The Instrument Landing System (ILS) Approach

Version 1.2

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The Instrument Landing System (ILS) Approach
Part 1 – The Theory

> **Air Traffic Control (about 70 nm out)**
> World Travel 109, you are 75 miles east. Turn right heading 250. Descend and maintain 9,000. Expect vectors for ILS runway 16 approach.

> **Air Traffic Control (about 25 nm out)**
> World Travel 109, you are 23 miles north. Turn left heading 159, descend to 3,000. Cleared ILS runway 16 approach. Maintain 3,000 until established on the localiser. Contact Melbourne Tower on 120.5.

Introduction

Possibly one of the most gratifying feelings in flight simulation is the experience of performing a good landing. How many of us in our early days of FS have been frustrated at our attempts with constant porpoising, burning lots of tyre tread or experiencing the dreaded crash on landing. Well a smooth, controlled landing, or 'greaser', is achievable.

When it comes to landing an aircraft under IFR conditions there are two types of approaches – precision and non-precision approaches. In this module we look at, in some detail, the precision approach utilising the **instrument landing system (ILS)** approach. We will look at the components of the ILS and how to fly the approach and also examine the charts associated with performing one. This theoretical tutorial section is followed up by a practical step-by-step application of this type of landing in the FS default Boeing 737-800.

The Instrument Landing System (ILS)

Let's start with the basics. IFR approaches come in two categories - non-precision and precision. Non-precision approaches include VOR, NDB and GPS and do not provide an electronic glide slope. The ILS is a precision approach to a particular runway. It gives both vertical guidance (the **glideslope**) and horizontal guidance (the **localiser**) accessed by Nav receivers. See Figure 1. There is more to an ILS than just the localiser and the glideslope. The full components include:

- **Guidance information**: the localiser and glide slope.
- **Marker beacons**: the outer marker (OM) and the middle marker (MM) beacons.
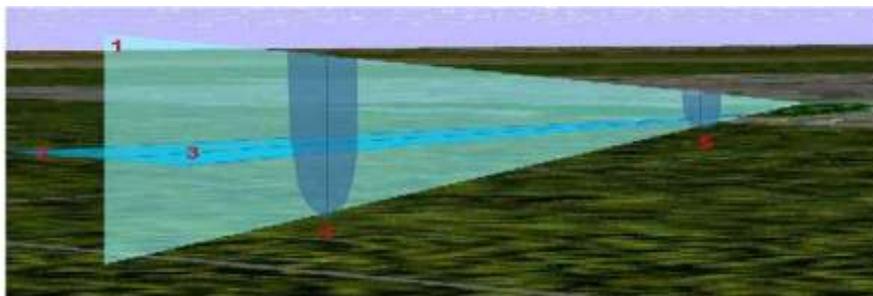- **Visual information**: approach lights, touchdown and centerline lights, runway lights.

Figure 1: Components of an ILS

1 Localiser plane
2 Glideslope
3 Glidepath
4 Outer marker
5 Middle marker

ILS categories

Three categories of ILS approaches exist, CAT I, CAT II and CAT III. Each category has successive lower minimums. CAT II and CAT III are only available at those airports where they are approved and published. Table 1 below shows the minimums for each category.

Category (CAT)	Minimum Decision Height (DH)	Minimum Runway Visual Range (RVR)	Notes
I	200 feet	2400 feet	
I	200 feet	1800 feet	With touchdown and runway centre lighting
II	100 feet	1200 feet	Half the minimums of a standard CAT I approach
IIIa	100 feet	700 feet	
IIIb	50 feet	150 to 700 feet	
IIIc	No DH	No RVR limitation	

Source: *Aeronautical Information Mannual, AIM, FAA*

Table 1: ILS Categories

Guidance information

The localiser

The localiser signal provides lateral information to guide the aircraft to the centerline of the runway. It is similar to a VOR signal except that it provides radial information for only a single course - the runway heading. Localiser information is displayed on the same indicator as your VOR information. The specifics aspects of the localiser are:

- The localiser antenna is located at the far end of the runway.
- The localiser consists of only a single course.
- The approach course of the localiser is called the **front course**.
- The course line in the opposite direction to the front course is called the **back course**.
- The localiser signal is normally usable 18 NM from the field.
- The localiser indicator reacts differently from a VOR in several ways.

The localiser course needle is four times as sensitive as a VOR needle. Heading adjustments must be much smaller because of the increased sensitivity of the indicator. For VOR work, each dot under the needle represents 2° deviation from course while for the localiser each dot under the needle represents 0.5° deviation from course. Near the Outer Marker, a one-dot deviation puts you about 500 ft from the centerline. Near the Middle Marker, one dot means you're off course by 150 ft!

Because the localiser provides information for only one radial, the runway heading, the Nav receiver automatically cuts out the Omni Bearing Selector (OBS). Rotating the OBS still orients the pointer on the instrument panel, but has no affect on it. Smart pilots, nonetheless, rotate the OBS to the desired localiser heading as a reminder of where they are going.

The glideslope

The glide slope is the signal that provides vertical guidance to the aircraft during the ILS approach. Think of it as a localiser laying on its side, squirting a signal 3° up into the air.
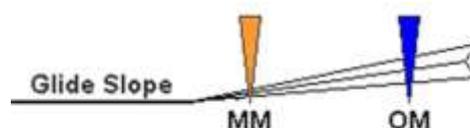

Figure 2: Glideslope

The glide path projection angle is normally adjusted to 3 degrees above horizontal so that it intersects the middle marker (MM) at about 200 feet and the outer marker (OM) at about 1,400 feet above the runway elevation. The glide slope is normally usable to a distance of 10 NM. See Figure 2. More on marker beacons shortly.

Tracking the glide slope is identical to tracking a localiser. If the glide-slope indicator swings away from centre—up or down—manoeuvre the aircraft towards the needle by adjusting the engine's power. Don't point the aircraft's nose up or down. Pointing the aircraft's nose up or down disturbs that stability. Changing the power doesn't.

The glide slope is much more sensitive than the localiser. At the OM, each dot of glide slope deviation equals about a 50-foot departure from the prescribed glidepath. At the MM, the sensitivity is an astounding eight feet per dot!

Marker beacons

Marker beacons are used to alert the pilot that an action is needed e.g. altitude check. This information is presented to the pilot by audio and visual cues. The ILS may contain three marker beacons: inner marker (IM), middle marker (MM) and outer marker (OM). An outer marker with an NDB associated with it is called a locator outer marker (LOM). The inner marker is used only for Category II operations. The marker beacons are located at specified intervals along the ILS approach and are identified by discrete audio and visual characteristics (See Table 2 below).

The OM: 4 to 7 NM from the runway threshold. Normally indicates where an aircraft intercepts the glide path when at the published altitude.

The MM: 3500 feet from the runway threshold. Is the Decision Height (DH) point for a normal ILS approach. On glide path at the MM an aircraft will be approximately 200 feet above the runway.

The IM: 1000 feet from the runway threshold. Is the Decision Height point for a Category II approach.

Marker	Code	Light	Sound
OM	_ _ _	blue	Two dashes per second
MM	._._._	amber	Alternate dot and dash
IM	. . . .	white	Dots only

Table 2: Marker beacon characteristics

Visual information

There are a number of visual cues a pilot can use in the transition from an instrument approach to a visual landing in the last few moments of an ILS landing, except for Cat. IIIc.

Figure 3: Visual Approach Slope Indicators

The basic **Visual Approach Slope Indicators (VASI)** consists of two sets of lights. One set marks the start of the runway, while the other is set up some seven meters (twenty feet) behind the first. Each set of lights is designed so that the lights appear as either white or red, depending on the angle at which the lights are viewed. When approaching the lights on the glide slope, the first set of lights appears white and the second set appears red. When both sets appear white, you are flying too high, and when both appear red you are flying too low. This is the most common type of visual approach slope indicator system. See Figure 3.

The **Precision Approach Path Indicator (PAPI)** consists of four sets of lights in a line perpendicular to the runway, usually mounted to the left side of the runway. These have a similar purpose to basic visual approach slope indicators, but the additional lights serve to show the pilot how far off the glide slope the aircraft is.

The PAPI in Figure 4 can be seen to the right of the runway, but usually they are located on the left of the runway.

Figure 4: The Precision Approach Path Indicator

When the lights show White-White-Red-Red the aircraft is on the correct glide slope for landing, usually 3.0°. Three red lights (White-Red-Red-Red) indicate that the aircraft is slightly below glide slope (2.8°), while four red lights (Red-Red-Red-Red) indicate that the aircraft is significantly below glide slope (<2.5°).

Conversely, three white lights (White-White-White-Red) indicate that the aircraft is slightly above glide slope (3.2°), and four white lights (White-White-White-White) indicated that the aircraft is significantly above glideslope (>3.5°). See Figure 5 opposite. Most large airports use this system.
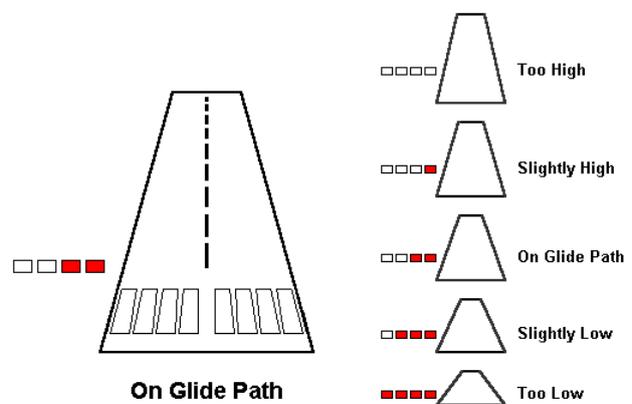

Figure 5: A pilot's view of the PAPI

Most large airports utilize this system. Although most airports use a PAPI based on a 3.0° glide slope, some airports may use a glide slope as great as 5.0° in order to have proper obstruction clearance.

Aiming point

While VASI lights are a useful aid for controlling the slope to the runway, you must also have an aiming point. The aiming point is the point where the airplane would impact the runway if you don't initiate a flare. Most IFR landings follow a long, straight-in instrument approach. The aiming-point technique will improve all of your landings, whether long, straight-in approaches, or the standard procedure landings. Once the landing becomes visual it will accurately get you to the threshold of the runway.

Begin by focusing your attention on the threshold end of the runway, an easily discernible point in Flight Simulator. The object is to adjust your rate of descent so that the aiming point does not move during your entire approach to land. It only gets bigger as you get closer.

A marker pen will be useful until you have a few landings under your belt using this technique. You'll practice this in the VFR landings with the VASI, but in actual IFR approaches you'll use this technique as soon as the runway becomes visible.

After you begin your descent down the glide-path and everything is fairly stable, pause your FS and mark a line on the monitor beside the approach end of the runway, to emphasize your aiming point. Then continue your approach. The end of the runway must not stray from the line you drew on the screen.

If you have set your rate of descent precisely correct, it will be as if you're suspended in air; there will be no movement of the runway as you approach. It will almost be eerie. Any movement of the approach end of the runway signifies that the point of your actual landing will differ from your point of intended landing. Figure 6 below will show you the possibilities.

1. Aiming point established at yellow mark.
2. No movement of the runway threshold as you near the airport. The rate of descent is perfect.
3. The runway threshold is creeping up the screen as you approach. The landing will be short, the rate of descent is too high.
4. The runway threshold is creeping down as you approach. The landing will be long, the rate of descent is too low.
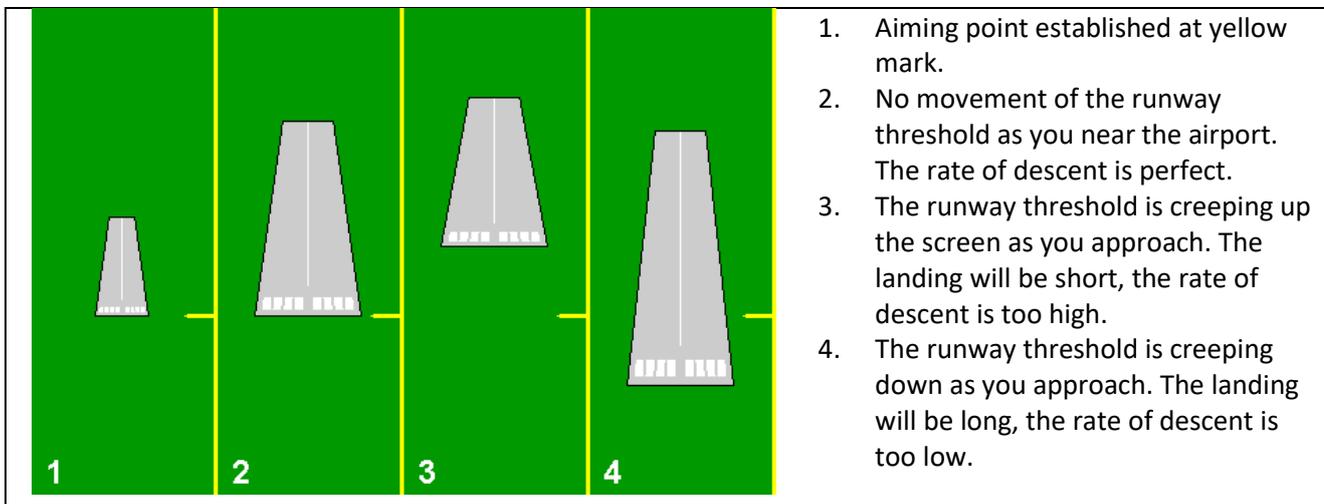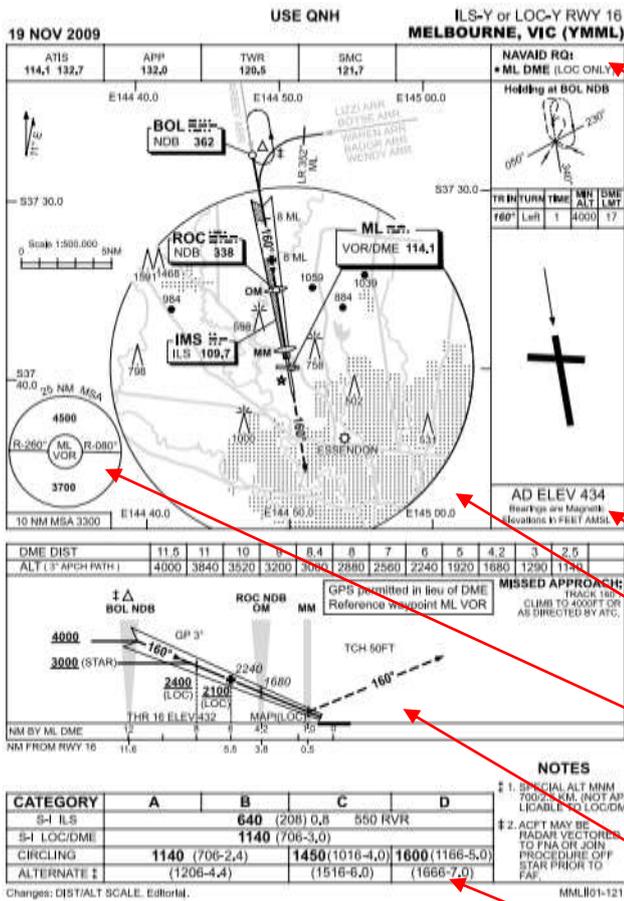
Figure 6: Aiming point possibilities
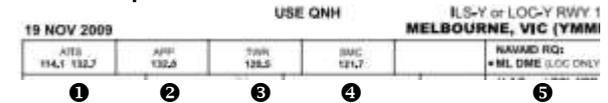
Using the approach plate

Approach plates are used by every real life pilot whether flying a small prop or a large jetliner. If virtual pilots want to achieve realism then familiarisation with them is a must. They also make landings easier and more realistic. The approach plate below is for an ILS Cat I approach to runway 16 at Melbourne International (YMML). It will be used for the tutorial flight featured later. The plate has been annotated to highlight the essential parts of the chart you need to be aware of to execute an effective ILS approach and landing. A full interpretation of plates could be a future tutorial.

The plate's layout

Source: Airservices Australia 2009

Aircraft category	A	B	C	D	E
Speed on final	0-90	91-120	121-140	141-165	165+

In this example, a Category C aircraft, performing a LOC/DME approach would have a decision height (DH) of 1140 feet.

Header. Indicates type of approach for a set runway at a designated airport

Comm frequencies

❶ ATIS 114.1 & 132.7
❷ Approach 132.0. Used during initial manoeuvring to the commencement of the ILS approach.
❸ Tower 120.5. Used during the approach itself.
❹ Ground 121.7 (Surface Movement Control). Used after landing and clearing the runway.
❺ Nav aid required (localiser only).

Airport elevation
in feet above mean sea level (AMSL)

Approach, plan view. See next page.

Minimum Safe Altitude (MSA)
The circle indicates the lowest altitude you can fly within 25 nm of the nominated nav aid – the ML VOR.

Approach, vertical profile. See next page.

Approach conditions table (minimums)
This table details the approach requirements for various categories of aircraft. Categories are determined by the speed of the aircraft on final. See the table opposite. Four approaches are shown on this plate: Full ILS (S-ILS); localiser/DME (S-I LOC/DME); Circling; and, Alternative.

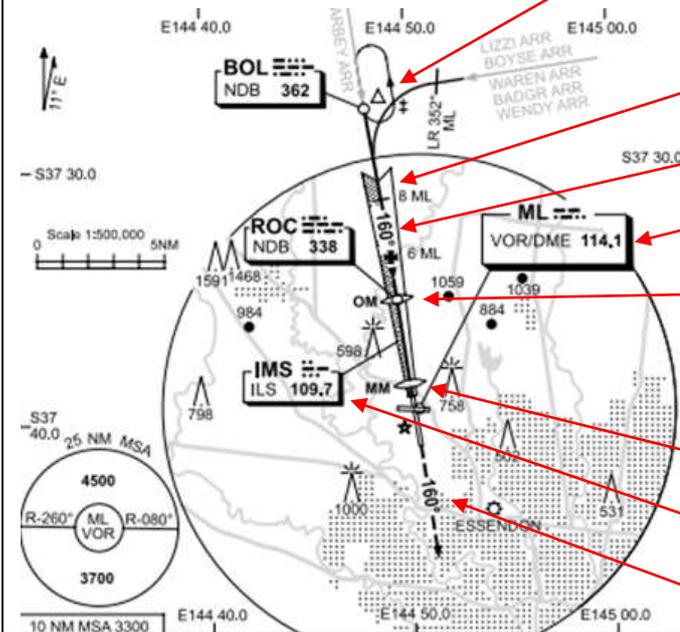For our purposes ignore the small numbers in brackets; they are radio altimeter settings for CAT II and CAT III ILSD approaches.

Approach plan view

This section provides all the navigation aid frequencies, altitudes, radials and marker beacons required for the ILS approach.

Initial Approach Fix (IAF) This is the point where the initial approach segment of an [instrument approach](#) begins. In this case it is the BOL NDB. In the trial instruction flight (TIF) we will be exercising an ARBEY SIX arrival.

Glidepath

Approach course (160°) Set in OBI

VOR/DME frequency (114.10) Set in Nav 2

Outer marker (OM). On some plates it may be designated as a **Locator Outer Marker (LOM)** as the OM is associated with an NDB, in this case the ROC NDB 338.

Middle Marker (MM)

Localiser frequency (109.70) Set in Nav 1.

Missed approach heading (160°). Heading bug set.

Approach vertical profile

The vertical profile is a simple summary of the approach and missed approach procedures. It is easier to check the required altitudes in this profile than the plan view.
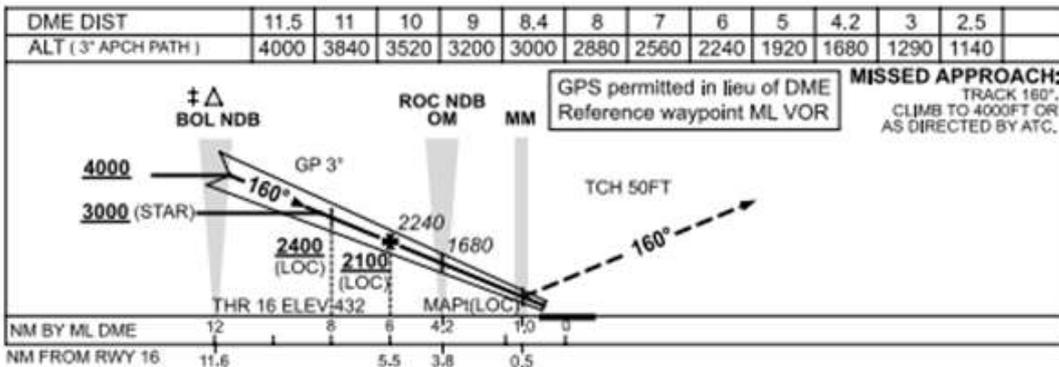
The table at the top of shows the altitudes you must be at, on a 3° glidepath, at set distances from the airport. This is also reflected in the graphic profile. Note the variation in distance in nm (a) from the ML VOR/DME, and (b) from runway 16.

In this example therefore you would have to be:
- At 4000 feet, at the BOL NDB, 12 nm from the ML VOR/DME (11.6 nm from RWY 16).
- At 3000 feet to intercept the localiser.
- At 2100 feet, 6 nm from the ML VOR/DME (5.5 nm from RWY 16) which is the Final Approach Fix (FAF) designated by the ✠ symbol.
- At 1680 feet at the ROC NDB OM, 4.2 nm from the ML VOR/DME (3.8 nm from RWY 16).

Final Approach Fix (FAF)

Final approach fix (FAF) is the point from which the IFR final approach to an airport is executed, and which identifies the beginning of the final approach segment – the point from which you report "on final". The FAF for a non-precision approach is designated on plates as a maltese cross � .

For a precision approach it is designated by a lightning bolt and specified altitude 2400

Decision height (DH)

The altitude published in the minimums section of approach plates shows the Minimum Descent Altitude (MDA). When flying a non-precision approach, you are not authorized to descend below the MDA unless you can see the runway or the approach lights and make a normal landing. The decision height (DH) for an ILS approach is the lowest height to which the approach can be conducted by instrument reference alone. From that point on you must be able to see either the runway or the approach lights and be able to execute a safe visual landing. If not, a missed approach is required.

Missed approach point (MAP)

The missed approach point is the point prescribed an instrument approach at which a missed approach procedure must be executed if the runway is not in sight. It defines the point for precision and non-precision approaches where the missed approach segment of a flight begins. A pilot must execute a missed approach if a required visual reference (normally the runway or its environment) is not in sight or the pilot decides it is unsafe to continue with the approach and landing to the runway.

MISSED APPROACH:
TRACK 160°.
CLIMB TO 4000FT OR
AS DIRECTED BY ATC.

The missed approach point is published in the approach plates and contains instructions for missed approach procedures to be executed at this point. The missed approach point is normally at the Minimum Descent Altitude (MDA), and may be less than a mile from the runway or several miles out, depending on the conditions related to that particular runway. In our plate example the MAP is the MM.

The missed approach procedure for RWY 16 at YMML is to track the runway heading (160°) and climb to 4000 feet, or as directed by ATC.

TCH 50FT

The TCH 50FT indicates that the glide slope hits the runway 50 feet in from the end of the runway

Conclusion

That completes the theoretical component of this tutorial on executing an ILS approach. A lot more could be explained and the unpacking of approach plates could be more detailed. However, for the purposes of flight simulation it provides the basics to help you exercise a well-controlled approach and "greaser" landings.

Following is a practical tutorial involving a flight in the default B737-800 from Canberra (YSCB) to Melbourne International Airport (YMML) requiring a full ILS approach to runway 16. That tutorial is also available on the Flight Simulation Australiawebsite at www.flightsimaus.com.au

The Instrument Landing System (ILS) Approach
Part 2 - Instructional Flight Tutorial

Air Traffic Control (about 70 nm out)
World Travel 109, you are 75 miles east. Turn right heading 250. Descend and maintain 9,000. Expect vectors for ILS runway 16 approach.

Air Traffic Control (about 25 nm out)
World Travel 109, you are 23 miles north. Turn left heading 159, descend to 3,000. Cleared ILS runway 16 approach. Maintain 3,000 until established on the localiser. Contact Melbourne Tower on 120.5.

Introduction

This practical training flight is based on the document, *The ILS Approach*: *A tutorial for flying the ILS approach in MS Flight Simulator X: Part 1 – The Theory.* Before undertaking the flight it is expected that you have read the document. The flight will be undertaken in a default B737-800 aircraft, from Canberra (YSCB) to Melbourne International Airport (YMML), Australia. The flight set up will be as in Figure 1 below.
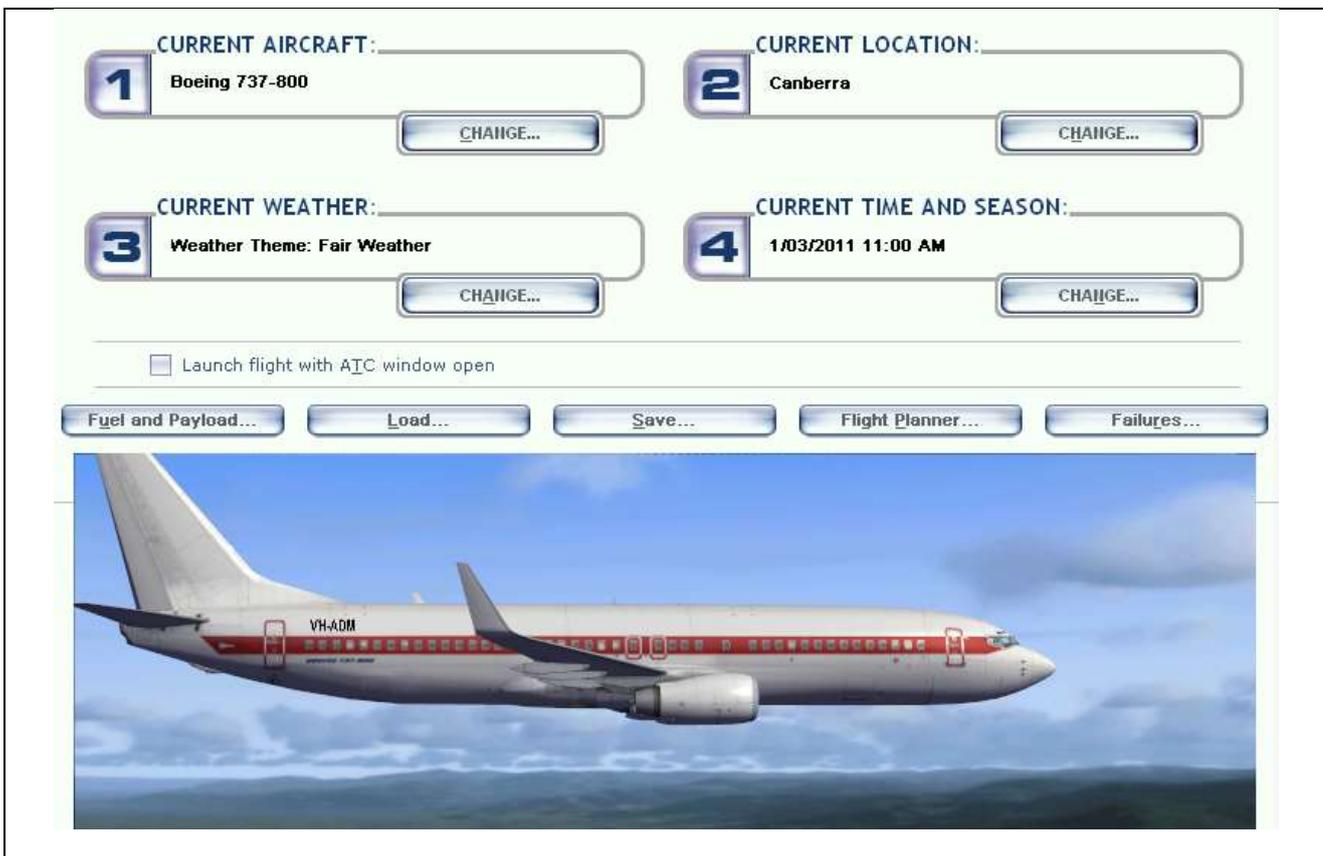

Figure 1: Set up for trial instructional flight

Pre-flight briefing

Outside of a nice smooth landing, executing a successful ILS is probably the second most rewarding part of flying. However, when I get behind on an approach, I feel like I haven't done as good of a job as I could. If I'm not on glideslope and the course deviation indicator (CDI) is not centred and it seems like my air speed and altitude are all over the place, I know I'm better than that and it usually means that I failed to prepare adequately both in my briefing and mental preparation. Therefore, adequate preparation at least 30 nm from the destination is essential in preparing for a good ILS approach. But when it all comes together, then what a thrill! Throw in a little weather like low cloud and some turbulence plus some bad or complicated instructions from air traffic control (ATC) and it makes a solid ILS approach and a safe landing all the sweeter. So, apply the theory of executing an ILS approach into practice as you fly from Canberra to Melbourne using this step-by-step tutorial.

The flight plan

As with any flight in a commercial airliner the first thing to consider is the actual flight plan. The flight plan in Appendix 1 is an amended FS version. Waypoints and altitudes have been changed to meet the requirements of the plate for an ILS approach to YMML runway 16. See Appendix 2. The route of our flight can also be seen marked on the en-route chart (ERC) found in Appendix 3.

There are a few things to note about the flight plan. Firstly, the flight is only about 280 nautical miles, approximately 35 minutes flying time. This means that you will not be able to have full fuel tanks on departure as we will be too heavy for landing in Melbourne. I would therefore recommend you reduce your gross weight. Change the payload by having no crew or passengers. Change your fuel load to 30% capacity in each tank. Secondly, note that we will be doing an ARBEY ONE arrival (STAR) into YMML. Since we will not have ATC to vector us, a procedural turn at Shepparton will be required to place us at the STAR waypoint (ARBEY) to set us up for the ILS approach. The flight plan should also be entered into the GPS. This will provide us with lateral navigation (LNAV) on autopilot with the NAV/GPS switch set to GPS until we are ready to initiate the ILS approach procedures.

Preflight set-up

I always prefer to "drive" using the 2D panel and fly using the 3D panels. As you can see opposite I re-size the GPS and radio stack panels and integrate them into the main panel. A quick click on the panel selector buttons gains access to the full panel as needed.

Panel selector buttons

Figure 2: 2D panel set-up

COM 1: 118.75

NAV 1: 116.70 - CB VOR

NAV 2: 117.90 – WJS VOR
AY VOR (115.60) on standby

ADF: 212.0 - SHT NDB

Figure 3: Frequencies

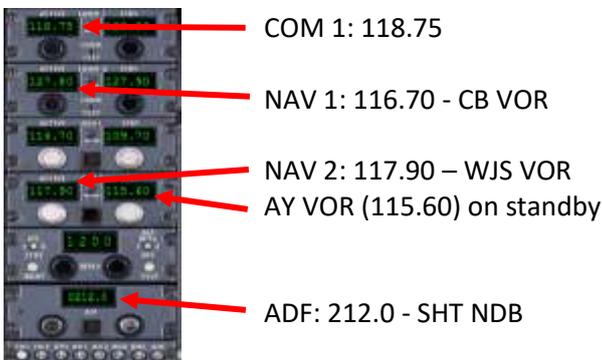Radio navaid frequencies are also set up at this time. You should therefore tune your nav radios as shown opposite and as indicated on the flight plan. COMM 1 (118.75) will be the frequency used to communicate with each other during the flight. There will be no ATC used during the instructional flight.

All other usual pre-flight set up requirements are carried out at this time also. Set altitude for 28000 feet.

The flight

Departure

Departure from Canberra will be via RWY 35 (348°). There is some high terrain to clear on take-off so a steeper than usual initial climb to 3,400 feet will be required. At 3,400 turn left HDG 240° to intercept the WJS radial of 259° and decrease the climb gradient. On the climb out a great view of Canberra and some of its significant public and government buildings can be seen. See Figure 5 below.

Figure 4: Terrain to clear on take-off

Figure 5: View of Canberra

En route

From here on climb to the cruise altitude of FL280 and proceed normally with the flight with the GPS providing lateral navigation (LNAV). Along the way adjust the navaid frequencies as you pass plotted waypoints. While you will by flying on autopilot using the GPS for navigation at this time, it is always a good idea to match the heading bug with the track shown on the GPS. See Figure 6.

Figure 6: Heading & track

It is also recommended that the selected navaid frequency is verified through its morse code ident. To determine what that code is, click on the Map view button and scroll the map to the selected airport facility. The example shown below is that of the Shepparton NDB.

The morse code is beep beep beep (pause) beep beep beep beep (pause) beeeep. By selecting ADF on the radio stack audio control panel you will be able to hear the code transmitted and verify the frequency.

Audio control panel

The real work for the ILS approach begins when about 70 nm from the destination and in this case it will be when over-flying Shepparton. So let's now start looking at the ILS procedures.

The ILS approach

Top of descent

A crucial aspect of performing a good ILS approach is being at the correct altitude at specified waypoints. If flying with ATC in operation you would be provided with vectors to locate you accordingly. In the absence of ATC however you need to be able to calculate this yourself. The ARBEY ONE ARRIVAL into RWY 26 Melbourne requires being at 10,000 feet at the ARBEY waypoint which is on the 30 nm DME arc from Melbourne (NAV 1 should be on the ML VOR/DME by now). From ARBEY track 159° to BUNKY, cross BUNKY at or below 9,000 then track 158° to BOL to be at BOL at 3000 feet to intercept the localiser. Descent speed from cruise

The first consideration here is where to commence the initial descent from cruise altitude, known as **top of descent (TOD).** The general rule of thumb to determine this is: **current altitude minus target altitude, drop off the last three zeros, and multiply by three.** In this case, you need to be at 10000 feet at the ARBEY waypoint from the cruise altitude of 28000 feet. Therefore, 28,000 – 10,000 = 18,ØØØ x 3 = 54 **OR** 28 – 10 X 3 = 54 nm from ARBEY. That would make it 19.4 nm beyond Shepparton (SHT) and 76.5 nm from Melbourne. See the red track in Figure 9. Add two extra miles for every 10 knots of tailwind.

Another way to look at it is to consider how far out of Melbourne you would we need to be to commence the descent, so you are at ILS interception height of 3,000 feet and at a glidepath angle of 3°. The calculation would be 28 – 3 x 3 = 75 nm from ILS intercept. That would make TOD 29.9 nm past Shepparton and 75 nm from Melbourne. It will put you at ARBEY at 10,000 feet and crossing BUNKY at 9,000 feet as the STAR requires, but saving the need to step down in altitude. See the blue track in Figure 7.
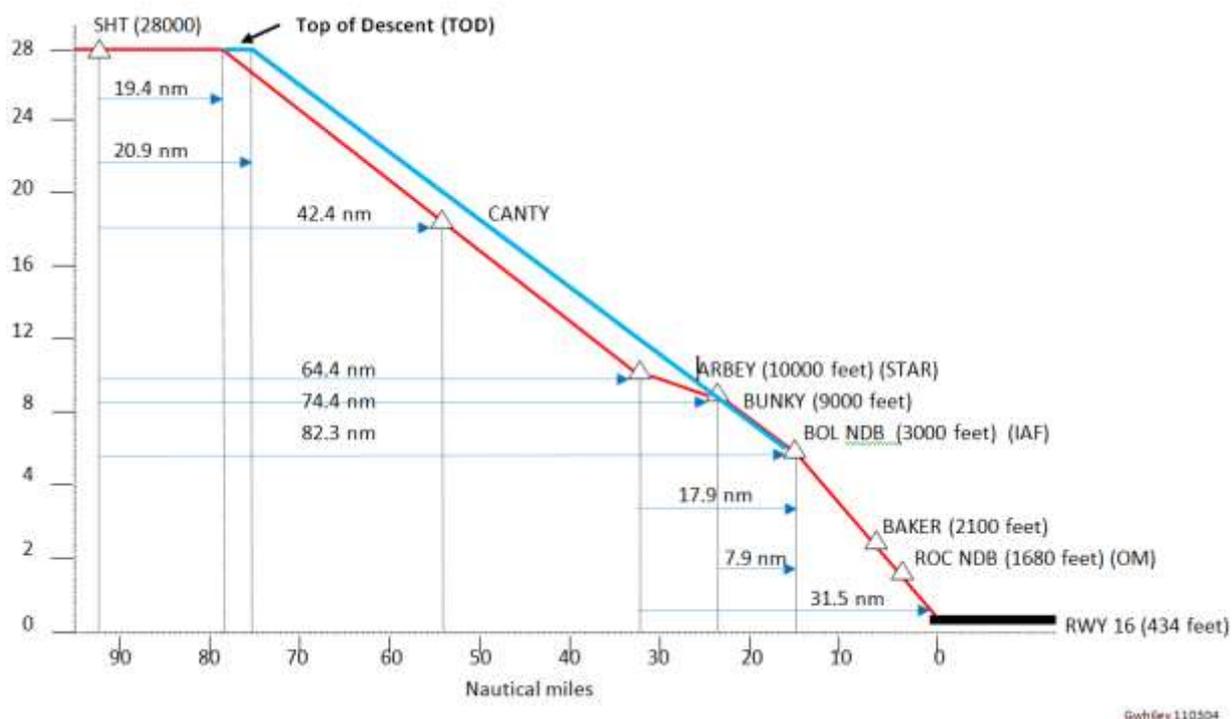
Figure 7: Approach profile and TOD

Rate of descent (ROD)

The next consideration is the speed at which you descend or **rate of descent (ROD)**. The flight notes for the 737-800 in the FSX Learning Centre says to maintain a speed of 250 knots and descend at a rate of 1,500 to 2,000 feet per minute, with thrust set at idle (about 45% N1). To descend, disengage the autopilot if you turned it on during cruise, or set the airspeed or vertical speed into the autopilot and let it do the flying for you. Reduce power to idle, and lower the nose slightly. The 737–800 is sensitive to pitch, so ease the nose down just a degree or two. Remember not to exceed the regulation speed limit of 250 knots below 10,000 feet. At this stage you can still be using the GPS for LNAV. Continue this profile down to the beginning of the approach phase of flight. An aviation

rule of thumb to calculate ROD is to **half your ground speed and add a zero** (or, current ground speed x 5). So if your ground speed was 400 knots, your ROD would be 2,000 feet per minute.

Deviations from this procedure can result in arriving too high at the destination (requiring circling to descend) or arriving too low and far out (requiring expenditure of extra time and fuel). Mastering the rate of descent is perhaps the trickiest part of making an arrival at an airport, either IFR or VFR. So don't be disheartened if you don't get it right the first time. It will take practice. Always plan to have an initial approach fix regardless of whether or not you're flying an instrument approach.

Descent speed

Speed of descent is yet another factor to be taken into calculation. It should not be confused with ROD. Rate of descent is in **feet per minute** whereas speed of descent is the **actual speed** of the aircraft in knots within that ROD. Descent speeds vary according to altitude. A 737-800, cruising at its maximum altitude of FL410, would have descent speed profile as follows, regardless of its ROD in normal operations.:

- to FL240: 0.75 mach
- to FL180: 0.65 mach
- to FL120: 280 knots
- below 10,000 feet: 250 knots

With thrust at idle it takes 35 seconds to decrease speed by 40 knots over a distance of 3 miles. Therefore, to decrease speed from 320 to 250 knots it would take 61 seconds over 5.25 miles. Descent speed decreases the further the aircraft enters its approach pattern. It is aided initially by speed brakes (or spoilers) if needed and then by the progressive application of flaps.

The ILS approach

Now you can turn your attention to the specifics of the ILS approach. Having commenced your descent and still flying by GPS, tune your navaid frequencies as required. NAV 1 needs to be set to the ILS frequency for the runway you will be landing on. NAV 2 is set the VOR/DME frequency for the airport. The ADF needs to be set to the initial approach fix (IAF) if there is one. In this flight it will be the BOL NDB. See Figure 8.

COMM 1: 118.75

NAV 1: 109.70 – ILS RWY 16

NAV 2: 114.10 – ML VOR/DME

ADF: 212.0 – BOL NDB
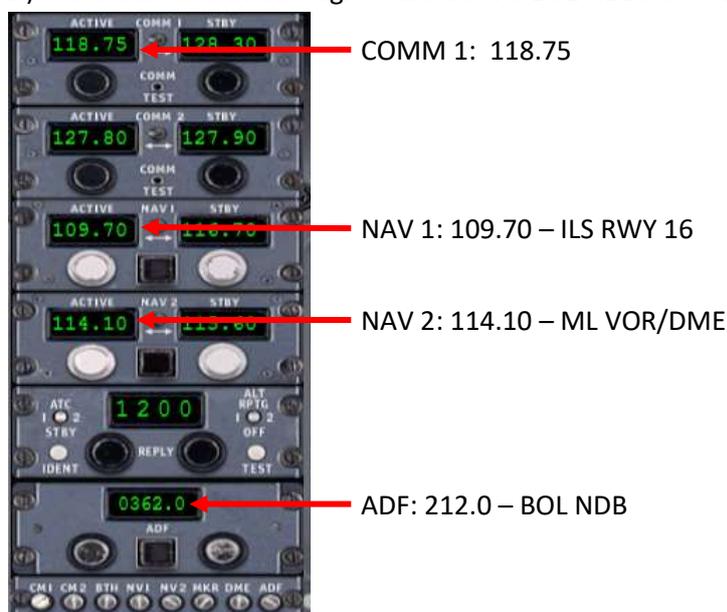
Figure 8: Navaid frequencies

The flight control panel should look like this:

At CANTY the GPS will turn you left to a heading of 159° for ARBEY. If you happen to reach 10,000 feet before reaching ARBEY, level out. From here-on things start happening pretty quickly. At ARBEY (crossing ideally at 10,000 feet) continue the descent to 3,000 feet, crossing BUNKY at or below 9,000 feet, HDG 159 for the BOL IAF. **At this point switch from GPS to NAV** but maintain a heading of 159°.   Slow to 210 knots. Use speed brakes if needed. Arm spoilers and set auto brakes. Have the NAV 1 frequency selected on the audio control panel so you will hear when the localiser kicks in. Your instrumental panel should be as in Figure 9.

Figure 9: Instruments approaching ARBEY

Figure 10: PFD before localiser

Take particular notice of what the primary flight display (PFD) looks like before (Figure 10) and after (Figure 11) the localiser becomes active. In particular see the magenta diamonds that appear once the localiser is active. These are the indicators for the **localiser A** and the **glideslope B**.

Figure 11: PFD after localiser active

From ARBEY continue the descent to 3,000 feet, reducing speed so you are at 175 knots by the time you reach BOL. Use 15 - 20° flaps. The rate of descent within the glideslope is calculated by multiplying ground speed (GS) by 5. To intercept the localiser you need to be below the glideslope and at a down angle of 3°. When this is reached the BELOW GS light will illuminate on the panel above the PFD. See Figure 12. **When this occurs switch from NAV to APP.**

Figure 12: GS and Approach mode indicators

The aircraft will practically fly itself down to the runway. Remember that the localiser is very sensitive so maintain flight by auto pilot until you have crossed the threshold. Use thrust if needed for forward movement to your touch-down point. At ROC, which is the outer marker, you should be at 140 knots and with 30° flaps, or full flaps if needed, at 1,680 feet. This is 5.7 nm out. Gear down. Final approach speed is 135 knots.

Figure 13: Pilot's view on final

Figure 14: Spot view on final

On crossing the threshold of the runway disengage the autopilot and flare for landing. Fly the aircraft onto the runway, don't hold off for a smooth landing. Apply reverse thrust. Cancel reverse thrust at 60 knots and make a left turn from the runway to taxi to parking. Welcome to Melbourne.

Figure 15: Touchdown

Figure 16: Arrived at Melbourne International – congratulations!

Conclusion

Well there it is – how to execute an ILS approach into runway 16 at Melbourne (YMML). I hope this tutorial has been of some assistance to you. The general principles outlined in this tutorial can be applied to any aircraft equipped with ILS capability. It is important to remember that much practice is needed to get it right; so don't be too disheartened if you make a mess of it at times. Good planning and concentration is essential if you want to get that 'as real as it gets' experience.

I should point out that I am not a real life airline pilot. However, I did have a Private Pilots Licence (PPL) to fly light aircraft back in the 1970s. While I don't fly for real any longer I have maintained my passion through many hours on flight sim. I conservatively estimate that I have around 1,500 hours on FS. That doesn't mean that I know it all. I am the first to admit that there is still a lot to learn and I mess it up often. If you believe any of the material in this tutorial is in need of amending, I would be please to hear from you.

The following pages contains a list of some ILS tutorials on YouTube sites that you may find useful. They give a very good visual perspective to what has been written here. They are worth a look. The final pages are the appendices referred to in the text of the tutorial.

Greg Whiley
March 2011

You Tube ILS tutorials

http://www.youtube.com/watch?v=6-c710SHDU0&feature=related
http://www.youtube.com/watch?v=5dHbxtVXlcY&feature=related

http://www.youtube.com/watch?v=hUI7SJYdQrs&feature=related

http://www.youtube.com/watch?v=faJTqjRbkxg&feature=related

http://www.youtube.com/watch?v=FvVYhVZTnfc&feature=fvw

http://www.youtube.com/watch?v=O7NX12pqgBo&feature=related

http://www.youtube.com/watch?annotation_id=annotation_644212&v=Rjx-_sduLVk&feature=iv

Microsoft Flight Simulator Flight Plan Canberra -> Melbourne Intl Distance: 281.3 nm Estimated fuel burn: 715.9 gal / 4796.4 lb Estimated time en route: 0:35			ARBEY ONE ARRIVAL At SHT ↘ 10,000 feet At ARBEY ↘ 9,000 feet At BUNKY ↘ 3,000 to intercept LOC			
Waypoints	**Alt (ft)**	**Hdg**	**Distance**	**GS (kts)**	**Fuel (gal/lb)**	**Time off**
			Leg		6830.3	0:00
Canberra YSCB			Rem	Est	Est	ETE
			298.4	Act	Act	ATE
Canberra VOR CB (116.70)	2511	354	1.6	472	3.7 / 24.9	0:00
			296.9		/	
Wee Jasper VOR WJS (117.90)	12870	259	25.9	474	66.3 / 444.3	0:03
			271.0		/	
Albury VOR AY (115.60)	28000	226	96.0	472	247.3 / 1657.0	0:12
			174.9		/	
Shepparton NDB SHT (212.0)	28000	242	79.0	477	201.3 / 1348.7	0:09
			95.9		/	
CANTY (waypoint)	21843	226	42.4	477	107.9 / 723.1	0:05
			53.5		/	
ARBEY (waypoint) **STAR**	10000	159	22.0	477	56.2 / 376.3	0:02
			31.5		/	
BUNKY (waypoint)	9000	159	10.0	477	25.4 / 170.0	0:01
			21.5		/	
Bolinda NDB BOL (362.0) **IAF**	3000	159	7.9	477	20.0 / 133.7	0:00
			13.6		/	
BAKER (waypoint) **FAF**	2100	159	6.1	480	15.2 / 102.0	0:00
			7.5		/	
Rockdale NDB ROC (338.0) **OM**	1680	160	1.8	477	4.4 / 29.5	0:00
			5.7		/	
Melbourne VOR ML (114.10)	1037	160	4.2	478	10.5 / 70.3	0:00
			1.5		/	
YMML RWY 16 (109.70) Left turn to parking	434	160	1.5	478	3.7 / 24.9	0:00
			0.0		/	

USE QNH

19 NOV 2009

ILS-Y or LOC-Y RWY 16
MELBOURNE, VIC (YMML)

ATIS 114.1 132.7	APP 132.0	TWR 120.5	SMC 121.7

NAVAID RQ:
• ML DME (LOC ONLY)

Holding at BOL NDB

TR IN	TURN	TIME	MIN ALT	DME LMT
160°	Left	1	4000	17

BOL NDB 362
ROC NDB 338
ML VOR/DME 114.1
IMS ILS 109.7

AD ELEV 434
Bearings are Magnetic
Elevations in FEET AMSL

25 NM MSA
4500
R-260° ML VOR R-080°
3700

10 NM MSA 3300

DME DIST	11.5	11	10	9	8.4	8	7	6	5	4.2	3	2.5	
ALT (3° APCH PATH)	4000	3840	3520	3200	3000	2880	2560	2240	1920	1680	1290	1140	

GPS permitted in lieu of DME
Reference waypoint ML VOR

MISSED APPROACH:
TRACK 160°.
CLIMB TO 4000FT OR
AS DIRECTED BY ATC.

‡ △ BOL NDB
ROC NDB OM
MM
4000
3000 (STAR)
GP 3°
160°
2400 (LOC)
2100 (LOC)
2240
1680
TCH 50FT
160°
THR 16 ELEV 432
MAPt(LOC)
160°

NM BY ML DME 12 | 8 | 6 | 4 2 | 1 0 | 0
NM FROM RWY 16 11.6 | 5.5 | 3.8 | 0.5

NOTES
‡ 1. SPECIAL ALT MNM 700/2.5 KM. (NOT APPLICABLE TO LOC/DME).

‡ 2. ACFT MAY BE RADAR VECTORED TO FNA OR JOIN PROCEDURE OFF STAR PRIOR TO FAF.

CATEGORY	A	B	C	D
S-I ILS		640 (208) 0.8	550 RVR	
S-I LOC/DME		1140 (706-3.0)		
CIRCLING	1140 (706-2.4)		1450 (1016-4.0)	1600 (1166-5.0)
ALTERNATE ‡	(1206-4.4)		(1516-6.0)	(1666-7.0)

Changes: DIST/ALT SCALE, Editorial.

MMLII01-121

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Aussie Star Flight Simulation