VOR Instrument Approach

5.98 When carrying out a VOR approach, as depicted in Figure 5–35 for Kalgoorlie-Boulder, the VOR is used as the sole tracking aid. Of course, the VOR must be identified before you may use it for navigation. The coded IDENT for the Kalgoorlie-Boulder VOR is shown as KG (dah-dit-dah, dah-dah-dit). To position the aircraft for the approach you must track to the KG VOR at or above the lowest safe altitude (LSALT) specified on the ERC for your inbound track, or the minimum sector altitude (MSA), which on the chart is 3100 ft AMSL.

5.99 The elevation of Kalgoorlie-Boulder aerodrome is 1203 ft AMSL and the runway threshold of RWY 11 (THE ELEV) is 1203 ft AMSL (shown on the profile view). The published aerodrome elevation should always be equal to or higher than any THR ELEV specified, since this, by definition, is the highest point on the landing area.

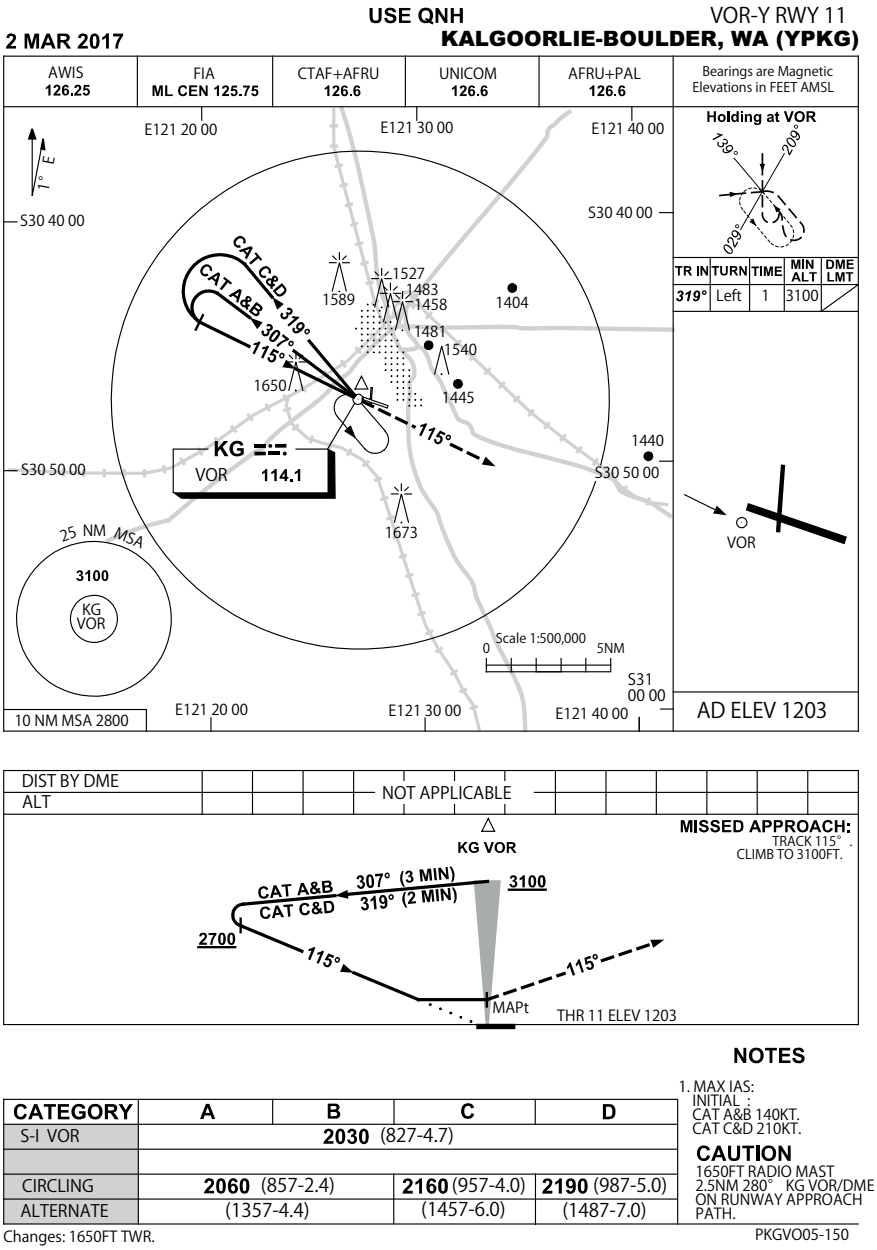

Figure 5-35 The Kalgoorlie-Boulder RWY 29 VOR approach.

7.60 The glideslope signal is only approved for guidance down to the decision altitude (DA) for the particular ILS. Reference to glideslope indications below the DA must be supported by visual references in the runway environment.

7.61 If the glideslope fails but not the localizer, then you may still be permitted to carry out a non-precision localizer approach, using checkpoints such as the marker beacons or DME distances, to monitor GP and adjust descent. The checkpoints and limiting altitudes will be marked on the profile section of the instrument approach chart. The minimum descent altitude (MDA) for LOC approaches will always be higher than the ILS approach DA.

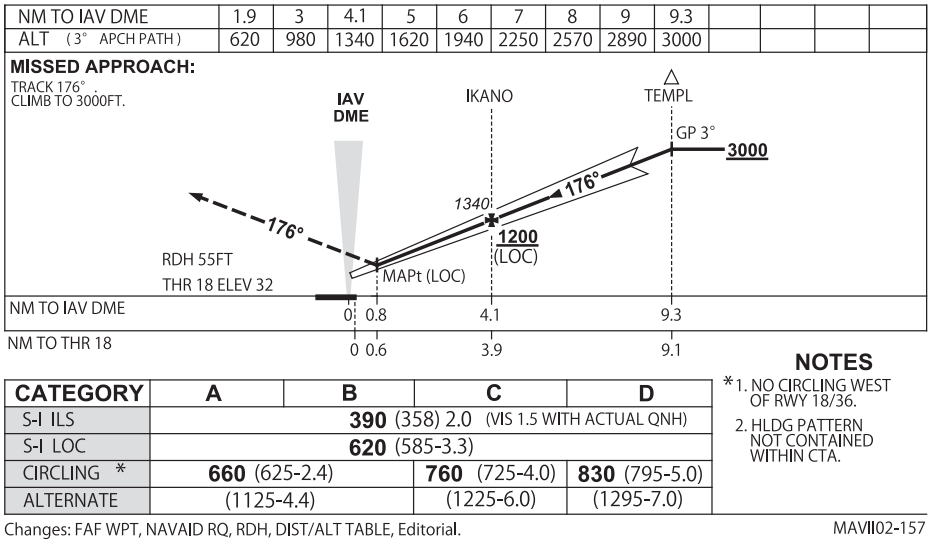

Figure 7-17 The Avalon RWY 18 ILS-Z approach.

7.62 The DA shown on the Avalon chart is 390 ft. Because this is a new criteria chart, you must add either the *pressure error correction* (PEC) for your aircraft or 50 ft, to the DA, to determine the aircraft landing minima. An operator must state in the company operations manual whether the PEC or 50 ft additive is to be used. If the aircraft is on slope when passing 4.1nm DME, the altimeter should read 1,340 ft on QNH. If the glideslope is not available, then a localizer approach can be made. However, you cannot descend below 1,200 ft AMSL until passing 4.1nm DME (which is the final approach fix for this non-precision approach). After this point, the descent may be continued to the minimum descent altitude (MDA) of 620 ft on QNH or 520 ft if you have the current QNH. Because the LOC is a non-precision approach, there is no requirement to add a correction for pressure error to the MDA value. *Pressure error correction* (PEC) only applies to a precision approach (ILS). Non-precision approaches require no PEC or 50 ft buffer.

Flying the Glideslope

7.63 The technique to adopt in flying the glideslope is similar to that of flying the localizer: small attitude changes are the key to success. The aim is to keep the aircraft on a constant descent path. Therefore, during an ILS, the glideslope needle is checked regularly to ensure that the desired slope is being maintained and any tendency to deviate is corrected immediaetly - by a small amount.

7.131 For any instrument approach, be sure you determine correctly the minima applicable to your aircraft, particularly if you regularly fly a number of different aircraft types of varying levels of sophistication or performance.

7.132 For a straight-in approach to RWY 12, using the full ILS procedure and assuming actual aerodrome QNH has been received, the decision altitude (DA) is 2000ft (the SI-ILS box is shaded, therefore 100 feet can be subtracted from the existing minima). A factor of 50ft must be added to the published DA to allow for altimeter pressure error unless and additive *pressure error correction* (PEC) is specified for the aircraft in the flight manual or you are required to operate to higher minima by the company operations manual. If Category I ILS approach requirements can be met, the minimum visibility of 800m applies if the actual QNH is available. If for any reason the ATIS or AWIS (and therefore actual QNH) is not available, the minimum visibility required is 1.2km and a DA of 2100ft.

7.133 Bear in mind that the 50ft allowance is not required for the MDA which applies to the LOC approach. If the glideslope is not available, a localizer approach may be flown in place of the ILS, provided that the aircraft has DME and the descent is flown using the DME DIST/ALT scale on the profile chart and the limiting altitudes specified are adhered to.

7.134 Note that this approach may only be conducted if the aircraft has a DME as indicated in the box near the upper right corner of the approach plate. However, GNSS is permitted in lieu of DME, with the reference waypoint AS VOR (see note above profile view of approach). For a LOC approach straight-in to RWY 12, the MDA is 2,320 ft and a minimum visibility of 2.1 km is required. To this must be added 900m visibility if HIAL is not available, making the minimum visibility 3 km.

7.135 Should you intend to make a circling approach to another runway, perhaps due to excessive crosswind on RWY 12, then an MDA of 2,470 ft AMSL and a visibility of 2,400 m applies for categories A and B. Remember, PEC or the 50 ft allowance does not apply to an MDA.

7.136 We mentioned that the missed approach procedure should be included in the pre-approach brief, and if there is any doubt about a successful approach being possible, such as cloud and visibility fluctuating around the minima, then you should also consider your options should you 'miss out'. For example, the minimum fuel on board required for a diversion and/or the amount of holding fuel available, should be calculated, allowing for the appropriate reserves. This will determine whether you will have sufficient fuel for another approach, whether you can hold to wait for conditions to improve, or whether an immediate diversion to a suitable alternate will be necessary after the missed approach. As part of this analysis, you should check the current weather at your alternate aerodrome(s); for example, the visibility at your nominated alternate may have deteriorated, making diversion to an unplanned alternate necessary. All planning and calculations in arriving at your options must be completed well before starting the approach.

7.137 Never commence any instrument approach without first having thoroughly considered your options should you not become visual.

7.148 Gradually, the glideslope needle will move down the scale from the upper peg as you intercept the glideslope from below. Commence descent in the appropriate configuration as soon as the glideslope is intercepted with a rate of descent to follow a 3° approach slope. There is a variety of methods used to achieve glideslope intercept, and you should use the technique recommended by your instructor. Two methods commonly used are:

- lower the undercarriage as the GS needle centres, thereby increasing drag, and then pitch down to maintain airspeed and the required rate of descent; or
- pitch down slightly to achieve the required rate of descent, reducing power to maintain airspeed.

7.149 Again, it is not necessary to have the GS needle perfectly centred immediately. It is far more important to establish the aircraft in a descent smoothly at the required rate and airspeed. However, you should not allow a glideslope error to persist for too long.

7.150 When the descent is stabilised, make minor pitch adjustments to centre the GS needle. Reference to the VSI can be of great assistance. Airspeed changes, if required, should be made by altering the power setting. Throughout the approach, make minor pitch attitude and heading corrections in response to any wind changes to keep the needles centred. Remember, the ILS indicator is a navigational performance instrument. Do not use it to make attitude changes, and never attempt to 'chase the needles'. Instead, include the ILS indicator in your scan, periodically noting any deviation from the localizer or glideslope, then return to the AI and performance instruments to make any small adjustments to pitch or heading. Aim to detect any deviations from the glideslope early, so that only small heading and pitch corrections are required.

7.151 Concentrate on flying on instruments regardless of whether the aircraft is in or out of cloud. Remember, if you treat instrument indications merely as a substitute for visual indications, and keep visualising your progress down the glidepath towards the runway, you can proceed as comfortably as you would on a visual approach.

7.152 During the descent, you will pass overhead the ALDIM waypoint, which is the final approach point (FAP). The FAP is identified by a Maltese cross symbol on the plan and profile diagram on the chart. Also shown is the minimum altitude of 3,600 ft for obstacle clearance when crossing ALDIM for a LOC approach.

7.153 As you pass ALDIM with the glideslope needle centred, you should check that the altimeter reads 3,100 ft with QNH set. This is an important check. Assuming you are within half-scale deflection of the glideslope needle, the aircraft is within acceptable tolerances, so no action is required. If either localiser or glideslope needle should reach full-scale deflection at any point after commencing the final descent, a missed approach should be commenced immediately. If at ALDIM, the glideslope needle is found to be within tolerances, but there is a discrepancy between the altimeter reading and 3,960 ft, you have the choice between initiating a missed approach, thus discontinuing the ILS approach, or converting it into a LOC approach. It could be that the QNH has been incorrectly set, but if the discrepancy cannot be satisfactorily explained, the safest course would be to initiate a missed approach.

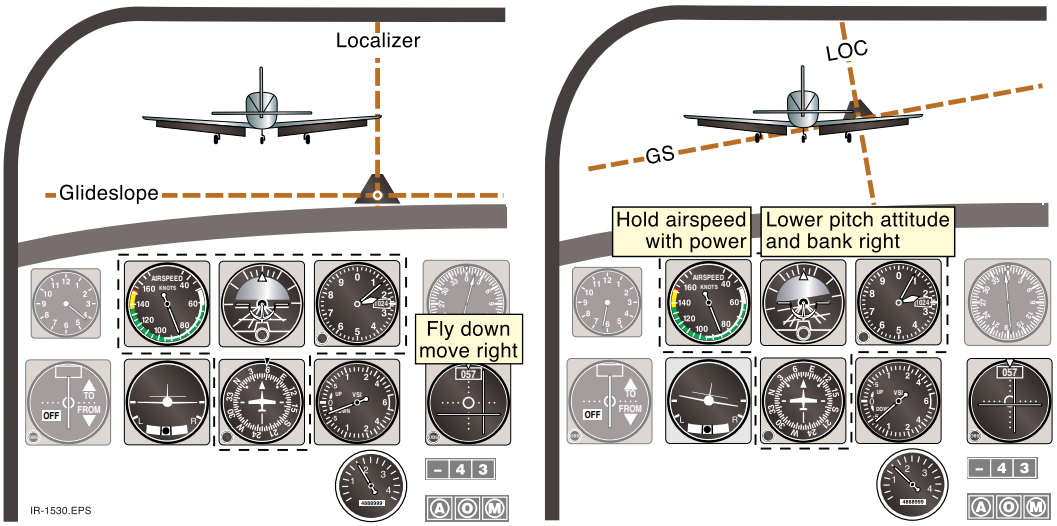

Figure 7-33 Flying the ILS.

7.154 After ALDIM, the glideslope and localizer will become increasingly sensitive. You should therefore aim to have the ILS needles 'tied down' by this point, so that only very small pitch and heading corrections will be required for the rest of the approach. The airspeed should also be stabilised at the approach value, and pre-landing checks completed, with possibly just the final flap setting left to go.

> **Note:** If there is a glideslope failure prior to ALDIM, and you decide to revert to a localizer approach, then you can monitor and adjust your descent by reference to the DME DIST/ALT scale at the base of the chart. In this case, it is essential that the DME indicator and the DME DIST/ALT table are incorporated into your scan. At each mile, you should note the difference, if any, between your altitude and the nominated altitude, and adjust pitch attitude and rate of descent to be at the altitude specified for the next mile ahead. In doing so, you must not allow the aircraft to descend below the LOC minimum heights for obstacle clearance shown on the profile diagram, i.e. not below 3,600 ft AMSL until passing the ALDIM, or below 2,800 ft AMSL until passing 4.2 DME or below 2,420 ft before passing 2.2 DME. Complying with the DME distance/altitude scale shown on the bottom of the chart will ensure this. Descent to the LOC MDA of 2,320 ft is then permissible for either a landing or a missed approach from the *missed approach point* (MAPt) approaching the middle marker.

7.155 If the full ILS approach is available, proceed down to the DA 2,100 ft (2,000 ft with actual QNH) AMSL (+ PEC additive), occasionally checking outside as you approach the minima for the runway environment, such as the approach lights and VASIS, or even the runway itself. If you break out of cloud at or above the DA, and the visibility is equal to or better than the minimum required, you may continue for a landing (select final flap, as required). The runway will be straight ahead, although possibly a little left or right of the nose, depending upon the wind correction angle (WCA) being applied.

7.156 During the final approach, from the point at which you first establish visual reference through to the commencement of the flare, it is vital that you continue to monitor the glideslope needle, the approach lights and the VASIS (if available) to confirm that you are still on glideslope. In poor visibility, watch for the tendency to steepen the descent momentarily and 'duck under', which, if uncorrected, can develop into a dangerous undershoot. Moreover, at night, you may encounter cloud that is not apparent when you first become visual. If this occurs while you are still above the DA, you can easily revert to instruments and continue the approach.

7.157 If it is necessary to apply a significant wind correction angle during an ILS approach, the runway and approach lighting will appear well to the left or right of the nose when you become visual. At low level and in poor visibility, avoid an almost instinctive tendency to turn towards the runway. If you do happen to head for the runway, the aircraft will immediately drift off the centreline, and in the remaining 200 to 300 ft it may be difficult to safely realign the aircraft and establish a stable flightpath.

7.158 With the aircraft satisfactorily maintaining the glidepath during the approach, experienced IFR pilots make a conscious effort to refrain from significant control inputs immediately after becoming visual. The aircraft should continue to maintain a stable descent along the glidepath, allowing the pilot to acquire visual cues to complete the approach and landing.

7.159 If you do not break out of cloud by the time the DA is reached, or the minimum required visibility does not exist, then you must carry out a missed approach, climbing straight ahead on 116° in the missed approach configuration for your aircraft (gear up, flaps as required).

7.160 Localizer indications will become unusable for track guidance very soon after the missed approach is commenced. Maintain track of 116° and climb to 5500ft or as directed by ATC. Although the chart indicates that the climb should be continued to track 116°M climbing to 5,500 ft AMSL, ATC may instruct you otherwise, possibly to enter a holding pattern overhead WAY to await further instructions.

7.161 Remember, a missed approach is a normal manoeuvre. It is simply an integral part of the total instrument approach procedure, carefully designed to provide safe vertical and lateral obstacle clearance along the path from the MAPt. It is a simple manoeuvre, so you should have complete confidence in carrying it out.

A Final Word of Advice

7.162 Low minima operations, although not inherently difficult to fly, require a high level of concentration, discipline and situational awareness. Often, a decision has to be made in a very limited time frame since things can happen fast as you approach the minima. You have to decide positively, on the basis of what you can or cannot see, to go around or to continue the approach. There is no room for indecision or error.

Summary of Symptoms

Condition	Cause/ altitude	Common symptoms	Notes	Actions
Hypoxia – a condition where oxygen concentration in the tissues is less than normal	Rare below 10,000 ft.	Euphoria. Visual disturbances. Dizziness. Light headedness. Confused thinking. Apprehension. Sense of well being.	May be unaware of condition due to decreased partial pressure of oxygen. Smoking increases your susceptibility.	Descend. Use oxygen. 10,000–33,700 ft, air-oxygen mix. 33,700–40,000 ft, 100% oxygen.
Hyper-ventilation – occurs when the body overbreathes due to some psychological distress, such as fear or anxiety (gasping for breath)	Anxiety. (Any altitude. Hypoxia if above 10,000 ft.)	Light headedness. Dizziness. Tingling. Tremors. Visual disturbances. Confused thinking. Faintness. Numbness.	Overbreathing, reduces carbon dioxide level in the blood.	Control breathing rate. If above 10,000 ft suspect hypoxia.
Carbon monoxide poisoning – is present in engine exhaust gases and in cigarette smoke. It is a colourless, odourless, tasteless and poisonous gas	Faulty exhaust/ heating. Smoking. Any altitude.	Headache. Breathlessness. Sluggishness. Impaired judgment. Feeling of warmth. Cherry red skin.	Haemoglobin has greater affinity for CO than for oxygen. (Smoking makes night vision poor.)	Immediate fresh air. Oxygen. Land and seek medical attention.
Decompression sickness (the bends) – condition that results when too rapid decompression causes nitrogen bubbles to form in the tissue of the body	Flying after diving. Unlikely below 18,000 ft.	Headache. Pain (joints). Paralysis. Choking. Skin irritation.	Nitrogen comes out of solution and forms bubbles in: ■ lungs (chokes); ■ joints (bends); ■ skin (creeps); ■ central nervous system (paralysis).	Do not fly for 4 hr for dive less than 30 ft; longer if deeper.
Dehydration – deficiency of water in the body tissue	Likelihood increases with altitude.	Thirst. Less urine. Darker urine.	Lower air temperature and air density increases the amount of water loss from the body.	Always carry drinking water to sip throughout the flight.

Table 22-1 Summary of symptoms.

15. Climbing right turn with a failed static system – right bank (AI, turn coordinator and HI); nose high (AI with no support, but fixed indications on the altimeter and the VSI along with an increasing indicated airspeed are consistent with a climb with a blocked static system).
16. AI (attitude), altimeter, VSI and ASI (flight-path).
17. AI, HI, turn coordinator.
18. Reduce power, roll to wings level, and then smoothly raise the nose to a level flight attitude.
19. Apply power, lower the nose to a level attitude, and simultaneously roll to wings level.
20. C.
21. A steep climbing turn to the right – apply power, lower the nose to a level attitude, and roll to wings level.
22. A nose-low spiral to the right – reduce power, level the wings, and raise the nose to a level pitch attitude.
23. Turn coordinator.
24. ASI, altimeter and VSI.

Review 19

1. Roll axis.
2. Without.
3. Circuit.
4. Decreases, decreasing, more.
5. Before flight on that day
6. Roll and pitch.
7. Cannot.
8. On the control column.
9. Pull the trim circuit breaker.
10. Grasp firmly and regain aircraft control, follow by press autopilot disengage switch, trim manually as needed and pull circuit breaker.

Review 20

1. There are no questions associated with this chapter.

Review 21

1. RNAV.
2. Waypoints.
3. ±2 nm.
4. 24, 12, 20,200 km.
5. 4.
6. Availability and continuity of service.
7. 12.5, track, and 95%.
8. Clear/acquisition (C/A), standard positioning service (SPS).
9. Selective availability (S/A).
10. The receiver measuring the period between the time of transmission and the time of reception of the satellite signal.
11. Barometric aiding.
12. Navigation with RAIM, navigation (two and three dimensional) without RAIM, and loss of navigation or DR.
13. By data received from the satellites.
14. By appropriate software modelling in the receiver.
15. ATC must be advised.
16. The relevant and current navigation chart.
17. It remains current for the duration of the flight.
18. Situational awareness.
19. An oblate spheroid.
20. WGS 84.
21. It is a two-way route.
22. True; however, area LSALTs are shown.
23. RNAV system keeps the aircraft within the tracking tolerances for the aids concerned.

Review 22

1. Hypoxia.
2. Insufficient partial pressure in the air and inability of the blood to carry oxygen.
3. 10,000 ft.
4. Yes.
5. Yes.
6. Gas bubbles form in the body and cause pain and immobilisation.
7. Hyperventilation.
8. Exhaust gases.
9. Slow down breathing rate, breathe into a paper bag.
10. Yes.
11. Empty field myopia.
12. To the side of.
13. Myopia.
14. Yes.
15. Yes.
16. Autokinesis.
17. Further away.
18. Either sloping cloud layers, and angled lines on the ground, or areas of light at night.
19. Greater.
20. Steeper approach and higher flare.
21. Spatial disorientation.
22. Sight.
23. You are entering a turn in the opposite direction.
24. Accurate and complete data and good judgement.
25. Situational awareness.