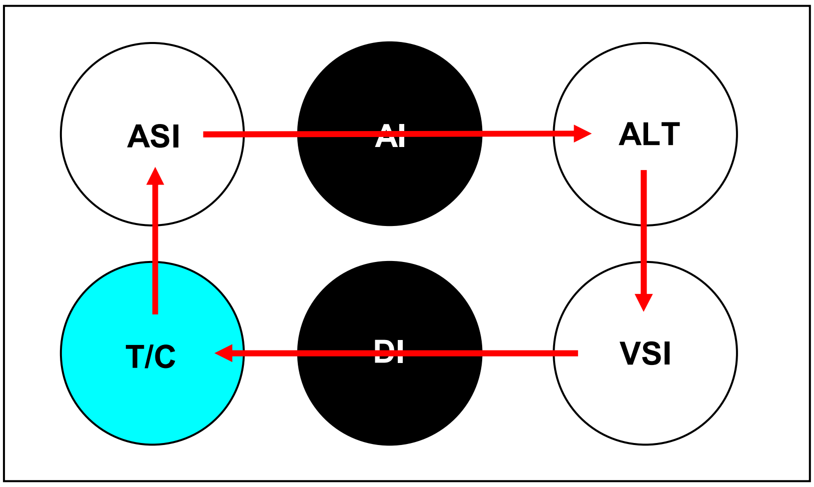
In some ways the scan becomes easier – there is less to look at!

We can still get roll and balance information from the T/C, but pitch information from the AI is lost. The turn coordinator becomes the master instrument, and we must derive pitch information indirectly from the remaining instruments, namely the ASI, ALT and VSI.

Figure 6 shows how the technique becomes a circular scan, originating from the T/C. Any errors in roll or balance can be corrected on the T/C. Any errors in pitch derived from the other instruments must however be corrected with (ideally gentle) changes of pitch on the control column until the desired flightpath is achieved.

Maintaining the aircraft in a trimmed condition makes this type of flying considerably easier, but we ***do not*** fly on the trimmer.

*Figure 6 – partial panel technique*




Climbing – Set climb power, and make gentle pitch movements until the desired speed is reached, then trim.

Descending – Reduce power, allowing the pitch to naturally change, until the required ROD is achieved. No change in trim should be required, unless a specific airspeed is required for the descent, in which case reduce power, hold attitude for required speed, then descent in a trimmed condition.

In both cases wings should be held level, with the aircraft in balance, whilst carrying out the procedure, otherwise heading will not be maintained.

**Turning whilst on partial panel**

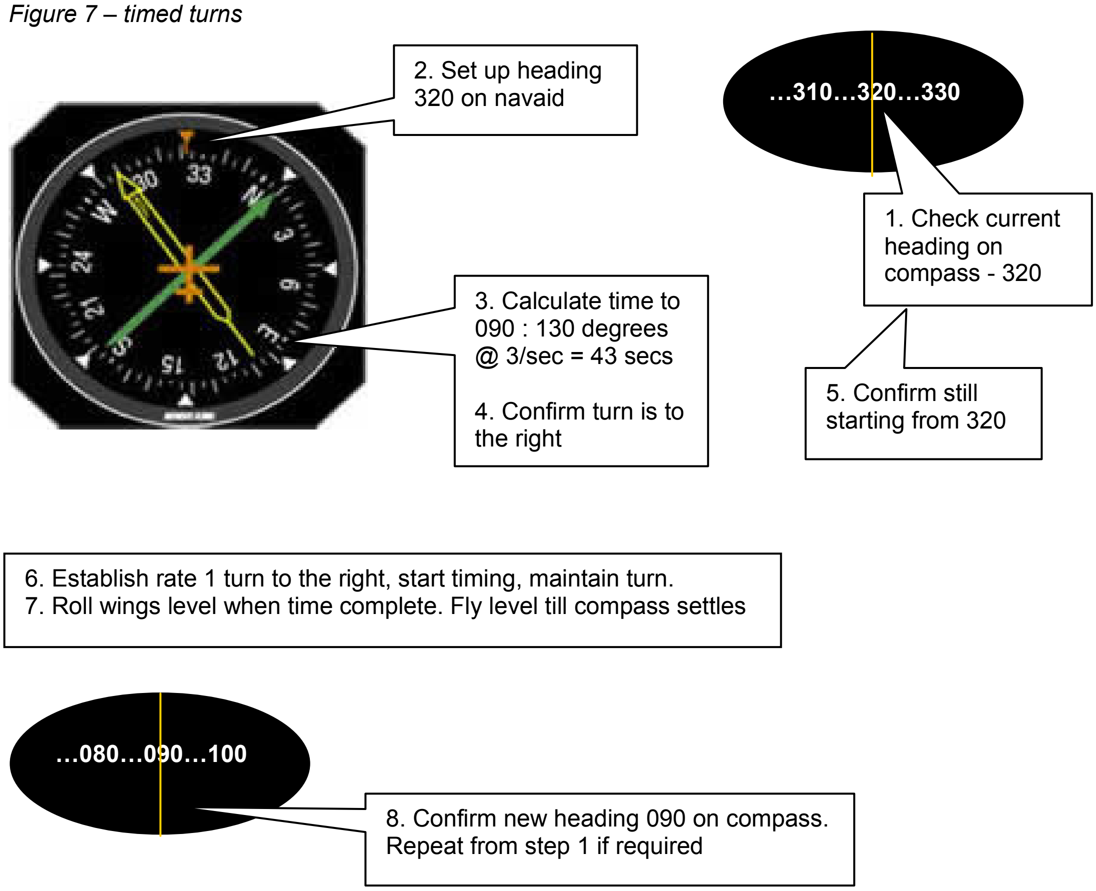
Making turns without the DI leads to issues with compass errors during turns. Because of this we cannot simply turn and roll level when the compass shows the new heading. The compass also reads in the reverse sense to the DI, and so is not a practical instrument to use. We do however know that we require our turns under instrument flying to be rate 1, so we can use this requirement for 3 degrees per second to time our turns in order to achieve the correct heading.

The following process should be adopted:

- Check current heading on the compass, and set this heading up on a navaid (VOR/NDB) not currently in use.
- Calculate the number of seconds for the turn (max 60 secs!), and establish the direction of the turn.
- Recheck starting heading, and make any minor adjustments as required to timing.
- Establish rate 1 turn, start timing and maintain turn at rate 1.
- Roll wings level when the time is complete.
- Fly straight and level for a couple of seconds to allow the compass to settle.
- Check correct heading has been achieved. Repeat if necessary to fine tune heading.

Figure 7 shows how to calculate the time for a turn. The example is turning from 320 to 090.

*Figure 7 – timed turns*




## Making corrections – Altitude and Heading

If altitude is changed then make a correction at a rate of no more than a rate not exceeding twice the amount of height to change ie if 100ft off target height then the rate of change should not exceed 200 ft/min.

Aim to make all heading corrections within 5º if possible. If a heading correction of up to 5º then use a slight rudder pressure or 5º of bank. IIf correction required is over 5º, then use bank but less than rate 1 for small heading change.